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Data Rights Relevant to Weapon Systems in Air Force Special Operations Command

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Preface

Air Force Special Operations Command (AFSOC) is dissatisfied with the support it is getting from the original equipment manufacturers (OEMs) for several of its core military aircraft assets and their subsystems. AFSOC feels that it is paying too much for and getting less-than-responsive service for the sustainment of these aircraft. In particular, it complains of difficulties in integrating new capabilities, obtaining timely support for aircraft when they fail in theater, and replacing lower-tier vendors that go out of business. AFSOC believes that better U.S. Air Force access to technical data on these systems would help resolve some of these problems because such data could improve competition for sustainment services or enable the Air Force to establish organic maintenance capabilities.[1] AFSOC asked RAND Project AIR FORCE (PAF) to help the Air Force assess what technical data rights and deliverables the Air Force should buy for major weapon systems and subsystems and when to buy them. In the case of existing programs, AFSOC asked PAF to help the Air Force assess potential alternatives to paying high premiums for technical data proposed by OEMs. This report presents the findings and recommendations from PAF's investigation into these questions. Data collection and analysis ended in August 2018.

Organizations throughout the Air Force and the rest of the U.S. Department of Defense (DoD) are experiencing similar problems. We have revisited these issues in a broader Air Force setting under the sponsorship of the Office of the Air Force General Counsel. The findings and recommendations of that study are documented in Frank Camm, Phillip Carter, Sheng Tao Li, and Melissa Shostak, *Managing Intellectual Property Relevant to Operating and Sustaining Major Air Force Weapons Systems*, Santa Monica, Calif.: RAND Corporation, RR-4252-AF, forthcoming.

This report should interest those involved in the acquisition of appropriate licenses to use technical data and the delivery of technical data packages that contain data that the government needs in an appropriate medium and format. We emphasize our focus on data associated with weapon system acquisition across DoD, but similar issues are likely to arise in any setting where federal agencies seek access to technical data and software.

The research reported here was commissioned by the AFSOC Directorate of Strategic Plans, Programs and Requirements (A5/8), and conducted within the Resource Management Program of RAND Project AIR FORCE as part of a fiscal year 2018 project, Weapon System Data Rights Analysis.

[1] Note that this report was written before the U.S. Space Force was created within the Department of the Air Force.

RAND Project AIR FORCE

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Summary

Air Force Special Operations Command (AFSOC) conducts global special operations missions, ranging from precision application of firepower to movement of personnel and materiel associated with the operational elements of special operational forces. To do this, AFSOC relies on small fleets of specialized aircraft, which it modifies quickly to address new threats as they arise. The result is a group of small fleets of aircraft in which almost every aircraft has a different configuration. Because the small fleets do not allow AFSOC to contract for unique airframes, it modifies airframes initially acquired by various parts of the U.S. Department of Defense (DoD), adding weapons and avionics customized to address its unique missions.

AFSOC depends heavily on the original equipment manufacturers (OEMs) of its core military aircraft assets and their subsystems for their life-cycle support. Since its founding in 1990, AFSOC has grown dissatisfied with the support it is getting from the OEMs. Different kinds of problems have arisen as it has sought to

- upgrade or expand in-house maintenance capabilities (so-called organic capabilities)
- access long-term contract sustainment alternatives to its OEMs
- simplify the process of designing, prototyping, integrating, and testing system modifications and upgrades
- recompete system production when appropriate
- manage diminishing manufacturing sources for system subcomponents.

Each of these kinds of problems is aggravated by shortfalls in the technical data that AFSOC has found it needs to pursue these strategies.

AFSOC asked the RAND Corporation to help the U.S. Air Force assess what technical data and data rights the Air Force should buy for major weapon systems and subsystems and when to buy them. In the case of existing programs, AFSOC asked RAND to help the Air Force assess potential alternatives to paying high premiums for technical data proposed by OEMs. This report presents the findings and recommendations from RAND's investigation into these questions.

Analytic Approach of the Project

The analysis underlying this report proceeded on four fronts: (1) We reviewed contract documents and the government, academic, and trade literatures on the role of technical data in defense acquisition and the challenges of managing technical data cost-effectively. (2) Following guidance from the sponsor, we conducted five case studies on recent Air Force experience with the use of technical data in the programs for the AC-130J Ghostrider, MC-130J Commando II, CV-22 Osprey, KC-46 Pegasus, and AN/APQ-187 Silent Knight Radar (SKR). AFSOC uses the first three systems. The KC-46 offers the opportunity to consider issues relevant to the broader

Air Force. AFSOC uses SKR on several of its airborne systems. (3) We conducted detailed interviews with officials in these programs, with Air Force officials elsewhere who work on a wide range of technical data-related issues, and with officials from relevant defense contractors. (4) We integrated our findings from these activities to develop recommendations for AFSOC and for the Air Force as a whole. Data collection and analysis ended in August 2018. We briefed our findings and recommendations to the sponsor on August 23, 2018.

