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Informal Technical Data

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INFORMAL TECHNICAL REPORT

For The

SOFTWARE TECHNOLOGY FOR ADAPTABLE, RELIABLE SYSTEMS

*Reusable Software Acquisition
Current FAR and Budget/Finance Requirements*

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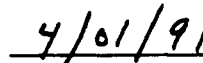
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INFORMAL TECHNICAL REPORT
Reusable Software Acquisition
Current FAR and Budget / Finance Environments

Approval:



Hans W. Polzer, Program Manager



Date

(Signatures on File)

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CDRL: 03501
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30 March 1991

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1. INTRODUCTION

1.1 Authority

Work was accomplished under STARS Contract F19628-88-D-0031, Delivery Order 0005, BOA #3695.STARS-045, Reusable Software Acquisition.

1.2 Scope

In today's acquisition environment, software is continually cited as the critical path to program success in terms of capabilities, budget and schedule. This increasing dependence of Department of Defense (DoD) programs on software development efforts dictates that software design issues must begin to incorporate the benefits of reusable and commercially available software. Breakthrough initiatives in the way DoD administers developmental software and uses commercially available software must be incorporated into the federal acquisition process if the full potential of the Software Technology for Adaptable, Reliable Systems (STARS) program is to be realized. We believe the STARS environment would be significantly enhanced if the software acquisition process, with regard to reusable software and commercially available software, were given full consideration.

1.3 Overview

Development of software-intensive systems in the DoD is typically characterized by programming of new software code. Even a cursory review of programs within a given functional area suggests that some level of commonality exists. Despite this commonality, acquisition experience has demonstrated that new programs focus almost entirely on new software development. In general, reuse is not addressed in Government Requests for Proposal (RFPs), contractor proposals or contracts. Incentives are not provided to software developers to engineer reusability into their products.

1.4 Executive Summary

1.4.1 Current FAR Environment and Proposed Changes (see Section 3.0)

The Federal Acquisition Regulation (FAR) and DoD FAR Supplement (DFARS), as well as service and agency supplements to the FAR, have been examined for impediments in the way data rights are acquired and software is contracted. The current FAR environment with regard to software development, software reusability, and the use of commercially available software has been documented in this Current FAR Environment report. Initial proposed changes to the FAR and proposed FAR language changes have also been incorporated.

1.4.2 Current Budget/Finance Environment and Proposed Changes (see Section 4.0)

Budgeting and program financial regulations have been reviewed to identify unnecessary cost restrictions and/or disincentives to providing financial resources for engineering software reusability and use of commercially available software. The current budget and program

financing regulatory environment with regard to software development, software reusability, and the use of commercially available software are documented in this Current Budget/Finance Environment report. Proposed changes have been recommended.

2. BACKGROUND

2.1 Current Software Acquisition Environment

The current software acquisition environment is not compatible with the advanced concepts proposed by the STARS program. Acquisition program offices cannot effectively incorporate reuse requirements into contracts. Software developers receive no incentives to either produce reusable code or to incorporate reusability into their design efforts. The acquisition community must adapt to accept reusability concepts.

2.2 Goal

Our goal is to enhance opportunities for software reusability. We plan to:

- (a) Define the current FAR and budget/finance environment
- (b) Identify existing barriers to reuse of software
- (c) Incorporate the advanced concepts of STARS into the formal acquisition environment
- (d) Address reusability in software acquisitions
- (e) Quantify software reusability benefits into source selection criteria
- (f) Incorporate reusability into the formal budget process
- (g) Identify opportunities to institutionalize the concept of reusability
- (h) Propose FAR changes to increase reusability
- (i) Propose budget/finance changes to increase reusability
- (j) Support a reusability environment in which both Government and industry benefit.

2.3 Approach

Incentives must be established to reward contractors who engineer reusability into their software development life cycle. This will require the identification and modification of any regulation, policy or procedure which impedes the establishment of such incentives. Government and industry software developers and Government acquisition personnel will be interviewed. The FAR and DFARS as well as service and agency supplements will be examined for impediments in the way data rights are acquired and software is contracted. Budgeting and program financing regulations and policies will be reviewed to identify unnecessary restrictions and/or disincentives to providing financial resources for engineering software reusability. Procedures and processes for providing program direction and acquisition strategy guidance will be examined for opportunities to emphasize and institutionalize the concept of engineered software reusability. This will include techniques such as issuing license rights to developing contractors and providing other business incentives to stimulate commercial custodianship and marketing of reusable software.

3. FAR ENVIRONMENT

3.1 The Current FAR Environment and Proposed Changes

3.1.1 Introduction

Any discussion of software reuse must ultimately include business considerations. These include questions of ownership, liability and incentives to create reusable software and/or actually reuse existing software within the Department of Defense (DoD). The subject of rights to software is covered in DoD Federal Acquisition Regulation Supplement (DFARS), Part 227, Subpart 227.4. The current DFARS coverage was published as an Interim Rule in 1988 and remains so today. It has received such extensive comment from industry and Government that on 15 October 1990, a new advanced notice of proposed rulemaking was published. The advanced notice provides revised coverage for comment prior to actually publishing a new interim rule. We comment on the advanced notice in this report.

Creating a software reuse acquisition strategy requires an understanding of the regulatory documents covering software. Reuse strategy is affected by the following considerations: who owns or will own the software; what kind of rights are available in reusing the software; how these rights can be protected and enforced; what one can do (incentivize) to create an environment where reuse is encouraged and rewarded; and what liabilities may exist if a party actually reuses software. What follows is an initial discussion of the current FAR/DFARS environment. We follow with considerations one must keep in mind when developing reuse strategy. We have also included discussion of Part 27 of the FAR itself (and in limited focus, National Aeronautics and Space Administration (NASA) regulations) to show some differences between DoD and the other executive agencies. While all other agencies follow FAR, Part 27, DoD has created DFARS, Part 227 to fit its unique requirements. The DoD policy for doing so is stated in DFARS 227.472. We note, however, that DFARS, Part 27 reflects a more conservative approach to determining Government interest in software rights than does the FAR. We will address these differences in our discussion.

3.1.2 The Current FAR/DFARS Environment

Whether or not one agrees with its contents, there is little argument that today's DFARS coverage on software and software rights is not well written, is poorly organized and very difficult to understand. While the FAR coverage is not perfect, going from DFARS, Part 227 to FAR, Part 27 is analogous to being lost in the darkness of the forest and suddenly discovering a trail leading to a valley of light. You may not yet know where you are, but your confidence in finding a way out increases dramatically because you can see things much more clearly. Issues become unnecessarily complicated, because neither the DFARS nor the FAR treat software separately from technical data. Each has a basic clause (DFARS 252.227-7013, Rights in Technical Data and Computer Software; FAR 52.227-14, Rights in Data) addressing both subjects. However, technical data and computer software are very different. This commingling in a single clause, we believe, exacerbates confusion in the treatment of software versus technical data.

3.1.2.1 Software: Definitions and Ownership Categories

The DFARS identifies three categories of software: commercial, unpublished and Government software. Table 1-1 includes extracts from the DFARS and FAR definitions for these terms and for restricted rights software. Succinctly stated, commercial software includes well-known products such as LOTUS 1-2-3; unpublished software is a product not yet released (with or without restrictions) by its owner; and, Government software is all software developed or required in the performance of a Government contract or subcontract. Unpublished software becomes Government-owned software if it is created during and required for Government contract performance, even if the contractor fully funded its development. This is, perhaps, the most contentious issue between Government and industry today in the debate concerning necessary DFARS changes. We will discuss this issue again when addressing DoD policy regarding acquisition of rights in computer software. In the definition of Government computer software, the FAR includes related documentation, giving it the same status as software when determining software rights to be acquired. Conversely, the DFARS treats this documentation as technical data, requiring a different assignment of rights. For example, under the FAR, restricted rights software (Table 1-1) would include the computer programs, databases and documentation. In contrast, the DFARS creates two environments: one for restricted rights software and one for its supporting documentation, which would be categorized as limited rights data. Thus, industry is forced to think and react differently when dealing with the DoD versus all other federal agencies.

3.1.2.2 Government Versus Private Funding of Software Development

Prior to discussing policy for software acquisition, it is important to first identify the sources of funding for software development. DFARS 227.471 and 252.227-7013 address Government and private funding, while DFARS 227.472-3 discusses mixed funding. These funding sources are synopsized below:

- (a) Developed Exclusively with Government Funds : Cost of development paid for in whole by Government, or development was required for performance of a Government contract or subcontract;
- (b) Developed Exclusively at Private Expense: No part of development cost paid for by Government (IR&D is considered private expense), and development not required for performance of a Government contract or subcontract; and
- (c) Mixed Funding: Combination of Government and private funds.

We can see that the definitions of funding include not only the sources of funds but also the assessment of whether the item (software) was required for performance. While DFARS 227.472-3 addresses itself only to technical data, there is no other mixed funding reference in DFARS, Part 227. Clearly, the documentation relating to software would fall under the subsection, even if software itself did not. The FAR provides no similar definition coverage for development at Government or private expense. FAR 27.498 does address co-sponsored research and development activities, specifically computer software and appropriate applications of limited rights for data and restricted rights for software. The FAR coverage here is clearer and more

useful than that provided by the DFARS. Even though the FAR provides no specific definitions for Government or private funding, its definitions of unlimited, limited, and restricted rights clearly employ the concept of private expense, and do not mix sources of funds and vagaries of performance in the definitions of funding at public or private expense.

3.1.2.3 Software Ownership Policies (See Table 3-1)

DFARS 227.481 establishes the policy for Government acquisition of rights to computer software, while DFARS 227.472-3 addresses rights to documentation (technical data) related to the software. This Subpart describes those circumstances under which the Government gains unlimited rights to software. These instances include:

- (a) Computer software resulting directly from performance or generated as part of the performance of experimental, developmental or research work specified as an element of performance in a Government contract, or subcontract;
- (b) Computer software required to be originated or developed under a Government contract, or generated as a necessary part of performing a contract;
- (c) Computer databases, prepared under a Government contract, consisting of (i) information supplied by the Government; (ii) information in which the Government has unlimited rights; or (iii) information in the public domain;
- (d) Computer software prepared or required to be delivered under a Government contract or subcontract, and consisting of corrections or changes to Government-furnished software; and
- (e) Computer software in the public domain, or normally furnished by a contractor or subcontractor without restriction.

Any documentation related to unlimited rights software would also be expected to be provided as unlimited rights data.

If software does not fall into one of the five categories described above, it must necessarily fall into the category of restricted rights software. DFARS 227.481 includes a reference to the DFARS 227.471 definition of restricted rights (Table 3-1) for a description of the minimum rights required by the Government. The clause in DFARS 252.227-7013(c) provides some further guidance relating to specific rights issues, for the most part repeating what we have just discussed. Government minimum rights under the category of restricted rights in computer software are:

- (a) Use of the software for the computer for or with which it was acquired, including use at any Government facility to which the computer may be transferred;
- (b) Use of the software with a backup computer if the computer for which or with which it was acquired is not working;

- (c) Copying the software for safekeeping or backup;
- (d) Modifying or combining it with other software as long as the delivered software portions containing restricted rights software remain subject to those rights; and
- (e) Any other rights not inconsistent with (a)-(d) above.

3.1.2.4 Software Ownership: Acquisition Scenarios (See Table 3-2)

Perhaps the best way to describe the current software acquisition environment in terms of practical applications is to specify scenarios for software acquisition, and to identify the rights which would accrue to either the Government or the contractor. Table 3-2 describes these scenarios. This information indicates that the Government will obtain unlimited (or close to unlimited in the case of mixed funding) rights in software, with the exceptions of commercial software and unpublished software in existence at the time of a contract award. The contractor will retain its copyright to software, unless the Government has invoked the Special Works clause. Friction exists between Government and industry regarding software developed at private expense, but in parallel with and required in the performance of a Government contract. Many in industry believe that the contractor should retain rights to this software, since the decision to invest corporate funds is often based on the opportunity to later capture a technical and/or monetary advantage or increased market share. Furthermore, industry would argue that many Government programs would not be affordable if the contractor did not invest; therefore, it should not be penalized for doing so. Rather, it should be rewarded and allowed to retain the software rights. However, the Government counters by arguing that if the software is developed in parallel with contract performance, and is required to meet contractual obligations, the Government must obtain unlimited rights since the software is an essential contract element. It is not popular to counter such an argument, especially if the Government contends that contractors may make the unlimited rights software dependent upon or integral to the privately-funded software developed in parallel, and cause the Government software to be critically dependent on it.

A rather significant difference exists between FAR and DFARS approaches to acquiring commercial software (Table 3-2). The FAR describes the Government minimum rights required in commercial software, and then states that no specific FAR clause is required (although one is provided). This allows commercial software acquisitions to be unhampered by the overly cumbersome and confusing basic Rights in Data clause. In contrast, the DFARS provides no practical guidance (227.481-1(f)), and requires the full, basic Rights in Technical Data and Computer Software clause (252.227-7013) be included, with reference to the specific portion dealing with commercial computer software (252.227-7013(c)(1)(ii)). While the subparagraph language is not objectionable, many commercial companies will not do business with DoD because they are put off by the DoD acquisition personnel's insistence on incorporating the whole 12-page clause (as required) in contract language. The companies become apprehensive that they may be somehow subject to the other, more threatening and pervasive sections, and walk away from the revenues rather than risk loss of their rights. We do not understand why the DoD has never adopted the simpler and more straightforward FAR approach for use in the DFARS.

Some contractors have noted that they've experienced problems with the Government claiming unlimited rights in unpublished software which existed at contract award. In these instances, the contractors have proposed use of the unpublished software and claimed restricted rights. The Government has countered that it should receive unlimited rights (without providing compensation), since the software was required for performance. Industry notes to date that the results of negotiations on this issue have been mixed. Claims are sometimes substantiated, with industry given restricted rights or receiving compensation when unlimited rights were provided to the Government. All such claims are negotiated on a case by case basis. There is no uniform policy governing compensation to contractors for restricted or limited rights software. The DFARS does not clearly describe the contractor's and Government's rights with respect to unpublished software existing at contract award.

Regarding copyrights, the DFARS and FAR are clear on policy. The contractor will typically retain its copyright to software developed under Government contract. The Government will be granted a license to use it for Government purposes, including preparation of derivative works (important for software reuse, to be discussed later). Strangely, while the DFARS copyright license includes the right to distribute copies to the public, the FAR does not, unless what is known as the Special Works clause is used (Table 3-1). When the Special Works clause (DFARS 252.227-7020) is invoked, the Government retains ownership and control (copyright) of the work. However, regarding software, it is difficult to ascertain why one would invoke Special Works based on the guidance for its use found in DFARS 227.476. This guidance talks about production of audiovisual works, television recordings, recruiting and other similar work, but says nothing about acquisition of products and systems associated with software.

A simple discussion of why copyrights are important at all is lacking in the DFARS. Those who prepared the regulations assumed that the reader would be well versed in copyrights - this is typically not true. FAR 27.404(f)(1)(i) is somewhat better (but not by much) in describing how contractors are normally granted copyrights to enhance dissemination of information produced at Government expense (i.e. commercialize).

NASA takes a very different approach to copyrighting software. In NASA FAR supplement 18-27.4046, the specified policy states that a contractor may not establish a copyright claim to software first produced in performance of a NASA contract without the contracting officer's prior, written permission. The regulation requires proactive Government team involvement (including patent or intellectual property counsel) in determining whether a contractor has specific commercial plans, and has made or will make a significant financial contribution to the development or maintenance of the software. If these conditions exist, the contractor may then be authorized a copyright. This regulatory coverage goes well beyond the DFARS and FAR in establishing the purpose of copyrights. It also takes a very different position concerning the granting of copyrights (automatic, in most cases, in the DFARS and FAR; a deliberate act in the case of NASA).

3.1.2.5 Software Rights Clauses

We have noted the difficulty that arises in working with the DFARS because of the synthesis of technical data and software into one category, and the poor structuring of the contents of DFARS,

Part 27. This difficulty is perhaps best exemplified in the basic Rights In Technical Data and Computer Software clause (DFARS 252.227-7013), which begins on DFARS page 252.227-8 and concludes on page 252.227-20 (12 pages), with five more pages covering alternatives to the clause. The clause includes technical data, software, copyrights, rights in software and technical data, limitation on charges for data and computer software, acquisition of technical data and software from subcontractors, notification procedures and other topics. It is unreasonable to expect even the most sophisticated person, knowledgeable in software, to be comfortable working with such a cumbersome structure. It becomes increasingly unrealistic to expect Government acquisition personnel, most of whom have little or no formal training in software, to be able to become proficient in this area when forced to work with such cumbersome guidance.

3.1.2.6 Disincentives in Software Rights Clauses

The Strategic Defense Initiative Organization's Strategic Defense System Computer Working Group Software Reuse Committee (26) has noted in their studies that industry is reluctant to provide new software technology because of the sweeping rights demanded by the Government, and concerns regarding loss of proprietary information. Similar concerns were raised in the Fall 1990 DoD STARS/Users Workshop. Much of this anxiety arises from the perception that the DoD will always try to insist on unlimited rights, whether or not it needs them or is even entitled to them.

We believe much of this "Government-must-have-it-all" atmosphere is created by a lack of understanding by federal acquisition personnel of software and its issues, compounded by existence of inadequate guidance (DFARS) to help accomplish effective and reasonable software acquisition practices. The Government by nature is a conservative consumer. Its personnel become more conservative when working with regulatory material that is confusing and cumbersome. The easiest approach is to insist on unlimited rights, thereby forcing industry into lengthy and expensive negotiation/litigation to prove otherwise. We agree that the language in DFARS which prescribes Government unlimited rights for software required in performance of the contract (even though not paid for by the Government) does create a disincentive to industry. It presents a potential disadvantage to the Government by encouraging the creation of an environment in which industry becomes increasingly reluctant to use its latest, privately-developed software technology in Government acquisitions. We will comment more on this issue later in the report when discussing the 15 October 1990 advanced notice on FAR, Part 27.

Perhaps the most significant impediment to improved software acquisition in existence today is the apparent lack of a concerted effort to provide the acquisition work force with adequate guidance to improve their understanding of this critical area.

As the FAR is modified and the DFARS rewritten, we will continue our investigation for any other significant issues regarding the DoD software acquisition environment.

3.1.3 Software Reuse

The conceptual framework for software reuse includes at least two models :

- (a) Reusing software/software components across similar applications (e.g., Air Defense Systems), and
- (b) Reusing software/software components across dissimilar applications (e.g., taking software from a business management system and reusing it in a command and control system).

This reusable software is either software in existence today, or software specifically developed to be reusable beyond its initial application. Our current experience base reflects, very predominantly, reuse of commercial software or non-commercial software not specifically developed to be reusable. The actual practice of reuse typically occurs through the forces of the competitive bidding process or happenstance. Of the non-commercial software that is reused, most was not designed or designated for reuse. The table below identifies current software reuse strategies:

Software Reuse Strategies
<ul style="list-style-type: none">• Reuse of actual code (as is or modified)• Reuse of software specifications• Reuse of software architectures• Reuse of domain knowledge bases• Generation of software through creation of reusable templates

Prior to discussing current reuse techniques, we will examine reuse in the context of the DFARS/FAR. We will then provide the results of our survey investigation, discussing reuse strategies, their degrees of success, ongoing efforts to improve reuse, liability issues and recommendations for additional improvements.

3.1.4 Software Reuse in the Current Environment

Clearly, there are no overwhelming impediments in the current DFARS/FAR preventing successful reuse. Strategies are being implemented today (not necessarily to the point where they've reached fruition) for software reuse within the Government. Industry already successfully practices reuse in the commercial world. As noted, we will discuss these experiences and provide observations on the differences in degrees of difficulty when dealing with intra- and inter-program/agency software reuse and intra- and inter-company reuse.

We identified several issues at the beginning of this report affecting reuse: liability, ownership and incentives. Each is discussed in the following paragraphs.

3.1.4.1 Liability

People within and outside Government immediately raise the liability specter when software reuse is discussed. When the Government provides software/software components, what responsibility does it assume? What warranty does it offer regarding how the product will perform? What is the Government's liability if the furnished products fail when used as is, or if a derived software product fails?

If the original software producer has warranted the product, the Government may be able to pass that warranty on, unless its application is restricted to the original contract under which the software was produced. However, the warranty, at best, is likely to only cover the software in a specific application, and remedies are not likely to offer more than repair or replacement of the software, so that its intended operation is unimpaired. Reusing the software to create a derivative work would typically void any existing warranty, even if it could be passed to another contractor. Therefore, if the software is used as is, a second contractor might have an opportunity to seek assistance under the warranty (not likely). When used in a derived work, any warranty is probably voided. Can the Government then indemnify a contractor when it is provided with Government software? We would suggest that the question need not even be asked. A better/more correct question is "should the Government offer protection?" and if it doesn't, is this a disincentive to reuse?

We do not believe the Government should attempt to offer liability protection when making software/software components available for reuse. It is not a practical alternative, and would require a prohibitively expensive testing and administrative organization. Rather, the Government should provide as complete a description as possible of the software (including source code if rights permit), all available documentation (including service reports) and identification of the original producer. Whether reuse is voluntary or mandated by the Government, the new contractor would have sufficient information available to make an intelligent technical and business decision regarding its ability to reuse the product and confidence in its quality. When reuse is mandated, the parties involved can construct added contract language to protect specific interests if contention arises during performance concerning each party's liability should contract requirements not be met.

We also note that commercial software is used (reused) over and over without the liability issue ever surfacing. The significant proliferation of these products actually creates greater business risks than the limited-use instances for Government software.

Is the liability issue a disincentive? It certainly is in those instances where software is unproven, is provided with little or no documentation, evidences no records of update or service, or is furnished with such restrictive licenses that it becomes impractical to consider the product for reuse. We contend that these circumstances would negate the viability of this software for reuse from the start, so the liability issue would become superfluous. Critics will argue that this position ignores the real world, in which overzealous or inexperienced Government organizations will force reuse even in this environment. While rare instances of this nature could occur, a prudent contractor can and should refuse to participate under these circumstances. In any event, it is impractical to attempt to protect against this "exception" to the rule, beyond a Government

commitment to adequately train acquisition personnel.

The Government must also recognize the need to provide a system that will ensure the independent testing/examination of software products made available for reuse.

3.1.4.2 Ownership

Ownership issues with respect to unlimited and restricted rights software and limited rights data (for the restricted rights software) are relatively straightforward when applied to software reuse. When the software and supporting data are provided with unlimited rights, a contractor is free to reuse without being concerned about protection of another party's proprietary interests. When the Government makes restricted rights software available under its license to another contractor for Government purposes, the process is more involved. The new contractor must protect and preserve the integrity of the original restricted software when preparing the new software (derived work). The newly created software would then have unlimited rights features for those portions funded by the Government. Should a contractor obtain the software from a library and privately fund the new development for another government application, it's conceivable that the newly created software would have two restrictions - the original software producer's and the new producer's. The levels of restriction could also differ. While this sounds complicated, it isn't difficult to construct. It is more difficult to manage, though, especially if further derivative works are created with or without Government funding. (Note: The restricted rights license granted to the Government does not permit creation of derivative works for non-Government purposes.) Another variant for reuse occurs when a contractor proposes to reuse some other party's legitimately restricted rights software. In this instance, the new contractor is obligated to provide the Government with at least a restricted rights license for the reuse software (assuming the government has agreed to the new contractor employing the existing restricted rights software). Again, the potential exists for two differing levels of restrictions on the resulting software package.

There are other variants regarding commercial software, but they result in essentially the same scenarios. For an interesting discussion of restricted rights in commercial vs noncommercial software, see the Carnegie Mellon University/Software Engineering Institute Technical Report, CMU/SEI-86-TR-2(6). When the software is obtained from a library, the administration, upkeep and management of the software and products is critical to liability and continued use. When the Government mandates use of the software, it must clearly articulate any restrictions and carefully construct the resulting language describing the agreement on rights to the new software product.

Of course, any limited rights data associated with the restricted rights software would follow the same track in maintaining/adding legends protecting the originator's interests. Disincentives exist only to the extent that a contractor or Government program organization believe the products limit creativity, inhibit competition, and/or make the new product more expensive. We would caution against mandating (some would argue that reuse should never be mandated) reuse unless comprehensive architecture analysis and cost estimates have been performed, and all alternative acquisition strategies have been examined (for both unlimited and restricted rights software). This simply makes good business sense for any Government acquisition, and is certainly not a

precaution unique to reuse. Rather, it is a recognition that the opportunity for successful reuse is enhanced by sound planning. We believe acquisition planning documents (such as service regulations for acquisition strategy meetings and DoD-STD-2167A) should require assessment of existing software for reuse potential.

The copyright is the second part of the ownership equation, and perhaps the more confusing one. As outlined in Table 3-1, the DFARS and FAR automatically allow the contractor to claim a copyright, even when the Government has paid for development. NASA's approach is the opposite, requiring an active determination. Utilizing the Special Works clause, though, can require that ownership be retained by the Government.

Note: Many in the legal community, including the authors of Software Engineering Institute reports CMU/SEI-86-TR-1(5) and TR-2(6), argue that while the Government can seek assignment of copyright, it cannot take direct ownership rights. This is due to a conflict with section 105 of the copyright act (17 USC Sec 105) which prohibits such action. This is a fairly esoteric legal issue, but one we should pursue because of its impact on reuse of software.

A contractor can retain its copyright even when the Government has obtained unlimited rights in software and its related documentation. The copyright is granted to promote commercialization. However, copyrights have significant potential implications which may impact incentives to reuse software. One example involves unlimited rights Government software in a situation where the development contractor has claimed a copyright. The software is successfully reused by another contractor under a Government-funded effort. Clearly, the Government retains full unlimited rights to the original and the derived software. But what happens to the copyright? The Government has a license under the original copyright to prepare, or have prepared, a derivative work for Government purposes, but can the new contractor claim a new copyright? Some argue yes, but others in the legal community argue no. The only clear thing is that the issue is unclear. Significantly more research on this issue must be undertaken with the intent of providing, if possible, an unambiguous interpretation and policy statement. If a contractor cannot claim a copyright when creating a derivative work, a certain degree of incentive to reuse is necessarily lost because of the unrealized potential for commercialization.

We could construct other scenarios for restricted rights in commercial and unpublished software, but the scenarios are worse than those described above. While this is not an insurmountable issue, we must conclude that it currently represents an impediment in those instances where a contractor's motivation is principally driven by success in the commercial market. Beyond this case, we see no preponderance of evidence that industry has spent any significant time on the issues of derivative works and copyrights. As reuse becomes more prevalent, we are sure the issue will receive much more attention. When the Government takes assignment of copyright or retains ownership, as is the case in DFARS Special Works (albeit a somewhat controversial step, assuming a DoD person even figures out why Special Works should be involved), the issue of copyrighting the derived software is less convoluted. Either the new software developer claims a copyright, or the Government continues to invoke Special Works, retaining ownership. When the new contractor retains its copyright (we're assuming unlimited rights), the prior scenario comes into play when future derivatives are created. When the Government continues to retain ownership, it impedes development of potential commercial markets, so the contractor's

incentive to participate must be derived from some other source (award fees, business base, program prestige, etc). We should point out that success in the commercial market is not solely linked to copyright ownership, but also to other issues such as quality of training, support and packaging of the software product.

We have only briefly captured the copyright issue here. The topic is extensively treated in works by Professor Pamela Samuelson, Mr. Kevin Deasy and Mrs. Anne Martin in several reports sponsored by DoD through the Software Engineering Institute. The identification of these works is found in the Bibliography of this report. While we may not agree with everything they've concluded, we believe future work in the copyright arena must begin with an analysis of these findings. We are also convinced that a process can be developed to satisfactorily resolve the copyright issue for both Government and commercial software reuse.

Patents are a third ownership issue. Today, we see an increase in the number of software patent applications, with over 200 having been granted in the last two years. We believe that the issues related to software copyrights are analogous to the patent rights arena.

3.1.4.3 Incentives

Many business advantages motivate contractors; profitability, sales volume/market share, technology lead, and prestige/recognition are some of the more significant motivators. When planning reuse strategies, one must consider each of these factors.

3.1.4.3.1 Profitability

Clearly, the opportunity to make money is a great incentive. Reuse can be promoted through classic methods such as royalty payments and award fees.