Basic Concepts Relevant to Data Rights and Deliverables

Technical data consist of "recorded information (regardless of the form or method of the recording) of a scientific or technical nature . . . relating to supplies procured by an agency" from a contractor.[2] This includes engineering drawings, designs, manuals, and blueprints of a weapon system. But "the term does not include computer software,"[3] which is defined separately as "computer programs, source code, source code listings, object code listings, design details, algorithms, processes, flow charts, formulae and related material that would enable the software to be reproduced, recreated, or recompiled."[4] The legal framework governing computer software is similar but not identical to the framework governing technical data.

To make use of a contractor's technical data (or computer software), the government must satisfy two conditions. First, the government must have the appropriate license rights. Federal procurement law and regulations grant the government standardized data rights based on the source of funding used to create the data. The government obtains "unlimited rights" when the item was developed exclusively with government funding; "government purpose rights" when the item was developed using mixed funding; and "limited rights" when the item was developed exclusively with private funding.[5] Limited rights are sufficient to establish an organic sustainment capability wherein data are used by and disclosed to only government employees. But if the government seeks to disclose data to third-party maintenance contractors or to compete spare parts, upgrades, or modification services, government purpose rights are required. Notably, government purpose rights become unlimited rights after five years from the "required development of the items, components, or processes or creation of the data."[6]

Second, the government must actually possess the data it seeks to use. Even if the government had a license right to use and disclose data in an unrestricted manner—for instance, when development was fully government funded—it could not exercise that right to develop an

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[2] 10 U.S.C. 2302(4); see also Defense Federal Acquisition Regulation Supplement (DFARS) 225.227-7013(15).

[3] 10 U.S.C. 2302(4). Technical data also do not include data incidental to contract administration, such as cost, pricing, wages rates, and management policies.

[4] DFARS 252.227-7014(3).

[5] DFARS 252.227-7013.

[6] DFARS 252.227-7013(b)(2).

organic or third-party sustainment plan when it does not physically possess the data. Thus, securing the data themselves is as important—if not more so—as having the appropriate data rights.

In the programs we examined, we found limited understanding of the role of data rights and deliverables. In some cases, government personnel inappropriately acceded to contractor claims about what rights the government could appropriately acquire. In others, personnel acquired the appropriate data rights but failed to list technical data as deliverables or failed to take delivery of technical data before relevant contract authority expired. Still in other cases, there were disputes between the government and contractors over rights, usually triggered by the marking of data by contractors with a legend indicating restricted or limited rights. Lack of access to relevant technical data complicated these programs' abilities to sustain their weapon systems.

Program Office Tasks Relevant to the Acquisition of Data Rights and Deliverables

Program offices execute the following activities to secure and manage technical data:

- Assess a program's needs for data rights and deliverables during the development of the acquisition strategy for a source selection.
- Translate data needs into detailed contract data requirement lists (CDRLs) that define the depth and breadth of data and the format and medium in which they will be delivered.
- Review OEM assertions about data rights in a thorough, informed, and timely manner.
- Track delivery of data deliverables, verifying that they arrive on schedule and properly match specifications.
- Review OEM markings about data rights in a thorough, informed, and timely manner.
- Include DFARS clauses in a request for proposal (RFP) that will allow the Air Force to recover as easily as possible from failures over the course of a program life to manage the definitions of deliverables, ascertains, markings, and funding as planned.
- Document agreements on assertions, markings, and funding thoroughly and ensure that the Air Force preserves this documentation in a format and medium that future programs can easily access.
- Build and preserve the skills required to execute these tasks in future programs.

The tasks are simple to list and can sound obvious. But, as a practical matter, most Air Force programs that we examined do not commit enough resources, with the right experience and skills, to these tasks to ensure that they are satisfactorily executed. Why this occurs today is unclear. But these tasks are classic examples of investments the Air Force should make today that will likely generate most benefits far in the future—too far, perhaps, for personnel in current individual system program offices (SPOs) to give them as much priority as they deserve from the perspective of the Air Force as an enterprise.

Tools Available to Support Effective Management of Data Rights and Deliverables

Tools available in the Air Force today offer alternative ways to review relevant subsystems associated with a new program and tailor data rights and data deliverables to needs associated with those programs in a way that facilitates the tasks listed above.