In the royalty arrangement, a contractor would be paid a set amount every time its software/software components were reused. Even if the Government paid for the software production, the royalty would be an added incentive to the contractor to use its best resources to assure that the developed software/software component(s) and related documentation were of high quality and would continue to be maintained in that state. The disadvantage of the royalty (unless it's a lump-sum payment based on reasonable anticipated reuse events) is that the contractor must wait and wonder whether or when the software will ever be reused. The Government's disadvantage lies primarily in the administration of the royalty payment(s). Funding should not be an issue, though. The program gaining benefit from reuse saves money and can afford the royalty cost. The program originally sponsoring development of reusable software can, however, be shortchanged, since it bears the expense without apparent benefit. This can be overcome by establishing a pool of money to add to programs promoting reusable software, or by some type of reimbursement to the original sponsoring program in addition to the royalty payment. Clearly, the mechanics are workable. The motivation of both parties may be lacking, though, because of the administrative burden and lag time in payback. Nonetheless, it is an avenue not yet thoroughly examined and exploited in reuse strategy. It is successful, though, in the commercial world in the form of licenses for products. The characteristics of high-volume use, dependable maintenance and continued upgrade have to be captured for it to

be successful in DoD. The library/repository concept may be the solution for at least some reuse packages.

Award fees are being used today to promote and reward reuse (we will examine some examples later). While somewhat subjective in nature, they are easily structured and create very little administrative burden for the Government and industry. They can also be structured to focus on the aspects of reuse most critical to the individual program or class of programs. Currently, the FAR (as required by public law) limits potential award fees to 15% for development and 10% for other efforts when using cost reimbursement type contracts (FAR 15.903(D)). While 15% remains reasonably acceptable, it is not sufficient to drive quality development of reusable software. Similarly, when preparing derivative works under a cost reimbursement contract, using other than development funding, 10% is much too low. In today's environment, it may be wise to consider a change to this part of the FAR, allowing higher award fees for contracts promoting development of reusable software assets, or requiring reuse of software assets. We recognize that some may argue award fees can be used without these restrictions when coupled with fixed price contracts. However, this is fine only for those instances where fixed price contracting is appropriate. We would argue that there are many situations where fixed price contracting is not an acceptable business arrangement for the encouragement of reuse.

Performance incentives (FAR 16.402-2) are also available, but we have not found any evidentiary material describing their use in reuse strategies. Some work could be done to explore the viability of structuring simple incentives to improve performance through reuse of software/software components. We emphasize simple because, historically, performance incentives have been overly complicated, and have created an imbalance with other contract incentives.

3.1.4.3.2 Sales Volume/Market Share

We have chosen to treat these together, yet recognizing that they are not identical concepts. A company's sales volume can grow without a corresponding increase in market share, if the rest of the industry is growing as quickly. A company's market share can fall, even with increased sales volume, when the rest of the industry is growing faster. The happy medium is increased sales volume with improved market share and, of course, ever increasing profitability! A company will be further motivated to reuse when the belief exists that there is also a potential to improve its volume and share positions, as well as gain rewards through lower risk and/or improved profitability on a particular contract employing reuse. DoD can foster that concept by zealously assuring that maximum software and data rights as well as copyrights pass to the contractor. This would motivate the contractor to pursue reuse with its best resources, because if it is successful, there exists the potential for more DoD and commercial business. The copyrights issue is most readily solved by not invoking today's Special Works clause when the contractor demonstrates a commitment to commercialization. However, if the contractor fails to commercialize a product within a specific period of time (minimum of 5 years), ownership would revert to the Government. The proposed advanced notice of rule making (FAR, Part 27) addresses copyrighting in a somewhat different manner. However, this is probably at least 12 months from implementation, and reuse can't wait. A simple DoD policy statement could make this happen without resorting to DFARS changes. Pursuit of improved contractor rights in

software and related documentation, though, is more difficult. Given the pending revisions on data and software rights, we expect that the best to be hoped for is a class deviation which would invoke some of the new features of the revised FAR, Part 27.

The Government should also initiate efforts to promote and market reuse of Government-owned software.

3.1.4.3.3 Technology Lead

This is a critical element in each contractor's strategy for maintaining and improving market share. Today, even when the Government funds software reuse projects, we don't believe it receives the best technology industry has to offer, because industry fears it will lose that precious element (its technology lead) under today's software and data rights policies. The Government contends that it should obtain all the rights when it pays for the product; one should recognize, however, that a contractor is not likely to provide a potentially lucrative commercial solution in a Government contract if it fears that it will lose its rights to that solution. More likely, the contractor will offer an acceptable alternative solution which is less creative and probably more costly in the life cycle of a system. The crux of this problem is that commercial software vendors do not believe a sizeable market for DoD-specific software exists, and thus will not participate with their highest-quality technology for fear of losing their competitive market positions. Additionally, DoD contractors which develop the DoD-specific software do not appear to have the expertise to create commercial products, and thus remain inhibited by the issues we have raised.

3.1.4.3.4 Value Engineering

Our research has uncovered no instance in which Value Engineering (VE) has been identified as a potential incentive for promoting reuse. FAR 48.001 defines VE as "... an organized effort to analyze the functions of systems, equipment, facilities, services and supplies for the purpose of achieving the essential functions at the lowest life cycle cost consistent with required performance, reliability, quality and safety". We believe reuse appropriately falls in these categories as an effective method to reduce overall system life cycle costs, while improving system quality and reliability through use of proven software products.

The Government may choose to mandate a VE program (FAR 48.101 (b)(2)) on a particular contract. This would require that the contractor devote specific efforts to VE, and that the Government fund that effort. In a VE reuse program, DoD could create a contract, funding and incentive environment in one act. It appears to represent a perfect potential vehicle for motivating reuse through funding support and incentive rewards. Even if the Government retained software rights, the contractor could earn incentive rewards which, incidentally, would not be subject to the limitations described in 3.1.4.3.1 and 3.2.5 of this report.

We recommend that this avenue be explored and a test program be selected to enable implementation of the concept.

3.1.4.3.5 Prestige/Recognition

There are more motivators than immediate financial rewards to incentivize industry. The Malcolm Baldrige Award for Quality is an excellent example. Right now, General Motor's Cadillac Division is buying full-page advertisements in newspapers (e.g., Wall Street Journal) announcing its designation as a recipient of this prestigious award. It provides instant credibility to Cadillac as a quality producer, a very desirable characteristic when selling automobiles. While near-term sales may increase, we expect Cadillac will attempt to capitalize on the award to produce strategic changes in long-term growth through attraction of new customers and increased return customer sales. The DoD could sponsor a similar award for reuse with the Defense Advanced Research Projects Agency (DARPA) as the selection organization, assisted perhaps by the services and the SEI. The award would recognize initiatives and/or results in promoting successful reuse. Carried further, some type of credit could be conferred on the recipient and other finalists (to a lesser degree) in DoD competitions (source selection) and award fee deliberations.

Through this award, recipients in industry would become recognized as quality software producers, and would be given a potential edge in DoD competitions. Commercial postures would undoubtedly be enhanced by receipt of the award. In the beginning, DARPA could present the award annually to assure its effectiveness as an incentive, while always emphasizing that awards would be made only when an acceptable finalist is presented. At some point, in a year of lesser candidates, the award might not be given to help reinforce its importance. We believe that this concept represents a significant incentive, and strongly urge its favorable consideration. Refinements could be pursued once its utility is accepted. Another point in its favor is that no regulatory changes are needed in the DFARS to accommodate the notion of its use in source selections, award fees or even non-competitive profit negotiations (it would be treated as a special factor under weighted guidelines (DFARS 215.902)). A simple DARPA regulation would be needed, as well as concurrence from the other potential board members in order to ensure their participation. We expect that all would be eager to serve. Senior personnel from Government, industry and academia should also be considered for involvement.

The current DFARS/FAR certainly do not prevent reuse. However, they do impede its practice because of the psychological business barriers believed to exist. Contractors today are reluctant to practice reuse because they believe it will weaken them competitively if they are forced to share trade secrets and technology, with resulting loss of favorable competitive posture and ultimately loss of market share. Perhaps it is time to reexamine the intent of the Competition in Contracting Act regarding the basis for other than full and open competition.

3.1.4.4 Implications of DFARS 52.235-7002, Recovery of Nonrecurring Costs on Commercial Sales

This clause requires contractor payback of Government development dollars which were used to provide contract support for development of an item. The clause requires payback when a contractor "intends" to enter commercial sales for the item or essentially similar items. It is currently an Interim DFARS Rule, signifying that the Government has accepted and is considering industry comment prior to implementing the clause as a Final Rule (permanent

DFARS coverage).

Industry is strenuously objecting to this coverage. NSIA has sponsored efforts to have this clause reworked or revoked. Apparently, the interpretation of the clause language has been that as little as 10% commonality is "essentially similar". Furthermore, Government investment has been interpreted as not just contract dollars but also IR&D and other factors. Finally, industry contends that the clause does not cap recovery and allows excess (and excessive) cost recovery.

There are implications to incentives for software reuse. If a contractor believes its motivation to commercialize is weakened by the clause, even the granting of a copyright to the contractor may not be sufficient to support commercialization and reuse objectives. The contractor will not pursue investment in reusable software if it believes that the Government can recover in excess of its legitimate development investment.

The contractor may also be reluctant to reuse other Government-sponsored software if it believes it may be subjected once again to this clause if it produces derivative software (a feasible scenario).

We support the NSIA efforts in urging the Government to restructure or rescind the clause, and will pursue our own further investigation of this subject for its impact on reuse.

3.1.5 Today's Reuse Strategies

We have found a number of examples of successful reuse strategies and others that are in the process of implementation. These are summarized in Tables 3-3 through 3-7 and detailed in the following sections.

3.1.5.1 Code Reuse (See Table 3-3)

This is perhaps the classic example of reuse. Here, code is taken from one application and reused "as-is" or modified in some way for use in another application. The new application may be similar or completely different from the original.

The Foxboro Company specializes in process control. It typically will perform systems engineering for an application, then design, install, test and maintain a system. It claims 80% code reuse in its work. We accept this claim since the applications are very similar in nature. Foxboro licenses its commercial software packages to companies designing their own systems. However, it only warrants applications when it has designed and installed the system.

The EVB Company licenses a group of software components that have common applications. They do not attempt to claim any copyright on derivative works beyond the original works copyright if their product remains intact. Their marketing strategy appears to focus on broad dissemination of their product base.

The Army Tactical Command and Control System (ATCCS) has mandated reuse by contractors participating in the program. They are requiring use of contractors' software across multiple

program segments. Reuse is experienced both at the code and specification level. The Government has funded all the development to the best of our knowledge. We were not told of any unresolved issues concerning software rights or copyrights. We suspect that as the program matures, additional issues will surface. ATCCS appears to be well along in successful reuse implementation. It definitely warrants continued monitoring to assess its progress, and to build case study materials for other applications.

The Army's Advanced Field Artillery Tactical Data System (AFATDS) has been promoting reuse of software code. Prior to initiating any new software development, the prime contractor is required to examine other code (both existing in-house or from other programs) for possible reuse. A portion of the contractor's award fee (10% in any one evaluation period) is dependent upon its success in reusing software. We have no status on the program. As in ATCCS, the initiative for reuse has originated within the Government.

The Air Force's Automated Weather Distribution System (AWDS) is a good example of external code reuse. In AWDS, the Air Force provided code "as is" from its development program. One competitor used the code, but not quite "as is". The firm subcontracted to have the software run through a translator and recreated in a higher order language. The firm was one of three successful competitors. In the ultimate production competition, the firm lost but not because of software. This is an excellent example of reuse not being mandated, but voluntarily initiated in a competitive environment. There were no liability questions raised. The firm assessed the software, and decided that it was fit for the intended purpose. There was never a production deployment, so we cannot assess what would have happened in post-deployment performance. We aren't aware of any copyright issues. AWDS represents another good example for case history development.

The Air Force's Command Center Processing and Display System Replacement (CCPDSR) program provides another reuse variation. TRW, the prime contractor, took software developed and funded under the CCPDSR contract, and updated and reworked the product using internal funds, with the intention of selling it commercially. TRW was successful and has since licensed it, under the acronym UNAS (Universal Network Architecture Services), to both Digital Equipment Corporation and Rational. We haven't found any evidence that the Government has reused the original software product. We have not verified this point, but assume that TRW claimed a copyright, allowing it to commercialize the product. Clearly, this reuse occurred through TRW's initiative, and has been commercially successful. Other applications which may benefit from work done under CCPDSR include ATCCS and the Air Force's Systems Software and Design Center.

AFATDS, ATCCS, UNAS and AWDS demonstrate sound reuse applications. However, they also demonstrate that it takes Government funding, or the incentive of competition or the commercial marketplace to make it work.

3.1.5.2 Specification Reuse See Table 3-4

Conceptually, reuse at the specification level appears to be very promising. As we described above, ATCCS is mandating reuse at this level. One contractor is developing common

specifications for use by ATCCS segment contractors. Its success can only be measured by future performance.

Since software specifications fall under the definition of data in the DFARS, all the copyright issues previously described don't apply. Specifically, an originator of software based on existing specifications would hold the first copyright claim. There would be no derivative, only original software. This model also holds promise because it is potentially easier to understand and use. We would support more research and practical applications in this area.

3.1.5.3 Top-Level Software Architecture Reuse (See Table 3-5)

Once again, we found a great deal of conceptual discussion. The Air Force's Granite Sentry Program managed by the Electronic Systems Division is one example of this type of reuse. The model envisions architectures that are generic in nature, which could be used over and over again across a variety of applications. The benefit is in saving the time and money typically involved in higher-level analyses. Presumably, there would be a corresponding risk reduction because the architecture would be proven. We accept and support the concept. However, it requires further development to produce results.

3.1.5.4 Domain Knowledge Base Reuse (See Table 3-6)

This model approaches software reuse from the perspective of analyzing existing software. This analysis is coupled with knowledge of a relevant technology base, as well as the theory and expertise developed in a particular domain (command and control, for example), which results in an engineering solution in which software and related documentation are reused. The model takes the more haphazard/serendipitous code reuse scenarios, and applies a systems engineering perspective to the concept of reuse. Its appeal results from the potential to realize not only a well-engineered solution involving software reuse, but also the construction of a permanent base of engineering knowledge through systematic examination of the particular domain. In turn, the model creates a resource for potentially unlimited future applications.

The DoD's Software Engineering Institute is currently performing research in this area. It has supported the ATCCS program in developing reuse strategies. The Joint Integrated Avionics Working Group (JIAWG) is also examining potential programs, including the F-18 and the Advanced Tactical Fighter, as candidates for domain knowledge base applications. In addition, the Strategic Defense Initiative Organization/National Test Bed Joint Program Office (SDIO/NTBJPO) and the Navy's Naval Research Laboratories' (NRL) Command, Control, Communications and Intelligence (C³I) efforts are being examined for their appropriateness for potential involvement.

3.1.5.5 Generation of Software (See Table 3-7)

This is, perhaps, the most radical of all current software reuse strategies. It has been implemented on the recently awarded (August/September 1990) Flight Simulator program at the Air Force's Aeronautical Systems Division with the help of the DoD SEI.

This model promotes use of templates to reengineer software. The templates capture elements common to particular applications. The elements are described in the template in a way which enables specific applications to merely identify their peculiar performance requirements for those template elements. Once the templates are created and the performance requirements identified, the software generation process is a routine event. There is no need to reuse the code, because the template is infinitely reusable within the application field. The concept, similar to specification and architecture models, obviates some of the reuse issues we've described. Its challenge lies in being able to construct a systematic engineering process which will consistently produce viable, workable templates. Our research to date suggests that a structure which would enable the process to be repeated for dissimilar applications does not exist.

The most notable aspect of today's reuse strategies is their common goal of eliminating the constant production of new software assets. The potential for risk reduction, schedule acceleration, improvement in quality and money savings is astounding. The next most notable aspect of the current reuse environment is the lack of a focused effort (within DoD, prior to STARS) to capture and promote reuse as a discipline. While reuse technology is currently being promoted, the business environment has a lot of catching up to do. Our examination of the current strategies, the DFARS and FAR and research on available techniques, has convinced us that the focus on business considerations must match the technology efforts to ensure that reuse becomes a viable, accepted technology. Much of that can be accomplished through new products for educating and training Government acquisition personnel in effective reuse strategies. Persons in all disciplines must eventually be educated, but efforts must first be targeted toward those persons in a position to effect the greatest change, namely program managers, contracting officers, logisticians and legal personnel.

3.1.6 Analysis of Advanced Notice of Rulemaking for FAR, Part 27 and Proposed Changes

As noted previously, the proposed regulatory change to the Federal Acquisition Regulation (FAR): Rights in Technical Data - Advanced Notice of Proposed Rulemaking, Federal Register, Vol. 55, No.199, 15 October 1990 proposes to replace the current DFARS 227.4 (Interim Rule, 1988) and FAR 27.4 with a single regulation for all Government agencies addressing rights in technical data and computer software. We attended the November 19, 1990 and January 11, 1991 public hearings on this advanced notice.

By presenting the regulatory change as an advanced notice, the Government has essentially acknowledged the potential for extensive comment and subsequent rewrite prior to publishing the change as an Interim Rule. While comments are accepted on Interim Rules, historically the final product has been essentially the same as the published Interim Rule. The FAR Council has not provided a timeline for publishing an Interim Rule; however, we anticipate that it will be published at least 12 months from the October 1990 Federal Register Notice.

There are some significant changes in the advanced notice. We will address these changes in general terms now, and later, as an update to this report, we will provide more detailed comments. We will continue to focus on the impact these changes will have on software reuse, and any other proposed modifications.

In combining DFARS 227.4 and FAR 27.4, the Federal Government has taken a giant step forward. Now, a single regulation will exist which addresses the Government's and contractor's rights regarding data and software. We thus immediately eliminate present inconsistencies (Table 3-1) between the documents. However, the controversies are not totally eliminated. In the following sections, we will review the more important issues, commenting on whether any improvements have occurred with respect to reuse.

3.1.6.1 Data and Software Continue to be Treated Together

During the 19 November 1990 public hearing, the Government stated that its decision to maintain combined coverage resulted from the conclusion that there were more similarities than differences in the topics. However, we continue to maintain that the existence of differences provides sufficient justification to separate treatment of software and data. Continuing to combine the topics unnecessarily complicates and confuses issues. As an example, Subpart 27.4 continues to be titled Rights in Data and Copyrights with no mention of software. Additionally, sections 27.402, 403 and 404 either initially address only data or only include "Data" in the title of the section. Finally, the phrase "developed and necessary" for performance is replacing the controversial term "required for performance". When the phrase is used in 27.404-1 (a)(1)(i)(B), it initially refers to data and software, but then reverts only to use of the term "data". When the phrase is used in 52.227-14, subparagraph (b)(1)(i)(B), the terms software and data are only used once, and do not create the potential confusion of whether the Government intentionally or unintentionally omitted software in the second reference in 27.404-1(a)(1)(i)(B). These examples reinforce our belief that as long as the topics are addressed together, software will not receive proper treatment. The FAR authors continue to create confusion due to their lack of understanding of software and its significance. A higher degree of sophistication regarding how software must be viewed, with respect to Government rights and industry intellectual property interests is required. Additionally, a more focused discussion of critical software issues, provided in a more readable style is still necessary.

3.1.6.2 Introduction of Government Purpose Rights (GPR)

The NASA approach to encouraging commercialization has been adopted in GPR. Under these circumstances, the contractor is allowed to retain exclusive commercial rights for a negotiated period of time, after which the software or data reverts to unlimited rights. The significance of this approach is that the contractor is provided with commercial protection in both mixed funding and 100% Government funding situations when it can demonstrate an intention to commercialize - a very different and progressive change from the current DFARS. Under GPR, the Government obtains a license for use and disclosure relating to Government purposes, providing the contractor's limited, exclusive commercial rights are protected. Is the coverage better? Yes. Is it as good as it could be? No.

The DAR Council's Deputy Director, Ms. Linda Greene is quoted in the 15 October 1990 issue of the Federal Contracts Report (Vol. 54, No. 15, page 549) as saying "The draft rule also establishes more of a preference for Government purpose rights [than unlimited rights] than is present under the [1988] Interim Rule. We think we've made a gigantic stride there." Unfortunately, while the coverage has improved, the advanced notice does not emphasize GPR

over unlimited rights. Examining Subpart 27.404-1, unlimited rights, and 27.404-4, GPR, reveals that the Government's stated policy is still to acquire unlimited rights unless the contract specifies GPR or copyrights. So, while intentions are good, policy statements do not promote commercialization objectives found in GPR over obtaining unlimited rights. Unless 27.404-1 is changed to explicitly favor GPR over unlimited rights, Government acquisition personnel will continue to pursue full rights and provide disincentives to industry to invest (mixed funding) or participate at all. Software reuse is not incentivized by the advanced notice policy language, even though GPR has provided a vehicle to protect commercial rights. The positive policy statements in Subpart 27.402 are negated by the ineffective implementation guidance in 27.404.

3.1.6.3 Copyrights

The FAR approach, which is more favorable to industry regarding commercial exclusivity (Table 3-1), has been adopted in the advanced notice. The Government's copyright for software does not include the right to distribute copies to the public as is now found in DFARS. This should help promote reuse, since a contractor will now be assured that its full commercial rights are protected. A more proactive Government approach (similar again to NASA) has been taken regarding the decision process governing the granting of contractors' copyrights. The coverage has also been improved by providing a more complete explanation of why copyrights are important (commercialization). However, copyrights, like unlimited rights and GPR, do allow full disclosure for Government purposes. Therefore, the contractor's incentive to partially fund creation of reusable software, or to put its best talent on totally Government-funded software projects remains inhibited, since the current structure doesn't enable the contractor to benefit from Government-sponsored reuse of its products.

The issues we've identified regarding the copyrighting of derivative works are not dispelled by the advanced notice coverage in Subpart 27.404-5 and its associated clauses.

The issue concerning use of the current DFARS Special Works clause is now covered in Subpart 27.406 and its associated clause in 52.227-17. We see no appreciable change beyond a statement regarding inapplicability to "Limited Rights Data or Restricted Rights - Software". This reference is not clear, and we maintain that copyright issues under 27.406 will continue to impact the DoD contractor community.

3.1.6.4 Commercial Software

Subpart 27.406(c) does incorporate the FAR approach to defining commercial software and providing more appropriate clause coverage (52.227-19). Unfortunately, it also allows Government personnel to revert to the basic Rights in Data clause by itself or in concert with 52.227-19. We expect the conservative acquisition professional will do just that, and continue to create unnecessary confusion and contention with commercial software vendors. The guidance also negatively impacts commercial software licenses by noting that the intent of 52.227-19 is to supersede any portions of those licenses that are inconsistent with Government restricted rights needs. This should be changed to state that a commercial software license will always be acceptable, unless it can be factually demonstrated to be inconsistent with the Government's minimum needs as found in the restricted rights definition. Without this type of change,

commercial vendors, especially the small and innovative ones, will continue to avoid Government business because they will perceive the Government as an unfriendly and threatening (loss of proprietary interests) customer. Once again, the opportunity for reuse enhancement is potentially lessened by what will be perceived as a negative approach.

On balance, the revised coverage of the FAR is superior to that currently found in the DFARS.

3.1.6.5 Mixed Funding

We noted that the DFARS only addresses mixed funding in the context of technical data. Subpart 27.402(c) of the advanced notice corrects this situation, also addressing computer software. It clearly directs the Government to consider not only shared funding, but also its ultimate requirements before determining appropriate rights to be acquired. It further directs the rights issue to be addressed at the lowest possible level of software identification. This should help focus issues on particular modules or components and narrow contentious areas. We believe Subpart 27.404 should contain a reference back to 27.402 to assure that rights issues will be properly considered where mixed funding occurs, and that GPR will be stated as the most stringent Government rights possible under such a scenario. Furthermore, the contractor should always be allowed to claim a copyright in mixed-funding situations.

3.1.6.6 "Required for Performance"

This term has been deleted. The advanced notice now makes reference to the concept of "developed and necessary" for performance (52.227-14(b)(1)(i)(B)) when identifying situations in which the Government must obtain unlimited rights. The advanced notice states a belief that this change has narrowed the application of the concept, but we do not agree. We see no change of any significance in the new 52.227-14 (b)(1)(i)(B), when compared to DFARS 227.471 and 252.227-7013 language. Since the advanced notice gives no further explanation or example to clarify how this "narrowing" has occurred, we suspect there is more show than substance in the claim. Another concern of even greater importance is the fact that the offensive DFARS language is now proposed for use throughout the Federal Government. Without deletion or radical modification, all federal agencies will now face the same contention existing today between industry and the DoD.

This "required for performance" issue continues to be the most significant potential impediment to software reuse. Industry will not provide its own products or use its best talent when faced with loss of its competitive position within the commercial and Government markets. While the Government can foster reuse through its own funding for new software, it continues to lose potential reuse opportunities derived from use of industry-funded software.

The concept should be changed to allow for more favorable industry treatment. A change in wording which would allow contractors to retain rights for the duration of the contract (or a minimum of 5 years) might be sufficient to overcome this impediment. We will continue to explore this potential solution.

3.1.6.7 Conclusion

We have addressed the most significant potential changes for software reuse in the advanced notice of rulemaking. Overall, it is a more understandable treatment of rights in data and software, though the basic Rights in Data clause remains horrific in its length and treatment of a multitude of issues.

We prepared specific language changes which were submitted to the FAR Council as formal comment on the advanced notice (Appendix D). The Council will now only accept comments on the advanced notice. Given the timing of the advanced notice, the DAR Council will not consider a DAR case on the existing DFARS.

3.2 Findings and Recommendations

The following findings and recommendations are based on the concepts and ideas expressed within Section 3.1. We have also drawn on our extensive review of supporting documentation (Appendix C). Our attendance at Government and industry briefings, conferences and workshops, coupled with numerous interviews provided us with an invaluable source of information and innovative ideas (Appendix B).

3.2.1 Ease of Use

3.2.1.1 Finding/Recommendation

Today's DFARS coverage on software and software rights is not well written, is poorly organized and very difficult to understand. The proposed regulatory change replaces the current DFARS 227.4 (Interim Rule, 1988) and FAR 27.4 with a single regulation for all Government agencies, addressing rights in technical data and computer software. The proposed FAR, Part 27 is an improvement, but still does not properly segregate and focus software.

A more focused discussion of critical software issues, provided in a more readable style is still necessary.

3.2.1.2 Finding/Recommendation

Neither the DFARS nor the FAR treat software separately from technical data. In the 19 November 1990 public hearing on revised FAR, Part 27, the Government stated that its decision to maintain combined coverage for technical data and software resulted from the conclusion that there were more similarities than differences in the topics.

Separate treatment is necessary for software to be adequately addressed. We continue to maintain that the existence of differences provides sufficient justification to separate treatment of software and data. Continuing to combine the topics unnecessarily complicates and confuses issues.

3.2.1.3 Finding/Recommendation

The DFARS Rights in Technical Data and Computer Software clause starts on page 252.227-8 and concludes on page 252.227-20 (12 pages). It is unreasonable to expect even the most sophisticated person, knowledgeable in software, to be comfortable working with such a cumbersome structure.

A new, concise clause is required for software. It should be easily understood, comparable to what the insurance industry has done with its policies.

3.2.2 Software Rights

3.2.2.1 Finding/Recommendation

Unpublished software becomes Government-owned software if it is created during and required for Government contract performance, even if it is 100% funded by a contractor. This is, perhaps, the most contentious issue between Government and industry today in the debate concerning required DFARS changes. The language in DFARS which acquires Government unlimited rights for software required in performance of the contract (even though not paid for by the Government) does create a disincentive to industry. The "required for performance" wording has been replaced with "developed and necessary" in the proposed revision to FAR, Part 27. The introduction to the revision states a belief that this change has narrowed the application of the concept.

The proposed regulation does not go far enough, and should be changed to allow for more favorable industry treatment. A change in wording which would allow contractors to retain rights for the duration of the contract (or a minimum of 5 years) might be sufficient to overcome this impediment. The concept could provide for an escrow provision to protect the Government's interests in the event of company failure or lack of continued product support. In the event the contractor did not commercialize within the stated period, ownership would revert to the Government. It is clear that a better solution than that found in the proposed FAR, Part 27 revision is required.

3.2.2.2 Finding/Recommendation

The DFARS (227.481-1(f)) provides no practical guidance for acquiring commercial software. It requires that the full Rights in Technical Data and Computer Software clause (252.227-7013) be included. The specific portion dealing with commercial computer software (252.227-7013, (c)(1)(ii)) is the only portion of the clause that is actually applicable to the purchase of commercial software.

We do not understand why the DoD has never adopted the simpler and more straightforward FAR approach for use in the DFARS. However, the proposed FAR, Part 27 revision does adopt the FAR approach (see next finding).