An Air Force Life Cycle Management Center approach, for example, uses a work breakdown structure (WBS) based on sustainment activities to consider how often a subsystem is likely to change in the future and seeks more-complete rights and data deliverables when more change is expected.[7] This approach looks at who paid for the subsystems in question and anticipates that more-complete data rights and deliverables are likely to be cost-effective, the larger the share of development that the Air Force paid for.

A C-5 program approach builds on this approach and uses it to create an administrative control system that ensures proper examination of data rights and deliverables relevant to each subsystem. For each subsystem, this system uses a WBS to track the funding source, the CDRL that defines the data deliverables, OEM assertions about rights, gaps between Air Force program and OEM positions on rights, names of parties that should be engaged to resolve gaps, details on the technical data package finally negotiated, and information on how and where these technical data will be stored and managed. Space and Missile Systems Center offers a similar approach that tracks CDRLs to Contract Line Item Numbers (CLINs) in the RFP, the rights the OEM asserts, and the price the OEM demands for the associated technical data.[8] In addition to helping plan and manage current procurements, these approaches preserve important data regarding funding and the creation and delivery of technical data that are essential to future disputes regarding ownership, rights, and potential uses of such technical data.

New Approaches to Contracting for Technical Data

We examined three contractual alternatives that could help the Air Force deal with some of the challenges discussed previously. A contract option would allow the Air Force to delay a final decision to buy technical data until it actually needs them. Other Transaction Authority (OTA) could free the Air Force from some of the constraints imposed by the Federal Acquisition Regulation (FAR) and DFARS, making it easier to define special negotiated rights for data. A performance-based contract could help the Air Force get better outcomes when it concludes that it is best to rely on a sole-source OEM without taking delivery of relevant technical data.

[7] AFLCMC, 2018.

[8] Office of the Staff Judge Advocate, 2018.

Contract Options

An option is a "unilateral right in a contract by which, for a specified time, the Government may elect to purchase additional supplies or services called for by the contract, or may elect to extend the term of the contract."[9] In commercial and government contracts, this option gives the buyer the ability to purchase some good or service at a future date, at the buyer's discretion, with the price and other terms set by earlier mutual agreement. An option for technical data or data rights might allow the Air Force to decide at some future point during (or even after) the Engineering and Manufacturing Development (EMD) contract that it needs certain data or data rights, and then purchase such data or rights according to the terms and pricing of the previous contract.

Options may allow the Air Force to extend a contract for years beyond the projected delivery date, enabling the Air Force to take delivery of technical data and associated rights years after an EMD contract ends. It is unclear how long a contract could be kept in force by the government through the exercise of options. Several legal decisions suggest that the parties could mutually agree to contract extensions, or the exercise of options, for longer than five years, if there is mutual agreement of the parties. Beyond EMD, such mutual agreement would, of course, occur between the Air Force and a sole-source OEM. And it is unclear that options could constructively extend the length of a government contract, with no other funding or activity occurring under the contract, without running afoul of the Antideficiency Act and other statutes requiring that "funds are available and obligated for the contract."[10] Nonetheless potential use of options to delay the date at which the Air Force must commit to buying data is worth further exploration.

OTA

OTA has evolved since its introduction in 1958 to allow more and more freedom in contracting language in a growing range of applications. The general rule of OTA agreements is that agencies may structure the agreements however they choose, provided that they reach mutual agreement with their counterparty (or parties) and do not run afoul of congressional oversight committees in doing so. In essence, the Air Force would be freer under an OTA agreement to negotiate special licenses for data and structure payment terms and periods of performance for those licenses, without regard for conventional FAR and DFARS requirements.

Today, the opportunities for AFSOC to use this authority remain limited. DoD has two primary types of OTAs: one for "basic, applied, and advanced research"[11] and a second broader authority that may include production to the extent that it "carr[ies] out prototype projects that

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[9] FAR 17.201.

[10] 41 U.S.C. 3903; 10 U.S.C. 2306c.

[11] 10 U.S.C. 2371.

are directly relevant to . . . improvement of platforms, systems, components, or materials in use by the armed forces."[12] However, these authorities would not automatically solve the Air Force's problems, because they would still require negotiation and mutual agreement on intellectual rights, as well as certifications of "exceptional circumstances" from agency leaders that may be difficult to obtain.[13]

However, it is unclear whether the special operations community would obtain value from pursuing OTA that it could not get through other means, such as rigorous negotiation of "[s]pecifically negotiated license rights" as provided for under current DoD acquisition regulations.[14] Furthermore, OTAs would not change the challenging economics dictated by AFSOC's heavy reliance on legacy airframes.