3.2.2.3 Finding/Recommendation

The revised FAR, Part 27, Subpart 27.406(c) does incorporate the more straightforward FAR approach to defining commercial software and providing more appropriate clause coverage (52.227-19). Unfortunately, it also allows Government personnel to revert to the basic Rights in Data clause by itself or in concert with 52.227-19. We expect the conservative acquisition professional will do just that, and continue to create unnecessary confusion and contention with commercial software vendors.

Subpart 27.406(c) should be changed to state that a commercial software license will always be acceptable, unless it can be factually demonstrated to be inconsistent with the Government's minimum needs as specified in the restricted rights definition.

3.2.2.4 Finding/Recommendation

The DFARS does not clearly describe the contractor's and Government's rights with respect to unpublished software existing at contract award.

The FAR, Part 27 revision should be altered to explicitly state that existing, unpublished software is restricted rights software unless the Government acquires greater rights through licensing or acquisition.

3.2.2.5 Finding/Recommendation

When reusing restricted rights software, the contractor must protect and preserve the integrity of the restricted software when preparing the new software (derived work).

More guidance is required for acquisition personnel on how to effectively reuse restricted rights software. The guidance should include methods for distinguishing between the original and derived work. The proposed handbook (3.2.4) could address this subject.

3.2.2.6 Finding/Recommendation

The NASA approach to encouraging commercialization has been adopted through the GPR description in the proposed FAR, Part 27 revision. Under GPR, the Government obtains a license for use and disclosure relating to Government purposes, providing the contractor's limited, exclusive commercial rights are protected. Unfortunately, while this change improves the coverage, the Part 27 revision does not promote GPR over unlimited rights. The positive policy statements in revised FAR, Part 27, Subpart 27.402 are negated by the ineffective implementation guidance in 27.404.

While the Government's intentions are good, the proposed new policy statements do not encourage commercialization objectives found in GPR over obtaining unlimited rights. Unless 27.404-1 is changed to explicitly favor GPR over unlimited rights, Government acquisition personnel will continue to pursue full rights, and provide disincentives to industry to invest (mixed funding) or participate at all. We recommend that 27.404-1 be changed to explicitly

favor GPR over unlimited rights.

3.2.2.7 Finding/Recommendation

Revised FAR, Part 27, Subpart 27.402(c) clearly directs the Government to consider not only shared funding, but also its ultimate requirements before determining appropriate rights to be acquired.

We believe Subpart 27.404 should contain a reference back to 27.402 to assure that rights issues will be properly considered where mixed funding occurs, and that GPR will be stated as the most stringent Government rights possible under such a scenario. Furthermore, the contractor should always be allowed to claim a copyright in mixed-funding situations.

3.2.3 Copyrights

3.2.3.1 Finding/Recommendation

While the DFARS copyright license includes the right to distribute copies to the public, the FAR does not, unless what is known as the Special Works clause is invoked (Table 3-1).

The proposed FAR, Part 27 revision adopts the current FAR approach, which encourages commercialization. The final Part 27 must retain this feature.

3.2.3.2 Finding/Recommendation

The DFARS and FAR automatically allow the contractor to claim a copyright, even when the Government has paid for development (Table 3-1). A simple discussion of why copyrights are important at all is lacking in the DFARS.

FAR 27.404(f)(1)(i) is somewhat better (but not by much) in describing how the contractor is normally granted a copyright to enhance dissemination of information produced at Government expense (i.e., commercialize). The proposed FAR, Part 27 revision is a further improvement, but still requires enhancement of the implementing guidance. The current NASA FAR supplement requires proactive Government team involvement (including patent or intellectual property counsel) in determining whether a contractor has specific commercial plans, and has made or will make a significant financial contribution to the development or maintenance of the software. The proposed FAR, Part 27 should incorporate more of the NASA supplement language. For now, the copyright issue is most readily solved by not invoking today's Special Works clause when the contractor demonstrates a commitment to commercialization. This will, at least, give the contractor full commercial rights.

3.2.3.3 Finding/Recommendation

If a contractor cannot claim a copyright when creating a derivative work, a certain degree of incentive is necessarily lost because of the unrealized potential for commercialization.

Alternate incentives must be used to offset any negative derivative work copyright issues. Award

fees could be used to partially offset potential losses.

3.2.3.4 Finding/Recommendation

Insufficient attention has been given to the impact of copyrights on reuse strategies. The issues we have identified regarding the copyrighting of derivative works are not dispelled by the proposed revision in FAR, Subpart 27.404-5 and its associated clause.

Future work in the copyright arena must begin with an analysis of the SEI findings on copyrights. We are convinced that a process can be developed to satisfactorily resolve the copyright issue for both Government and commercial software reuse. The issue of patents also requires further exploration.

3.2.3.5 Finding/Recommendation

The FAR approach, which is more favorable to industry regarding commercial exclusivity has been adopted in the proposed FAR, Part 27 revision. However, copyrights, like unlimited rights and GPR, do allow full disclosure for Government purposes. Therefore, the contractor's incentive to partially fund creation of reusable software, or to put its best talent on totally Government-funded software projects remains inhibited, since the current structure doesn't enable the contractor to benefit from Government-sponsored reuse of its products.

Consequently, a policy change which would prevent Government disclosure for a stated period should be considered.

3.2.4 Education/Training

3.2.4.1 Finding/Recommendation

We believe much of the tension between industry and Government, and resulting industry apprehension is created by a lack of understanding of software and its issues by federal acquisition personnel. This is compounded by inadequate guidance (DFARS) to help accomplish effective and reasonable software acquisition practices. There is an apparent lack of a concerted effort to provide the acquisition work force with new guidance to improve their understanding of software acquisition.

A handbook is necessary to provide acquisition personnel with a road map to the development of effective reuse strategies. It should be written for the experienced acquisition professional, not as a tutorial for the beginner.

3.2.4.2 Finding/Recommendation

Reuse planning in today's environment is characterized by fragmented efforts, with no central guidance to properly focus acquisition personnel.

We believe acquisition planning documents (such as service regulations for acquisition strategy

meetings and DoD-STD-2167A) should require assessment of existing software reuse potential.

3.2.4.3 Finding/Recommendation

Software is not delivered to the "Government", but rather to a particular agency or office. In most cases, other agencies are totally unaware of its existence, much less of its potential utility to their problem/mission.

An agency (or set of agencies - by service or command, for example) that acts as a center for receipt of software separate from the mission organization could be established to act as reuse advocates in the procurement process.

3.2.5 Incentives

3.2.5.1 Finding/Recommendation

Industry is reluctant to invest in new technology for software because of the sweeping rights demanded by the Government, and concerns regarding loss of proprietary information. Much of this reluctance arises from the perception that the DoD will always try to insist on unlimited rights, whether it needs them or is even entitled to them.

The proposed FAR revision must include clear policy statements concerning the Government's position on software and copyrights. Our recommendation is that the Government's stated preference not extend beyond Government Purpose Rights.

3.2.5.2 Finding/Recommendation

The mechanics to provide royalty payments for software reuse are workable. The motivation of both parties may be lacking, however, because of the administrative burden and lag time in payback.

Royalties are an avenue not yet thoroughly examined and exploited in reuse strategy. They are successful in the commercial world, though, in the form of licenses for products. More guidance is required for effective royalty use. The organization recommended in 3.2.4.3 above could accept these administrative tasks. The proposed handbook (3.2.4) could also address this issue.

3.2.5.3 Finding/Recommendation

Award fees are being used today to promote and reward reuse. They are easily structured and create very little administrative burden for the Government and industry.

In today's environment, it may be wise to consider a class deviation to FAR 15.903(d), allowing higher award fees for contracts promoting development of reusable software assets, or requiring that software assets be reused. Since FAR 15.903(d) is derived from statute, revisions to the applicable public laws may also be required.

3.2.5.4 Finding/Recommendation

Our understanding and interpretation of FAR, Part 48, Value Engineering (VE) is that it can be an effective vehicle for promoting development/modification of reusable software. It appears to be a perfect potential vehicle for motivating reuse through funding support and incentive rewards. Even if the Government retained software rights, the contractor could earn incentives which, incidentally, would not be subject to the fee limitations in FAR 15.903(d).

A test program should be selected to institute a software reuse VE program.

3.2.5.5 Finding/Recommendation

There are more motivators than immediate financial rewards to incentivize industry. The Malcolm Baldrige Award for Quality is an excellent example.

The DoD could sponsor a similar award for software product reuse, using the Defense Advanced Research Projects Agency (DARPA) as the selection organization, assisted perhaps by industry, the services and the SEI. Carried further, some type of credit could be conferred on the award recipient and other finalists (to a lesser degree) in DoD competitions (via source selection), award fee deliberations and profit negotiations using weighted guidelines.

3.2.6 Liabilities

3.2.6.1 Finding/Recommendation

People within and outside Government immediately raise the liability specter when software reuse is discussed.

We do not believe that the Government should attempt to offer liability protection when making software assets available for reuse. It is not a practical alternative, and would require a prohibitively expensive testing and administrative organization. The Government should provide as complete a description as possible for the software. The contractor will then have sufficient information available to make an intelligent technical and business decision regarding its ability to reuse the product and confidence in its quality.

3.2.7 Reuse Strategies

3.2.7.1 Finding/Recommendation

There are no overwhelming impediments in the current DFARS/FAR preventing successful reuse. However, there is a lack of adequate guidance and training.

The proposed handbook (3.2.4) should incorporate case studies on successful reuse programs, as well as guidance (such as decision trees) in creating and implementing reuse strategies.

3.2.7.2 Finding/Recommendation

We would caution against mandating reuse unless comprehensive architecture analysis and cost estimates have been performed, and all alternative acquisition strategies have been examined (for both unlimited and restricted rights software).

There is no existing formal guidance on considerations to be evaluated in assessing reuse viability in a program. The proposed handbook (3.2.4) and current acquisition planning documents should be revised to include this guidance.

3.2.7.3 Finding/Recommendation

A company will embrace reuse when it believes it can improve its volume and market share positions.

The DoD can foster that concept by zealously assuring that maximum software and data rights as well as copyrights pass to the contractor. This would motivate the contractor to pursue reuse with its best resources, because if it is successful, there exists the potential for more DoD and commercial business. A simple DoD policy statement could effect this change without requiring alteration of the current DFARS.

3.2.7.4 Finding/Recommendation

The current DFARS Interim Rule on Recovery of Nonrecurring Costs on *Commercial Sales* (DFARS 52.235-7002) has negative incentive implications for software reuse. Industry currently perceives that the clause creates an unfavorable environment for commercialization. This, in turn, impacts the creation of reusable software if the contractor believes there is no financial incentive available.

DFARS 52.235-7002 should be rescinded or a cap established to limit the Government's potential recovery, and the regulation should clearly state that the Government's investment base is limited to contract dollars.

3.2.7.5 Finding/Recommendation

The current DFARS/FAR certainly do not prevent reuse. However, they do impede its practice because of the psychological business barriers believed to exist.

Perhaps it is time to reexamine the intent of the Competition in Contracting Act regarding the basis for other than full and open competition. The purpose would be to assess whether changes are needed in the Act to facilitate reuse, and whether current policy interpretations are unnecessarily restrictive.

3.2.7.6 Finding/Recommendation

Our examination of the current strategies, the DFARS and FAR, and research on available

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techniques has convinced us that the focus on business considerations must match the technology efforts to assure that reuse becomes a viable, accepted technology.

Much of the business considerations focus can be accomplished through new products for educating and training Government acquisition personnel in effective reuse strategies. Persons in all disciplines must eventually be educated, but initial efforts must be targeted toward those persons in a position to effect the greatest change, namely program managers, contracting officers, logisticians and legal personnel.

4. BUDGET/FINANCE ENVIRONMENT

4.1 The Current Budget/Finance Environment and Proposed Changes

4.1.1 Introduction

We have used the Air Force 170 series of regulations for our analysis of potential impediments to reuse in the budget and finance procedures. We were at least partially influenced by the currency (15 October 1990) and comprehensiveness of AF Regulation (AFR) 172-1, USAF Budget Policies and Procedures. It represents an outstanding compendium of the intricacies of budget and finance issues. Other principal reference sources were AFR 177-16 (30 November 1988), Administrative Control of Appropriations and the AF primer on the Biennial Planning, Programming, and Budgeting System (BPPBS, January 1989) issued by the Directorate of Program and Evaluation, Deputy Chief of Staff/Programs and Resources, Department of the Air Force. The bibliography of this report identifies the remaining documents that we examined.

Our analysis again focuses on the subject of software reuse and actual or perceived impediments to its implementation and proliferation. The background information in section 3 of this report remains applicable.

4.1.2 The Current Budget/Finance Environment

Similar to our description in the FAR/DFARS environment section (3.1.2), software is not treated separately in the budget regulations. As an example, AFR 172-1 addresses software as a subset (often no more than parenthetical) of the hardware application discussion. A specific instance is the treatment of general purpose (Information Processing Equipment (IPE)) versus embedded (integral component of a weapon system) computers. IPE software (Vol. I, paragraph 4-b, 4-f of AFR 172-1) is discussed in the context of its related hardware, and is funded for purchase through the Operation and Maintenance (O&M) account. Software for embedded systems is discussed in paragraph 4-9.a. This paragraph essentially states that all software developed and/or commercial software initially integrated (up to the point where an operational configuration has been tested, evaluated, and accepted or qualified) will be acquired with Research, Development, Test and Evaluation (RDT&E) funding. In all this discussion, it's not clear in which category reuse funding would fall. If one were modifying existing software in the Research and Development (R&D) phase of a particular weapon system with embedded computers, we would expect RDT&E funds to be used. However, it is unclear what type of funds would be used to support the generic modification of existing software to be used across new systems. Perhaps this example would fall under Product Improvement in Vol. I, paragraph 8-3 or under paragraph 4-9.e for embedded systems, both providing the possibility of using multiple funding types to potentially support reuse. Program managers do not have the necessary budget guidance to clearly depict how software reusability (outside the normal development process) should be properly funded, and funding guidelines are inadequate to address these needs.

4.1.3 Impact of Reuse in a Declining Defense Budget

There is a real danger that investment in reuse will be viewed as unaffordable in today's declining Defense budget. In a speech to the TRI-Ada '90 Conference, LtG James S. Cassity, Jr. stated that the DoD budget will have decreased 25% in real dollars over the period from 1985 to 1995. He went on to cite that software development consumes 10% of today's total Defense budget, with 80% of those dollars expended for software maintenance and upgrade. There are a number of points to be gleaned from the General's remarks, not one of which maintains that reuse is not an affordable initiative. On the contrary, reuse has the potential to soften the impact of a declining budget by reducing new software development costs, using proven software with the effect of reducing maintenance costs, and providing software and software products which make upgrades more affordable.

4.1.4 Advocacy

Notwithstanding the positive potential impact of reuse on the budget, it will be very difficult in today's environment of strict budgeting constraints to promote any reuse strategy which requires an unanticipated investment. Program managers have to believe that it's worth their while to invest today's dollars for tomorrow's payoff, or that there will be support for such an investment even when the program may not have sufficient initial funding to implement a reuse strategy. This can be fostered, in part, by formally establishing reuse advocacy in the Office of the Secretary of Defense (OSD) and the services, including the identification of senior individuals to sponsor reuse. We are not recommending the establishment of a new reuse advocate position in each organization. Rather, we recommend that an appropriate senior official in each organization who is already responsible for software be given the charter for reuse advocacy. This individual should be in a position in which his/her office would normally be involved (or could easily become involved) in requirements validation, program direction documentation, budgeting formulation cycles, and acquisition strategy planning and execution. These interfaces are necessary to assure that reuse is properly considered in the requirements definition, funding and program execution processes. OSD and the services currently are structured to easily accommodate this recommendation.

The advocacy position is important because reuse is not widely understood or practiced today. While reuse technology is proven, it is continually evolving. Therefore, senior management influence and oversight are required to ensure effective implementation and institutionalization. Over time, we would expect formal advocacy to become unnecessary, since reuse would continually demonstrate its effectiveness.

4.1.5 Investment Requirements

While the establishment of a reuse advocate would represent a positive and bold initiative, it's not sufficient to ensure success. Reuse will add investment dollars to some programs in which software is being developed, modified or improved with the intent of future reuse. Where will the money come from? Even in today's environment, there will be programs which can afford the investment within their current budget profiles. However, most others can not support such an investment. Therefore, we recommend that DARPA and the services sponsor initiatives to

create reuse technology budgets under Program Elements (PE). The PEs would address the development of reuse technology, the funding for new programs which would benefit from reuse but do not have sufficient resources to implement the strategy, and dollars to modify/improve existing software products to make them reusable. We are not so naive as to expect that this will be easy to accomplish or that, even if success were demonstrated, it would have more than a modest budget initially. We are confident, however, that it would prove its worth and eventually be soundly supported in the years to come.

The PE could even be established as a management fund (see AFR 172-1, Vol I, Chapter 11). Under this type of fund, there is an opportunity for reimbursement of investment dollars to the PE if development, production or maintenance costs are reduced. Depending on when (and if) the reimbursement occurs, these dollars might be available to help other programs. The management fund concept would reinforce the notion of "investment now means payback/savings later", and perhaps make reuse a more inviting concept to pursue.

4.1.6 Program Executive Officer (PEO)

We also recommend that each service provide financial resources and a charter (Program Management Directive (PMD) language) to support reuse, and that each PEO provide the management advocacy so necessary to successful reuse. Given the PEO's broad acquisition charter across a common family of programs, there is significant opportunity to provide reuse investment resources in one PEO program with the potential of benefitting many other programs or program components under the PEO's management. Some PEOs may view this as an intrusion into their management authority and prerogative; however, we contend that it is necessary even if viewed in this context. The greater DoD mission and its budget constraints demand that we aggressively seek opportunities.

4.1.7 Funding Types and Use

There are three types of funds typically used for software, which could also fund reuse efforts: Research, Development, Test and Evaluation; Production; and Operation and Maintenance. Each has a different life cycle, starting in the year the funds are appropriated by Congress: 2 years for RDT&E; 3 years for Production and 1 year for O&M. These funds must be obligated (placed on contract) within the stated periods. The funds remain available for two years following the conclusion of these periods for payments, after which they lapse into what is known as a merged or M account.

Reuse can be introduced at any time in an acquisition life cycle. The following diagram shows what type of funds would be used for particular acquisition phases where software reuse might be employed. Typically, the same type and year of funds required for the basic effort would be expected to fund reuse. For example, a reuse product improvement identified against an FY91 requirement would use that year's funds.

Acquisition Period	Funding Type		
	RDT&E	Production	O&M
Research & Development	•		
Production		•	•
Engineering Change	•	•	•
Product Improvement	•	•	•
Aircraft Modifications	•	•	•

Funding for Software Acquisitions

Some production portions of contracts (product improvements and aircraft modifications) might require different funding types dependent upon the nature and timing of the change. This is not a significant issue unless identified outside the budget cycle (discussed later).

There are two potential impediments to reuse in the area of funding types and uses. Both are more perceived than real. The first concerns the manner in which software is treated in the regulations; the second issue deals with annual appropriations language. We would favor a simple matrix which shows that reuse investment can be made from essentially any of the three funds identified, appropriate to the specific phase of a particular program's acquisition life cycle. While some will argue that today's guidance is adequate, we cannot agree (see paragraph 4.1.2 for a more detailed discussion). Handbook material should be developed to interpret current regulations and provide specific guidance.

We have heard arguments stating that funds earmarked for a specific program (in a PE) cannot be expended on reuse. Essentially, some are arguing that program- specific dollars cannot be spent for software development to make it reusable across other programs. This, it is argued, would be expenditure of the funds for a purpose not originally intended. We do not agree, but we were puzzled about the origination of this perception. Our research suggests that it traces back to the now annual language cited in 31 USC 1301(a) (see AFR 177-16, para. 4.0) which states, "Appropriations shall be applied only to the objects for which the appropriations were made except as otherwise provided by law". We understand that the language would prohibit, for example, the use of funds under the B-2 PE to support development of a new targeting satellite. It stretches interpretation beyond credibility, though, to say that B-2 funds could not be used in developing its avionics software in a manner that would also make it reusable across

other airborne platforms. The Congressional intent was to prohibit the undermining of specific legislative authorizations regarding program starts, modifications and continuance. We are convinced that no legislator would argue or interpret this statutory language so narrowly as to act against a technology concept which not only makes software more affordable across programs, but also makes software more structured and maintainable within programs. Nonetheless, we recommend provision of handbook guidance on how to implement reuse funding and budgeting, in addition to specific legislative language endorsing use of program funds to foster reuse.

4.1.8 The Budget Process Impact on Reuse

We are currently in fiscal year 1991 (FY91). Near-term specific funding for reuse is difficult unless: (1) a funded program can support it; (2) a general fund for software (such as STARS) exists to fund reuse strategies; or (3) formal reprogramming (moving funds from one PE to another) is accomplished. FY92 prospects are no better. The budget cycle initiates approximately 18 months prior to the fiscal year. The FY92 budget cycle started its formal process in April, 1990, and is now being finalized as the President's budget is to be submitted to Congress during February, 1991. Unless already identified in the FY92 budget (in a manner as described above), there is scant opportunity to provide additional support for reuse and effective reuse strategies during that fiscal year. The management fund concept we identified may not be possible until FY94, because the FY92 budget also introduced the biennial DoD budget, and FY93 is essentially fixed now except for an execution review which will occur during the spring of 1991. However, we strongly recommend that DARPA and the services support a spring 1991 initiative in the execution review of the FY93 budget which would introduce reuse funding and adopt the management fund concept. Similarly, the FY94 budget can now be planned. We would also encourage FY92 reprogramming of funds to programs with near-term, measurable benefits to be realized through reuse.

4.1.9 Conclusion

The budget process creates impediments to reuse due to its lengthy and increasingly intractable process. Until reuse is recognized as an essential acquisition strategy element and integrated into the program budget process, we will play a game of catch up, which has already begun. It is critical to maintain the momentum, point to successes and achieve the recommendations outlined here.

4.2 Finding/Recommendation

The following findings and recommendations are based on the concepts and ideas expressed within section 4.1. We have also drawn on our extensive review of supporting documentation (Appendix C). Our attendance at Government and industry briefings, conferences and workshops, coupled with numerous interviews has provided us with an invaluable source of information and innovative ideas (Appendix B).

4.2.1 Ease of Use

4.2.1.1 Finding/Recommendation

Comparable to what we described in the FAR/DFARS environment, software is not treated as a separate entity in the budget regulations. Today's program managers do not have the necessary policy and budget guidance to clearly specify how software and software reusability should be funded.

Regulations addressing Budget Policies and Procedures should be revised to treat software (including software reuse) separately from hardware. Handbook material should be developed to interpret current regulations and provide specific guidance.

4.2.2 Reuse Investment

4.2.2.1 Finding/Recommendation

There is a real danger that investment in reuse will be viewed as unaffordable in today's declining Defense budget. However, reuse has the potential to soften the impact of a declining budget by reducing new software development costs, using proven software with the effect of reducing maintenance costs, and providing software and software products which make upgrades more affordable.

We recommend that each service provide financial resources and a charter (PMD) to support reuse. PEOs must also provide the management advocacy so necessary for successful reuse.

4.2.2.2 Finding/Recommendation

It costs money to make software reusable. Reuse will add investment dollars to programs in which software is being developed, modified or improved for reuse purposes.

We recommend that DARPA and the services sponsor initiatives to create reuse technology budgets under Program Elements.

4.2.2.3 Finding/Recommendation

We are currently in fiscal year 1991 (FY91). Near-term specific funding for reuse is difficult unless: (1) a funded program can support it; (2) a general fund for software (such as STARS) exists to fund reuse strategies; or (3) formal reprogramming (moving funds from one PE to another) is accomplished.

We strongly recommend that DARPA and the services support a spring 1991 initiative in the execution review of the FY93 budget, which would introduce reuse funding and adopt the management fund concept. We would also encourage FY92 reprogramming of funds to programs with near-term, measurable benefits to be realized through reuse.

4.2.3 Education and Training

4.2.3.1 Finding/Recommendation

We have heard arguments stating that funds earmarked for a specific program (in a PE) cannot be expended on reuse. Our research suggests that it traces back to the now annual language cited in 31 USC 1301(a) (see AFR 177-16, para. 4.0) which states, "Appropriations shall be applied only to the objects for which the appropriations were made except as otherwise provided by law".

The Congressional intent was to prohibit the undermining of specific legislative authorizations regarding program starts, modifications and continuance. However, the legislative language does not prohibit allocation of specific program funds for reuse. Therefore, handbook guidance on how to implement reuse funding and budgeting is required. We also recommend that the legislature provide specific language endorsing use of program funds to foster reuse.

4.2.4 Advocacy

4.2.4.1 Finding/Recommendation

Notwithstanding the positive potential impact of reuse on the budget, it will be very difficult in today's environment of strict budgetary constraints to promote any reuse strategy which requires an unanticipated investment.

A reuse advocate should be designated in the Office of the Secretary of Defense (OSD) and the services, in addition to the identification of senior individuals to sponsor reuse. We do not recommend establishing a new reuse advocate position in each organization. Rather, we recommend that an appropriate senior official in each organization who is already responsible for software be given the charter for reuse advocacy.

	Commercial Software	Government Purpose License Rights (GPLR)	Unpublished Software	Required for Performance Of A Government Contract or Subcontract
<u>DFARS</u>	Computer software used regularly for non-government purpose & is sold, licensed or leased in significant quantities to the general public at established, catalog or market prices.	Right to use, duplicate or disclose data (& software only in the SBIR program) in whole or in part, in any manner for Gov't purposes. Gov't purposes include competitive procurement but not commercial purposes. Gov't can authorize others to use for Gov't purposes.	Not yet released to public or furnished to others without restriction on further use or disclosure.	The development was called for in the contract, or subcontract, <u>or</u> it was accomplished during and was necessary for performance of a Gov't contract or subcontract
<u>FAR</u>	No formal definition. However, FAR 27.405(b)(2) references "existing computer software" as privately developed software normally vended commercially under a license or lease agreement restricting its use, disclosure or reproduction.	No similar definition.	None	No similar FAR coverage (note: FAR 52.227-14(b)(i) may be similarly interpreted)
<u>Comment</u>		GPLR would apply to any computer software documentation for which the Gov't obtained such rights.	DFARS definition encompasses developed software not yet, or perhaps never intended to be commercialized	Under DFARS 252.227-7013, Rights in Technical Data & Computer Software, subparagraph (c)(2)(ii), this language requires unlimited rights pass to the Gov't. A contentious issue between Gov't & industry

Table 3-1 Comparative Analysis of DFARS and FAR

Software Definition	Government Unlimited Rights Software	Government Restricted Rights Software	Copyrights (Legal Right to Reproduce, Publish & Sell)
<u>DFARS</u> Computer software and computer databases (227.471)	Use, duplicate, release, disclose in whole or in part in any manner, for any purpose. Same rights can be given other parties (227.471)	<ul style="list-style-type: none"> •Use with the computer for or with locations where computer may be transferred) •Use on backup computer if primary computer fails •Copy for safekeeping (archive) •Modify or combine with other SW, assuring the derivative SW based on restricted rights SW contains the same restrictions •Any other rights not inconsistent with the stated minimum rights (227.471) •Commercial software restricted rights also include: <ul style="list-style-type: none"> - title/ownership remains w/contractor - limit use to facility where computer is located - can not be made available to 3rd party without contractor's permission (252.227-7013(c)(1)(i)) 	<ul style="list-style-type: none"> •Contractor authorized to copyright unless work (SW) is considered a special work (227.476/252.227-7020), in which case work (SW) becomes sole property of Gov't and is treated the same as unlimited rights SW. Gov't granted nonexclusive, paid-up license to reproduce, to distribute to the public, to perform or display publicly, and to prepare derivative works & have others do so for Gov't purposes (227.480/252.227-7013(3))
<u>FAR</u> Computer programs, computer databases, and documentation thereof (27.401)	Use, disclose, reproduce, prepare derivative works, distribute to public, perform & display publicly, in any manner, for any purpose. Same rights can be given to other parties (27.401)	Developed at private expense and is considered secret; commercial or financial and confidential or privileged; published copyright SW; including minor modifications of such software (27.401)	<ul style="list-style-type: none"> •Contractor authorized to establish copyright claim. Gov't granted paid-up nonexclusive, irrevocable worldwide license to reproduce, prepare derivative works perform and display publicly by or on behalf of Gov't Gov't license does not include right to distribute SW to public (27.404(f)(iv)) •FAR subparagraph (g)(3)(i) under the Alternate III to the Rights in Data Clause 52.227-14 provides the same restricted rights as DFARS with addition of providing SW with same restrictions to support services contractors.
<u>Comment</u> DFARS treats computer software documentation as <u>technical data</u> , not <u>software</u>	FAR provides specific treatment of rights for derivative works based on unlimited rights software.	DFARS definition is based in rights in use; FAR relies on basis of funding and/or control /ownership of SW.	<ul style="list-style-type: none"> •DFARS copyright license includes right to distribute to public where FAR license does not, unless special works is used.