Incentivizing Sole-Source OEMs

A third contractual alternative is not to buy technical data from a sole-source OEM but to incentivize the OEM to reduce the price it charges the Air Force, improve the performance of the services that it provides to the Air Force, or both. Performance-based contracting is designed to incentivize OEM process improvements and could benefit the OEM while reducing prices or improving services.

Depending on the Air Force's priorities, it can design a contract that increases the OEM's profits only if the OEM reduces the price or increases the level of performance that it offers the Air Force over the term of the new agreement. A cost-plus-incentive-fee contract does precisely this within individual periods of performance; profit within a period of performance depends directly on cost or performance improvements during that period.

A more aggressive version of such a mechanism is a price cap, which price regulators of public utilities use. Something analogous could be applied in an Air Force setting. In a utility setting, a regulator and service provider negotiate a fixed price that will apply for, say, three years for the delivery of power with specific performance attributes—for example, for electric power, reliability, or quality of power. The service provider receives the fixed price regardless of what cost it achieves during the period. Meanwhile, the regulator monitors the actual cost and performance achieved. When meeting to negotiate the price for the next three-year period, the regulator and service provider review the cost and performance achieved and reduce the price or increase the performance level for the next period with a goal, over time, of allowing the service provider to earn a "reasonable" return on investment.

For such performance-based contracts to yield improvements that will ultimately benefit the Air Force, Air Force contracting officials must allow a contractor to benefit from its effort. They

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[12] 10 U.S.C. 2371b.

[13] 10 U.S.C. 2371b (d).

[14] DFARS 252.227-7013(b)(4).

cannot behave as though they are involved in a zero-sum game in which the contractor's gain is the Air Force's loss.

Alternatives to Buying Data Rights and Deliverables

During the source selection for EMD, competition gives the Air Force leverage to get the data rights and deliverables it wants at a reasonable price. If the Air Force wants technical data to help it execute the sustainment activities described above, this is the time to buy them. If this opportunity lapses, the Air Force faces a sole source that will try to extract monopoly profits in any new arrangement that it negotiates with the Air Force.

The Air Force must remember that it need not buy technical data in such a setting to address its sustainment responsibilities. Here are alternatives that the Air Force has today:

1. It can rely on the OEM to provide support and pay what this monopolist provider demands for the level of service that it is willing to provide without transferring the technical data.
2. The Air Force can negotiate a contract with a monopolist OEM that rewards the OEM for reducing the cost of providing service or increasing the quality of the service. Doing this must give the OEM at least as much profit as it earns today; therefore, for the Air Force to get a lower price for the service, the OEM must reduce its cost of service more than the agreement increases its profit.
3. The Air Force can work around the items associated with the technical data so that the Air Force need not deal with the OEM to get the services it needs. Such a work-around could increase the cost of service or reduce its quality, but these negative effects could be acceptable if the work-around allows the Air Force to stop paying the OEM profit.
4. If the technical data apply to a single item and the Air Force has form-fit-function interface data for the item, the Air Force can pay to develop a new version of the item and acquire a technical data for this new item in a competitive setting. The development will cost the Air Force money, but it could be worth spending if the investment allows the Air Force to avoid paying the OEM profits in the future.
5. If the existing agreement on the use of technical data allows it, the Air Force can reverse engineer an item or some portion of a larger system and create the technical data for its own use. Again, the reverse engineering will cost the Air Force money, but it could be worth spending if the investment allows the Air Force to avoid paying the OEM profits in the future.

When asking whether it should buy technical data from a sole-source OEM, the Air Force must consider the costs and benefits of these alternatives relative to those of buying the technical data. It can potentially use the existence of these alternatives to temper the price that the OEM demands for the technical data, a price the Air Force will ultimately have to accept from a sole source, if the OEM is even willing to sell the technical data.

Air Force Willingness to Pay for Data Rights and Deliverables

As it examines the price that the OEM offers, the Air Force can use a simple formula to ask itself whether it would be worthwhile to get the technical data in question. This brings us back to the five sustainment activities that potentially drive the Air Force's demand for such data. For example, how would access to data simplify organic maintenance? Could organic maintenance be executed more quickly or at lower cost? Would organic maintenance improve access to long-term sustainment alternatives—for example, a third-party provider of sustainment? How much would the threat of a third-party provider reduce the cost of maintenance or improve the responsiveness of the provider? And so on through the list.