Table 3-1 (Continued)

DFARS Scenario	Government SW Rights	Government Data Rights	Copyright	Comments
Acquisition Commercial Software (e.g. Lotus 123)	Restricted	Limited	<ul style="list-style-type: none"> •Contractor retains •Gov't license for specific use 	FAR 27.405(b)(2) allows this type of SW to be acquired under contractor license w/o need for a FAR clause on rights. In contrast (DFARS 227.481-1(f) requires the clause in 252.227-7013 be used.
Gov't totally funds new software development (e.g. new command & control system)	Unlimited	Unlimited	<ul style="list-style-type: none"> •Contractor retains •Gov't license (Table 3-1) •If special work, gov't owns 	
Contractor totally funds and completes development prior to any award, SW not yet commercialized (unpublished)	Restricted	Limited	<ul style="list-style-type: none"> •Contractor retains •Gov't license for specific use 	
Contractor totally funds; development continues after contract award; SW unpublished but required for performance of the contract	Unlimited	Unlimited	<ul style="list-style-type: none"> •Contractor retains •Gov't license (Table 3-1) •If special work, gov't owns 	FAR does not include the provision requiring passing unlimited rights to the government for SW paid for by a contractor but used in contract performance.
Mixed gov't and contractor funding on new SW in performance of the contract	Restricted at some level To be negotiated	Limited at some level To be negotiated	<ul style="list-style-type: none"> •Contractor retains •Gov't license (Table 3-1) •Special work may apply 	FAR provides more specific guidance regarding determining rights and distinguishing between software and data rights

Table 3-2 Software Acquisition Scenarios

Reuse Category	Internal Reuse	External Reuse	Comment
•CODE REUSE			
<u>As Is</u>			
•Similar Domain	1. Foxboro Co. 2. EVB 3. ATCCS 4. AFATDS	1. Foxboro Co. 2. EVB 4. AFATDS	1. Foxboro claims 80% of internal reuse, also sells code packages under license 2. EVB license code packages 3. Army requires use by ATCCS contractors 4. Magnavox requires in-house reuse assessment prior to initiating new development. Government award fee criteria assesses degree of reuse
•Dissimilar Domain	1. EVB 2. AFATDS	1. EVB 2. AFATDS	
<u>Modified</u>			
•Similar Domain	1. AFATDS		1. Modified SW creates new code which is considered derived SW. This may raise issues regarding who owns copyright for derived SW.
•Dissimilar Domain	1. AFATDS	2. UNAS	1. See above comment regarding Magnavox 2. TRW developed UNAS. Derived from Gov't owned software and sold commercially.
<u>Translated</u>			
•Similar Domain		1. AWDS	1. Company took competitor's development code & ran through translator.
•Dissimilar Domain			1. May increase lines of code. Considered derivative SW. Copyright issues may exist.

Table 3-3 Code Reuse

Reuse Category	Internal Reuse	External Reuse	Comment
Specification			
"A" Spec		1. ATCCS	1. Appears to raise level of interface to avoid changing software. 2. ATCCS associate contractors required to use specifications generated by TRW. 3. Award fee to incentivize contractors to reuse.
"B" Spec CSCIs		1. ATCCS	1. Same as above.
"C-5" Spec		1. ATCCS	1. Same as above.

Table 3-4 Specification Reuse

Reuse Category	Internal Reuse	External Reuse	Comment
•Top Level Architecture	Granite Sentry		Air Force acted as system integrator

Table 3-5 Architecture Reuse

Reuse Category	Internal Reuse	External Reuse	Comment
•Domain Knowledge Base	<ol style="list-style-type: none"> 1. ATCCS 2. JIAWG 3. SDIO National Test Bed 4. Navy Research Lab C/I 		<ol style="list-style-type: none"> 1. SEI support for ATCCS 2. Candidate JIAWG program being identified 4. STARS Task UR40

Table 3-6 Domain Knowledge Reuse

Reuse Category	Internal Reuse	External Reuse	Comment
-Regeneration of Software			
-Templates	•ASD(WPAFB) Flight Simulator Program (B-2, C-17)		•LORAL is prime contractor for simulator. SEI helped develop templates •NO CSCIs. Templates preclude their necessity.

Table 3-7 Reuse

APPENDIX A

ACRONYMS

AFATDS	Advanced Field Artillery Tactical Data System
ATCCS	Army Tactical Command and Control System
ATF	Advanced Tactical Fighter
AWDS	Automated Weather Distribution System
BPPBS	Biennial Planning, Programming, and Budgeting System
C ³ I	Command, Control, Communications and Intelligence
CCPDSR	Command Center Processing and Display System Replacement
CMU	Carnegie Mellon University
DARPA	Defense Advanced Research Projects Agency
DFARS	DoD Federal Acquisition Regulation Supplement
DoD	Department of Defense
DoD-STD-2167A	Defense System Software Development Standard
FAR	Federal Acquisition Regulation
FY	Fiscal Year
GPLR	Government Purpose License Rights
GPR	Government Purpose Rights
IPE	Information Processing Equipment
JIAWG	Joint Integrated Avionics Working Group

APPENDIX A (con't)

NASA	National Aeronautics and Space Administration
NRL	Naval Research Laboratories
O&M	Operation and Maintenance
OSD	Office of the Secretary of Defense
PE	Program Element
PEO	Program Executive Officer
PMD	Program Management Directive
R&D	Research and Development
RDT&E	Research, Development, Test and Evaluation
RFP	Request for Proposal
SDIO/NTBJPO	Strategic Defense Initiative Organization/National Test Bed Joint Program Office
SEI	Software Engineering Institute
STARS	Software Technology for Adaptable, Reliable Systems
TR	Technical Report
UNAS	Universal Network Architecture Services
USC	United States Code

APPENDIX B

Personnel Interviewed / Contacted

<u>Individual</u>	<u>Organization</u>	<u>Date (90)</u>
Robert Kent	<u>ESD/AVS</u>	13 July
Jim Henslee		
Capt. Rothrock	<u>RAPID</u>	2 August
Joanne Piper		
Bob DiBona	<u>SofTech</u>	
Bob Roe	<u>Boeing</u>	14 August
George Hadley		
Robert Kent	<u>ESD/AVS</u>	16 August
Dennis Turner	<u>CECOM</u>	27 August
Ed Gallagher		28 August
Jerry Brown		
Dr. Marty Wolfe		
Mike Zelinki		
Dr. Mary Shaw	<u>SEI</u>	11 September
John Foreman		14 September
Bob Halibaugh		September
Rick D'Ippolito		
Jeff Stewart		
Ken Lee		
Charles Plinta		
Pam Samuelson	<u>Univ of Pitt</u>	13 September
Sholom Cohen	<u>SEI</u>	14 September
Major Mather	<u>SAF/AOC</u>	18 September
Dr. Tom Frazier		19 September
Dr. Betsy Baily	<u>IDA</u>	
Bruce Angier		
LtC. Gross	<u>Office Asst Secy for</u> <u>Comm/Comp/Log-AF</u> <u>USAF/LE</u>	19 September
LtC. Adams		
Major Nelson		
Jim Hess	<u>Office Asst Secy of</u> <u>Army for RDA</u> <u>DAR Council</u> <u>CECOM</u>	20 September
Linda Nielson		20 September
Bruce Gray		2 October
Stan Levine		

APPENDIX B (con't)

Personnel Interviewed / Contacted

<u>Individual</u>	<u>Organization</u>	<u>Date (91)</u>
Hans Polzer	<u>Unisys</u>	11 October
Major Baxter	<u>Office of the</u>	15 October
Tony Lane	<u>Judge Advocate</u>	
Earl Reichart	<u>General - Army</u>	
Robert Kempf	<u>NASA</u>	15 October
Bonnie Dancy	<u>EVB</u>	16 October
Dave Ceely	<u>IBM</u>	16 October
Jack Cooper	<u>Anchor Software</u>	17 October
	<u>Management</u>	
Steve Grimaldi	<u>ARINC</u>	17 October
John Gaffney	<u>SPC</u>	18 October
Robert Cruickshank		
Alec Grindlay	<u>SPAWARS</u>	18 October
Dr. Raghu Singh		
LtC. Boyle	<u>Dept of the Army</u>	19 October
	<u>(STARS)</u>	
LtC. Morrison	<u>SDIO / NTBJPO</u>	25 October
Boyd Clark	<u>Loral</u>	25 October
Jim Frahn		
Barry Lauritzen		
Marty Wyatt		
Dr. Ron Green	<u>USA SDS</u>	31 October
Jay Crawford	<u>Navy (China Lake)</u>	9 November
	<u>JIAWG</u>	
FAR Council	<u>Public Hearing on</u>	19 November
	<u>Advanced Notice of</u>	
	<u>Proposed Change to</u>	
	<u>FAR Part 27 and</u>	
	<u>DFARS 227</u>	
Dr. Jack Kramer	<u>DARPA/STARS PM</u>	20 November
Walker Royce	<u>TRW</u>	27 November
Bob Wasilausky	<u>NOSC</u>	28 November
Karen Mackey	<u>ESL</u>	29 November
Don Reifer	<u>Reifer Consultants</u>	5 December
LtC. Lyons	<u>WPAFB/ATF (JIAWG)</u>	6 December
Frank Poslajko	<u>USA SDS</u>	11 December
Christopher Stone	<u>Object Management</u>	20 December
	<u>Group</u>	

APPENDIX B (con't)

Personnel Interviewed / Contacted

<u>Individual</u>	<u>Organization</u>	<u>Date (91)</u>
Harley Ham	<u>Naval Avionics Center</u>	9 January
Alan Impicicche		
Bruce Pulliam		
Ed Gallagher	<u>CECOM</u>	11 January
Walt Truszkowski	<u>Goddard Space Flight Center/NASA</u>	14 January
Elizabeth Wald	<u>NRL</u>	15 January
Joe Fox	<u>Software A & E</u>	15 January
Whit Ludington	<u>ARINC</u>	15 January
Jim Hess	<u>Office Asst Secy of Army for RDA</u>	16 January
Bonnie Danner	<u>TRW</u>	16 January
LtC. Gross	<u>Office Asst Secy for Comm/Comp/Log-AF</u>	17 January
LtC. Adams	<u>USAF/LE</u>	17 January
Major Nelson		
William Carlson	<u>Intermetrics</u>	18 January
Shirley Peale	<u>Fleet Combat Direction</u>	22 January
Tom Coneeney	<u>System Support Activity</u>	
Dr. Tom Frazier	<u>IDA</u>	24 January
Bruce Angier		
Kathy Wilson		
Dr. Dennis Ahearn	<u>Westinghouse Electric</u>	25 January
Chuck McNally		
Dr. Jack Kramer	<u>DARPA/STARS PM</u>	29 January

APPENDIX C

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APPENDIX D

Comments on the Advanced Notice of Proposed Rulemaking for the Proposed FAR, Subpart 27.4
- Rights in Data and Copyrights

This Appendix consists of the following Segments:

Tasking Synopsis	D-2
General Comments	D-3
Specific Comments	D-4-6
Report Extractions	D-7-11

APPENDIX D (con't)

TASKING SYNOPSIS

Reusable Software Acquisition Environment (DSD Laboratories)

The purpose of this task is : To investigate and identify current business impediments to the reuse of software; and to enhance software reusability through the establishment of a framework for industry incentives to commercialize reusable software packages. Two major areas have been identified for study:

Area 1: Incentives must be established to reward contractors who engineer reusability into their software development lifecycle. This will require the identification and modification of any regulation, policy or procedure which impedes the establishment of such incentives. These incentives could take the form of specific, increased funding to contractors incorporating reusability into their software development efforts.

- The Federal Acquisition Regulation (FAR) and the DoD FAR Supplement as well as service supplements will be examined for impediments in the way data rights are acquired and software is contracted.
- Budgeting and program financing regulations and policies will be reviewed to identify unnecessary restrictions and/or disincentives to providing financial resources for engineering software reusability.
- Procedures and processes for providing program directions and acquisition strategy guidance will be examined for opportunities to emphasize and institutionalize the concept of engineered software reusability. Techniques such as license rights to developing contractors; cataloging of software products across functional lines (by industry or government); and other business incentives and processes to stimulate commercial custodianship and marketing of reusable software packages will be identified, critiqued, legitimized and presented in the proper regulatory or procedural framework for DoD implementation. Ease of use will be the basis for any methodology developed.

Area 2: Examine the feasibility and utility of applying the techniques listed above on an "across the board" versus selective basis. Reusability effectiveness may, for instance, be most promising across a given functional area (e.g. Command and Control), but only when programs exceed thresholds in terms of program value, anticipated length of software development cycle or other significant parameters. We will insure that our recommendations are based on assessments from all functional areas within the development, acquisition and using communities.

After an initial effectiveness screening, those concepts and issues meriting further study will be processed within the framework described in the two major study areas.

APPENDIX D (con't)

GENERAL COMMENTS

- (1) The proposed Subpart 27.4 continues to maintain combined coverage for both technical data and software. At the November 19, 1990 Public Hearing on the Advance Notice, the Council stated this combined coverage was retained because it believed there were more similarities than differences between Technical Data and Software. We maintain the existence of differences is precisely why the topics must be treated separately. Software deals in restricted, not limited rights. Software copyright issues, especially with regard to software reuse, are conceptually and fundamentally different from those for Technical Data. Continuing to combine the topics unnecessarily complicates and confuses issues. If the council publicly (Federal Register) expressed its intent to separate the topics, we would be happy to participate in the rewrite. We do not have the resources to engage in this substantial effort without knowing it would reach fruition.
- (2) Subpart 27.4 remains poorly organized and is written for those with a legal background. The basic rights in data clause (notice no software mentioned in the title) (52.227-14) is a classic example. It rambles for pages, loosing the reader in its depth and breadth. We recommend the council follow the insurance industry which was forced to rewrite its policies so a layman could have more potential for understanding the scope of coverage being provided and the specific exclusions which applied. A good example of a separate software rights clause can be found in the Software Engineering Institute (SEI) Technical Report CMU/SEI-86-TR-2 (Sept., 1986). In fact, the SEI has several other reports on software which the council should examine, including CMU/SEI-86-TR-1 (April, 1986) and CMU/SEI-87-TR-2 (January, 1987). We note the Unified Industrial Association also made reference to the SEI reports at the January 11, 1991 Public Hearing on the Advanced Notice. It appears to us little has been done to examine the SEI's work in the area of software rights.