Note four things about these five activities:

1. Each is likely to benefit from different technical data, and any technical data could easily generate more than one type of benefit. When assessing its willingness to pay for any technical data, it should consider all the benefits that the technical data might support.
2. These benefits will occur in the future, potentially 30 years or more. The Air Force must discount any benefits to determine how much it would be willing to pay today for such future benefits. For example, if the Air Force were to apply the current Office of Management and Budget real (adjusted for inflation) annual discount rate for 20 years in the future—0.6 percent per year—it would be willing to pay about $0.89 today to get $1.00 of benefits 20 years from now. If, on the other hand, a SPO commander faces a fixed budget and believes that, within that budget, the SPO has opportunities to achieve a real annual rate of return on investment of 15 percent, the program manager would be willing to pay only about $0.04 today to achieve a $1.00 benefit 20 years from now. What a SPO will pay for data rights and deliverables is highly sensitive to what the SPO thinks the opportunity cost is for committing current resources to acquire benefits in the far future.
3. Today, the Air Force cannot be sure which of these five activities would actually benefit from having appropriate technical data. As a result, the Air Force should think in terms of the expected benefits it might receive in the future if it buys specific technical data today.
4. Not all the benefits are clearly monetary. For example, more-responsive support could be of great value to a warfighter, but this value can be hard to monetize.

The report provides a simple set of equations that an Air Force SPO could use to combine the three monetary considerations above into a single number that would represent what the SPO would be willing to pay for these monetary benefits. They can also be used to tabulate nonmonetary benefits that the SPO can assess as it considers its willingness to pay. The value to a SPO of any particular technical data obviously depends heavily on the circumstances in any program and on the professional judgment of the SPO personnel assessing the monetary and nonmonetary benefits in play.

In principle, a SPO could use these equations to support a discussion with the OEM to determine whether sufficient mutual gains from trade actually exist in any circumstance—that is, whether it is plausible to imagine that the Air Force values a technical data package enough to compensate the OEM for the losses in future expected profits that the OEM would expect to flow

from the sale. This raises important questions about the discount rates in play. The real annual discount rate for the OEM is likely to be in the range of about 7 to 10 percent. At these rates, the OEM is willing to accept about $0.12 to $0.23 today as compensation for a loss of $1.00 20 years from now. If the Air Force SPO uses the Office of Management and Budget rate to make decisions, it is likely that significant opportunities exist for gains from trade, because the Air Force SPO then values benefits in the far future relevant to the transferred technical data far more than the OEM values its expected losses. If, on the other hand, the SPO believes that it operates in a fund-constrained setting in which it can exhaust its budget on investments that achieve more than a 15 percent real annual return on investment, the SPO values the benefits in the far future relevant to the transferred technical data far less than the OEM values its expected losses. It might be hard to identify gains from trade that could justify a transfer. The discount rate the Air Force SPO implicitly applies in this setting matters a great deal.

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We thank them all for their help. We remain responsible for any factual errors or misjudgments.

Abbreviations

AFLCMC	Air Force Life Cycle Management Center
AFSOC	Air Force Special Operations Command
ASBCA	Armed Services Board of Contract Appeals
BCA	Board of Contract Appeals
C-5 CNS/ATM	C-5 Communications, Navigation, Surveillance/Air Traffic Management
CDRL	contract data requirements list
CLIN	Contract Line Item Number
COTS	commercial off-the-shelf
CPD	Comptroller General Published Decisions
CPIF	cost-plus-incentive fee
DARPA	Defense Advanced Research Projects Agency
DFARS	Defense Federal Acquisition Regulation Supplement
DoD	U.S. Department of Defense
EMD	Engineering and Manufacturing Development
FAR	Federal Acquisition Regulation
FFF	form, fit, and function
FY	fiscal year
GAO	Government Accountability Office
IP	intellectual property
JCIDS	Joint Capabilities Integration and Development System
LRU	line replaceable unit
NDAA	National Defense Authorization Act
O&S	operations and support
OEM	original equipment manufacturer
OMB	Office of Management and Budget

OMIT	operations, maintenance, installation, and training
OTA	Other Transaction Authority
RFP	request for proposal
RMA-C	reliability, maintainability, availability, and operating and support cost
SKR	Silent Knight Radar
SMC	Space and Missile Systems Center
SNL	specially negotiated license
SOCOM	U.S. Special Operations Command
SPO	system program office
U.S.C.	United States Code
WBS	work breakdown structure

1. Introduction

Air Force Special Operations Command (AFSOC) provides "Air Force special operations forces for worldwide deployment and assignment to regional unified commands. . . . [It] conducts global special operations missions ranging from precision application of firepower to infiltration, exfiltration, resupply and refueling" of special operations forces operational elements. To do this, AFSOC relies on small fleets of CV-22B Ospreys, AC-130 gunships, EC-130 Commando Solos, MC-130 variants, MQ-9 Reapers, U-28s, C-145As, and C-146A Wolfhound aircraft.[15] As the unique threats that AFSOC faces change, AFSOC quickly modifies select aircraft to address the new threats. The result is a group of small fleets of aircraft in which almost every aircraft has a different configuration. Because the small fleets do not allow AFSOC to contract for unique airframes, it modifies airframes initially acquired by various parts of the U.S. Department of Defense (DoD), adding weapons and avionics customized to address its specific missions.

These fleets face distinct challenges of life-cycle support. For reasons that we will discuss, AFSOC depends heavily on the original equipment manufacturers (OEMs) of its core military aircraft assets and their subsystems for life-cycle support. Since its founding in 1990, AFSOC has grown dissatisfied with the support it is getting from the OEMs. Different kinds of problems have arisen as AFSOC has sought to

- upgrade maintenance capabilities that it has retained in-house (so-called organic capabilities)
- access long-term contract sustainment alternatives to its OEMs
- simplify the process of designing, prototyping, integrating, and testing system modifications and upgrades
- recompete system production when appropriate
- manage diminishing manufacturing sources for system subcomponents.

Each of these kinds of problems is aggravated by shortfalls in technical data that AFSOC has found it needs to pursue these strategies. Types of data that might interest AFSOC include engineering data, product design details or drawings, and system or subsystem software, such as (potentially) executable code, source code, and similar technical information. These technical data may be relevant to a variety of needs, including system design; system operation, maintenance, installation, and training; and form, fit, function, and testing. Because the government did not buy the technical data for the C-130J and V-22, which provide the airframes for AFSOC's core military fleets, AFSOC continues to rely on the OEMs for these airframes for a wide range of services. When AFSOC develops new, government-funded guns, munitions,

[15] AFSOC, 2017.

radars, and other avionics, it has a greater opportunity to acquire technical data that it can use to support a number of activities, including simplified upgrading and modernization of subsystems, replacement of lower-tier vendors that have gone out of business, and responsive support for aircraft that fail in theater while deployed.

OEMs own the data for the systems and subsystems they developed. The government acquires a license to use the data, then lists the data as a contractual deliverable, and then verifies that the data are delivered in a technical data package with appropriate attributes. The price of that package can depend on how broad a license the government wants and how much detail it wants in that package. In some cases, limitations on the government's rights to use these data prevent it from pursuing the strategies in the bullet points above. In other cases, the government may have rights to use the data but has not arranged to take possession of the data. In any effort to expand its rights to data or take delivery of them, AFSOC has found that it faces a sole-source OEM that can dictate the terms under which AFSOC gets the data it wants. These problems are by no means unique to AFSOC. But because of the nature of AFSOC's fleets and how it has chosen to sustain them, they impose particular burdens on AFSOC.

AFSOC asked the RAND Corporation to help the U.S. Air Force assess what technical data rights that the Air Force should buy for major weapon systems and subsystems and when to buy them.[16] In the case of existing programs, AFSOC asked RAND to help the Air Force assess potential alternatives to paying the high premiums for technical data proposed by OEMs. In this report, we examine policies that frame how AFSOC can acquire data licenses and take delivery of relevant technical data. We propose frameworks that AFSOC can use to determine what technical data it should acquire, how broad the licenses for the use of data in these packages should be, and what AFSOC should be willing to pay for these technical data.

The analysis uses details about technical data associated with five systems to provide a concrete policy context for these questions: the AC-130J Ghostrider, MC-130J Commando II, CV-22 Osprey, KC-46 Pegasus, and AN/APQ-187 Silent Knight Radar (SKR). AFSOC selected all these systems but the KC-46. AFSOC selected systems that present difficulties with technical data and data rights, systems that account for significant shares of its sustainment and modernization efforts, and systems that provide a range of capabilities within AFSOC. It included SKR to allow us to see a subsystem that AFSOC had more potential control over access to data and data rights. RAND offered the KC-46, because AFSOC wanted us to include a non-AFSOC system in our sample and we had entrée through another project to that program; AFSOC approved inclusion of the KC-46.

This report presents the findings and recommendations from RAND's investigation into these questions.

[16] Note that this report was written before the U.S. Space Force was created within the Department of the Air Force.