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SPECIFIC COMMENTS

- (1) Use of the term "Developed and Necessary". We see no difference in the intent and effect of this term as used in 52.227-14 (b)(1)(i)(B) and the current term "Required for Performance". In both cases, a contractor's initiative in funding development of a product is crushed by the Government's insistence that unlimited data or software rights pass to the Government. We recognize and support the need for the Government to maintain its systems. A more workable alternative than presented in 111.A of the Advance Notice overview would be to allow the contractor to retain all rights, including copyright, for the duration of the contract or a minimum of 5 years. After 5 years, Government purpose rights could become effective with the contractor retaining copyright (license for Government use to be negotiated). This would allow the contractor to establish a commercial position and be rewarded for its investment. The contractor would also retain a potential advantage in future competitive or non-competitive Government business. We believe this is also reasonable in exchange for a firm's initiative and risk exposure in making the private development investment. Should national security or other impelling interests dictate the need for greater rights, license arrangements could be structured to at least provide the contractor with recovery of its initial investment plus a reasonable profit (royalty) for lost opportunities. Unless the Government accepts a more reasonable policy on privately funded development, the contentions between it and industry will continue. More importantly, industry will no longer provide its resources to initiate development without at least a clear commercial opportunity. Finally, since this restrictive language would now apply to all federal agencies (not just DoD), the Government at large will certainly see less technologically innovative solutions and more old technology approaches, leaving it with continuing and growing problems in system supportability.
- (2) The proposed FAR Part 27.4, Subpart 27.406(c) does incorporate the more straightforward FAR approach to defining commercial software and providing more appropriate clause coverage (52.227-19). Unfortunately, it also allows Government personnel to revert to the basic Rights in Data clause by itself or in concert with 52.227-19. We expect the conservative acquisition professional will do just that, and continue to create unnecessary confusion and contention with commercial software vendors.

Subpart 27.406(c) should be changed to state that a commercial software license will always be acceptable, unless it can be factually demonstrated to be inconsistent with the Government's minimum needs as specified in the restricted rights definition.

- (3) The proposed FAR Part 27.4 does not clearly describe the contractor's and Government's rights with respect to unpublished software existing at contract award. The proposed revision should be altered to explicitly state that existing, unpublished software is restricted rights software unless the Government acquires greater rights through licensing or acquisition.

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- (4) The NASA approach to encouraging commercialization has been adopted through the GPR description in the proposed FAR, Part 27 revision. Under GPR, the Government obtains a license for use and disclosure relating to Government purposes, providing the contractor's limited, exclusive commercial rights are protected. Unfortunately, while this change improves the coverage, the Part 27 revision does not promote GPR over unlimited rights. The positive policy statements in Subpart 27.402 are negated by the ineffective implementation guidance in 27.404.

While the Government's intentions are good, the proposed new policy statements do not encourage commercialization objectives found in GPR over obtaining unlimited rights. Unless 27.404-1 is changed to explicitly favor GPR over unlimited rights, Government acquisition personnel will continue to pursue full rights, and provide disincentives to industry to invest (mixed funding) or participate at all. We recommend that 27.404-1 be changed to explicitly favor GPR over unlimited rights.

- (5) Subpart 27.402(c) clearly directs the Government to consider not only shared funding, but also its ultimate requirements before determining appropriate rights to be acquired.

We believe Subpart 27.404 should contain a reference back to 27.402 to assure that rights issues will be properly considered where mixed funding occurs, and that GPR will be stated as the most stringent Government rights possible under such a scenario. Furthermore, the contractor should always be allowed to claim a copyright in mixed-funding situations.

- (6) The current DFARS and FAR automatically allow the contractor to claim a copyright, even when the Government has paid for development. A simple discussion of why copyrights are important is lacking in the DFARS.

The Current FAR 27.404(f)(1)(i) is somewhat better (but not by much) in describing how the contractor is normally granted a copyright to enhance dissemination of information produced at Government expense (i.e., commercialize). The proposed FAR, Part 27.4 revision is a further improvement, but still requires enhancement of the implementing guidance. The current NASA FAR supplement requires proactive Government team involvement (including patent or intellectual property counsel) in determining whether a contractor has specific commercial plans, and has made or will make a significant

financial contribution to the development or maintenance of the software. The proposed FAR, Part 27 should incorporate more of the NASA supplement language. For now, the copyright issue is most readily solved by not invoking today's Special Works clause when the contractor demonstrates a commitment to commercialization. This will, at least, give the contractor full commercial rights.

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(7) Copyrights

- (a) While the DFARS copyright license includes the right to distribute copies to the public, the FAR does not, unless what is known as the Special Works clause is used.

The proposed FAR, Part 27 revision adopts the current FAR approach, which encourages commercialization. The final Part 27 must retain this feature.

- (b) The FAR approach, which is more favorable to industry regarding commercial exclusivity has been adopted in the proposed FAR, Part 27 revision. However, copyrights, like unlimited rights and GPR, do allow full disclosure for Government purposes. Therefore, the contractor's incentive to partially fund creation of reusable software, or to put its best talent on totally government-funded software projects remains inhibited, since the current structure doesn't enable the contractor to benefit from Government-sponsored reuse of its products.

Consequently, a policy change which would prevent Government disclosure for a stated period should be considered. Our comment (1) addresses this issue.

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REPORT EXTRACTIONAnalysis of Advanced Notice of Rulemaking for FAR, Part 27 and Proposed Changes

The proposed regulatory change to the Federal Acquisition Regulation (FAR): Rights in Technical Data - Advanced Notice of Proposed Rulemaking, Federal Register, Vol. 55, No.199, 15 October 1990 proposes to replace the current DFARS 227.4 (Interim Rule, 1988) and FAR 27.4 with a single regulation for all Government agencies addressing rights in technical data and computer software. We attended the November 19, 1990 and January 11, 1991 public hearings on this advanced notice.

By presenting the regulatory change as an advanced notice, the Government has essentially acknowledged the potential for extensive comment and subsequent rewrite prior to publishing the change as an Interim Rule. While comments are accepted on Interim Rules, historically the final product has been essentially the same as the published Interim Rule. The FAR Council has not provided a timeline for publishing an Interim Rule. We anticipate that it will be at least 12 months from the October 1990 Federal Register Notice.

There are some significant changes in the advanced notice. We will continue to focus on the impact on software reuse of these changes and any other proposed modifications.

In combining DFARS 227.4 and FAR 27.4, the Federal Government has taken a giant step forward. Now, a single regulation will exist which addresses the Government's and contractor's rights regarding data and software. We thus immediately eliminate present inconsistencies between the documents. However, the controversies are not totally eliminated. In the following sections, we will review the more important issues, commenting on whether any improvements have occurred with respect to reuse.

Data and Software Continue to be Treated Together

During the 19 November 1990 public hearing, the Government stated that its decision to maintain combined coverage resulted from the conclusion that there were more similarities than differences in the topics. However, we continue to maintain that the existence of differences provides sufficient justification to separate treatment of software and data. Continuing to combine the topics unnecessarily complicates and confuses issues. As an example, Subpart 27.4 continues to be titled Rights in Data and Copyrights with no mention of software. Additionally, sections 27.402, 403 and 404 either initially address only data or only include "Data" in the title of the section. Finally, the phrase "developed and necessary" for performance is replacing the controversial term "required for performance". When the phrase is used in 27.404-1 (a)(1)(i)(B), it initially refers to data and software, but then reverts only to use of the term "data". When the phrase is used in 52.227-14, subparagraph (b)(1)(i)(B), the terms software and data are only used once, and do not create the potential confusion of whether the Government intentionally or unintentionally omitted software in the second reference in 27.404-1(a)(1)(i)(B). These examples reinforce our belief that as long as the topics are addressed together, software will not receive

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software will not receive proper treatment. A higher degree of sophistication regarding how software must be viewed, with respect to Government rights and industry intellectual property interests is required. Additionally, a more focused discussion of critical software issues, provided in a more readable style is still necessary.

Introduction of Government Purpose Rights (GPR)

The NASA approach to encouraging commercialization has been adopted in GPR. Under these circumstances, the contractor is allowed to retain exclusive commercial rights for a negotiated period of time, after which the software or data reverts to unlimited rights. The significance of this approach is that the contractor is provided with commercial protection in both mixed funding and 100% Government funding situations when it can demonstrate an intention to commercialize - a very different and progressive change from the current DFARS. Under GPR, the Government obtains a license for use and disclosure relating to Government purposes, providing the contractor's limited, exclusive commercial rights are protected. Is the coverage better? Yes. Is it as good as it could be? No.

The DAR Council's Deputy Director, Ms. Linda Greene is quoted in the 15 October 1990 issue of the Federal Contracts Report (Vol.54, No. 15, page 549) as saying "The draft rule also establishes more of a preference for Government purpose rights [than unlimited rights] than is present under the [1988] Interim Rule. We think we've made a gigantic stride there." Unfortunately, while the coverage has improved, the advanced notice does not emphasize GPR over unlimited rights. Examining Subpart 27.404-1, unlimited rights, and 27.404-4, GPR, reveals that the Government's stated policy is still to acquire unlimited rights unless the contract specifies GPR or copyrights. So, while intentions are good, policy statements do not promote commercialization objectives found in GPR over obtaining unlimited rights. Unless 27.404-1 is changed to explicitly favor GPR over unlimited rights, government acquisition personnel will continue to pursue full rights and provide disincentives to industry to invest (mixed funding) or participate at all. Software reuse is not incentivized by the advanced notice policy language, even though GPR has provided a vehicle to protect commercial rights. The positive policy statements in subpart 27.402 are negated by the ineffective implementation guidance in 27.404.

Copyrights.

The FAR approach, which is more favorable to industry regarding commercial exclusivity, has been adopted in the advanced notice. The Government's copyright for software does not include the right to distribute copies to the public as is now found in DFARS. This should help promote reuse, since a contractor will now be assured that its full commercial rights are protected. A more proactive Government approach (similar again to NASA) has been taken regarding the decision process governing the granting of contractors' copyrights. The coverage has also been improved by providing a more complete explanation of why copyrights are important (commercialization). However, copyrights, like unlimited rights and GPR, do allow full disclosure for Government purposes. Therefore, the contractor's incentive to partially fund creation of

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reusable software, or to put its best talent on totally Government-funded software projects remains inhibited, since the current structure doesn't enable the contractor to benefit from Government-sponsored reuse of its products.

The issues we've identified regarding the copyrighting of derivative works are not dispelled by the advanced notice coverage in Subpart 27.404-5 and its associated clauses.

The issue concerning use of the current DFARS Special Works clause is now covered in Subpart 27.406 and its associated clause in 52.227-17. We see no appreciable change beyond a statement regarding inapplicability to "Limited Rights Data or Restricted Rights - Software". This reference is not clear, and we maintain that copyright issues under 27.406 will continue to impact the DoD contractor community.

Commercial Software

Subpart 27.406(c) does incorporate the FAR approach to defining commercial software and providing more appropriate clause coverage (52.227-19). Unfortunately, it also allows government personnel to revert to the basic Rights in Data clause by itself or in concert with 52.227-19. We expect the conservative acquisition professional will do just that, and continue to create unnecessary confusion and contention with commercial software vendors. The guidance also negatively impacts commercial software licenses by noting that the intent of 52.227-19 is to supersede any portions of those licenses that are inconsistent with Government restricted rights needs. This should be changed to state that a commercial software license will always be acceptable, unless it can be factually demonstrated to be inconsistent with the Government's minimum needs as found in the restricted rights definition. Without this type of change, commercial vendors, especially the small and innovative ones, will continue to avoid Government business because they will perceive the Government as an unfriendly and threatening (loss of proprietary interests) customer. Once again, the opportunity for reuse enhancement is potentially lessened by what will be perceived as a negative approach.

On balance, the revised coverage of the FAR is superior to that currently found in DFARS.

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Mixed Funding

We noted that the DFARS only addresses mixed funding in the context of technical data. Subpart 27.402(c) of the advanced notice corrects this situation, also addressing computer software. It clearly directs the Government to consider not only shared funding, but also its ultimate requirements before determining appropriate rights to be acquired. It further directs the rights issue to be addressed at the lowest possible level of software identification. This should help focus issues on particular modules or components and narrow contentious areas. We believe Subpart 27.404 should contain a reference back to 27.402 to assure that rights issues will be properly considered where mixed funding occurs, and that GPR will be stated as the most stringent Government rights possible under such a scenario. Furthermore, the contractor should always be allowed to claim a copyright in mixed-funding situations.

"Required for Performance"

This term has been deleted. The advanced notice now makes reference to the concept of "developed and necessary" for performance (52.227-14(b)(1)(i)(B)) when identifying situations where the Government must obtain unlimited rights. The advanced notice states a belief that this change has narrowed the application of the concept, but we do not agree. We see no change of any significance in the new 52.227-14 (b)(1)(i)(B), when compared to DFARS 227.471 and 252.227-7013 language. Since the advanced notice gives no further explanation or example to clarify how this "narrowing" has occurred, we suspect there is more show than substance in the claim. Another concern of even greater importance is the fact that the offensive DFARS language is now proposed for use throughout the Federal Government. Without deletion or radical modification, all federal agencies will now face the same contention existing today between industry and the DoD.

This "required for performance" issue continues to be the most significant potential impediment to software reuse. Industry will not provide its own products or use its best talent when faced with loss of its competitive position within the commercial and Government markets. While the Government can foster reuse through its own funding for new software, it continues to lose potential reuse opportunities derived from use of industry-funded software.

The concept should be changed to allow for more favorable industry treatment. A change in wording which would allow contractors to retain rights for the duration of the contract (or a minimum of 5 years) might be sufficient to overcome this impediment. We will continue to explore this potential solution.

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Conclusion

We have addressed the most significant potential changes for software reuse in the advanced notice of rulemaking. Overall, it is a more understandable treatment of rights in data and software, though the basic Rights in Data clause remains horrific in its length and treatment of a multitude of issues.