Analytic Approach

The project that generated this report chose these five cases in cooperation with the sponsor. We sought weapon systems that would be of immediate interest to AFSOC but that could also help us generate recommendations useful in a broader setting. We collected government, trade, and academic literature on data rights, technical data, and the five systems we emphasized in our case studies. We conducted interviews with Air Force personnel associated with these programs, personnel who specialized in policies and practices associated with data rights and technical data in other Air Force settings, personnel developing courses and templates relevant to these topics, and personnel from defense contractors. We integrated our findings and developed recommendations for AFSOC.

In addition, we held discussions with program managers, acquisition and test engineers, contracting officers, logisticians, requirements specialists, and intellectual property (IP) lawyers in the following organizations:

- AC-130J System Program Office (SPO)
- MC-130J SPO
- CV-22 SPO
- KC-46 SPO
- SKR SPO
- B-21 SPO
- C-5 SPO
- C-17 SPO
- C-130J SPO
- AFSOC headquarters
- Air Force Rapid Capabilities Office
- Air Force Reserve Command Aircraft Airworthiness Policy Office
- Air Force Life Cycle Management Center (AFLCMC) Software Data Rights Team
- Tinker Air Force Base Software Maintenance Team
- Secretary of the Air Force General Counsel
- Space and Missile Systems Center (SMC) General Counsel
- Air Force Institute of Technology
- Defense Acquisition University
- Lockheed Martin Aircraft Company
- Raytheon Missile Systems Company.

Road Map

Chapter 2 discusses three broad topics relevant to AFSOC's interest in technical data. These include places where access to technical data could potentially improve the operation and sustainment of AFSOC fleets, places where Air Force treatment of technical data has changed over the past three decades, and the willingness of senior leaders to invest in technical data today to generate operational benefits decades in the future. Chapter 3 addresses AFSOC's use of

technical data today. It discusses tasks that SPOs execute as they manage technical data and summarizes data-related issues that have arisen in the programs we examined in the five areas of interest. Chapter 4 briefly describes three tools we discovered in use in the Air Force today that might improve Air Force management of technical data if applied more broadly. Chapter 5 describes three approaches to contracting that could potentially improve AFSOC's leverage when it discusses access to technical data and data rights with a company that owns the data. Given its options, Chapter 6 presents a way for AFSOC to assess how much it should be willing to pay for technical data and data rights that it has determined would benefit its operations. Chapter 7 summarizes our findings and recommendations. Appendix A provides a brief legal primer on the management of technical data and data rights in DoD today. Appendix B presents background information on the five case studies we conducted as part of the analysis documented here.

2. Broad Factors Affecting AFSOC's Interest in Technical Data

As noted in Chapter 1, AFSOC's interest in technical data has grown from problems it is encountering in five activities. This chapter adds detail on what AFSOC is encountering in these activities. These issues are not new. During the Cold War, the Air Force gave technical data much more attention in such activities than it does today. Perhaps ironically, at just the time when AFSOC was formed, the Air Force and the rest of DoD were changing how they managed technical data. This chapter explains how AFSOC is now living with the unintended consequences of those changes. Recommendations for managing technical data differently often sound like calls to return to perspectives that prevailed in this earlier period. A key argument that runs through many of these arguments is the need for the Air Force to give the long-term consequences of resources decisions made today more emphasis than they typically get. This chapter explains this perspective and how it relates to differences between how decisionmakers in OEMs and government agencies think about the future.

Five Places Where AFSOC Wants Better Access to Technical Data

Chapter 1 lists five activities in which AFSOC faces difficulty because of its inability to access the technical data it needs to improve the performance and cost of its operations. This chapter discusses these difficulties in more detail.[17]

Organic Operation and Support

AFSOC requires access to technical data to operate the sophisticated major weapon systems that it uses. This consists of two types of technical data statutorily required to be delivered with "unlimited rights" to the government: technical data that "relates to form, fit, or function" or technical data that "is necessary for operation, maintenance, installation, or training."[18] By statute and regulation, the government obtains a license for the unlimited use of these data, sometimes called *operations, maintenance, installation, and training* (OMIT) data or *form, fit, and function* (FFF) data, because of the importance for government personnel's daily utilization of these technical data and for the sustainment of the system being acquired. Organic operation

[17] This section draws heavily on the discussion of these difficulties in Camm, Carter, et al., forthcoming. That report considers technical data issues relevant to the Air Force as a whole. We first became aware of those difficulties in our analysis, documented here, of AFSOC's situation.

[18] 10 U.S.C. 2320. Appendix A provides a primer on how the Federal Acquisition Regulation (FAR), Defense Federal Acquisition Regulation Supplement (DFARS), and other government policy define *technical data rights* in a legal setting.

consists of training, operation, and deployment in operations by government personnel, including, in this case, Air Force military personnel and civilians.

Third-Party Support

AFSOC relies heavily on contractors to maintain its major weapon systems. It would like to have access to third-party contractors (other than the OEM) that could provide maintenance support or serve in public-private partnerships to Air Force depot facilities alongside government civilian and military personnel. Consequently, AFSCO can, in principle, have a requirement for access to technical data relating to these systems and the legal ability to share those technical data with a non–U.S. government entity. Under the current rights regime relating to technical data on major weapon systems, AFSOC can generally share the OMIT and FFF data that it receives, because it takes an unlimited rights license for those data. It may also, under certain circumstances, share other technical data that it obtains under a "government purpose rights" license.[19] However, the default positions in procurement regulations limit the ability of AFSOC to share contractors' technical data with third parties, even for official purposes, if it obtains anything less than unlimited rights for those technical data.

Upgrades, Modernization, and Service-Life Extension

The average life cycle for an Air Force aircraft is more than 28 years.[20] Some Air Force systems (such as the C-130) live multiple lives—beginning first in service with the conventional Air Force and migrating eventually into the Air National Guard and also such commands as AFSOC. For each of these evolutions in the life of a major weapon system, such as an aircraft, the Air Force requires technical data to upgrade, modernize, or extend the life of the system. The technical data needed to complete these requirements often exceed what exists within the OMIT or FFF data required to be provided and therefore require the provision of an unlimited rights license that would allow the participation of third-party contractors in this activity. In the commercial aviation sector, there is a baseline of technical data in the "flight worthiness data" required by the Federal Aviation Administration to be delivered and maintained for collective use.[21] There is also a custom and practice of using FFF data, and a certain degree of modularity and interoperability with commercial systems, to substitute components and modernize aircraft based on the FFF data provided as part of a commercial aircraft acquisition. However, current procurement law limits the Air Force's ability to use OEM technical data (to the extent that it has possession of them) for these purposes, let alone share these data with third-party contractors, and there is no analogous reservoir of "flight worthiness data" the Air Force can use to support

[19] See Defense Federal Acquisition Regulation Supplement (DFARS) 252.227-7013, described in more detail in Office of the Staff Judge Advocate, 2018.

[20] Wood, 2018.

[21] See Van Atta et al., 2017.

its aircraft either, especially after major modifications that might affect the flight profile of an aircraft, as they often do in AFSOC.

Procurement of Additional Systems and Subsystems

Over the life of an AFSOC major weapon system, the command is likely to need additional systems or subsystems—to increase the size of its fleet, replace damaged or destroyed systems, or acquire new capabilities. If AFSOC had sufficient technical data about the system or subsystem, it could use competitive selection to choose a contractor from which to procure the additional systems or subsystems. Without adequate technical data, AFSOC will be limited to procurement from the OEM. AFSOC may require more technical data than it typically receives under a production contract, particularly for the integration of new subsystems into legacy aircraft.

Replacement of Diminished Sources

Over the long life cycle of an aircraft, AFSOC has found that the designers and manufacturers of its systems and subsystems go through business cycles of their own. They may be acquired by a new parent company, be sold in pieces to acquirers, or go out of business altogether. New manufacturing methods may also displace ones necessary to maintain older systems; certain materials or parts may simply become unavailable from their original sources. Yet AFSOC must continue to operate and support its aircraft, notwithstanding these changes within its industrial base. This may require AFSOC to create new sources for parts or support, such as by reverse-engineering those items or working with industry to create new sources of supply and service. Doing so requires technical data from the OEM—often in ways that far exceed the original licenses granted for those technical data, and the OEM's intent in sharing it.

Two Related Sets of Problems: Legacy and New Systems

AFSOC faces two overlapping and related sets of challenges when developing strategies for technical data for its major weapon systems. The first set of challenges arise during procurement, operation, and sustainment of legacy programs. Like the Air Force as a whole, AFSOC spends the majority of its operations and support (O&S) dollars on legacy systems, in absolute and percentage terms.[22] However, there may be less room to make new decisions with respect to technical data on these programs, because the original Engineering and Manufacturing Development (EMD) contracts for these legacy projects might have been awarded decades ago, reflecting the strategic, fiscal, and procurement policies of the time. If AFSOC wants to change the decisions the Air Force or some other part of DoD made about technical data in the past, it typically faces a sole-source provider that controls any additional technical data that AFSOC

[22] Boito et al., 2018.

might want to access. AFSOC has limited leverage when negotiating with any sole-source provider.

For new systems, a different set of challenges exists, based on the fact that design, prototype, and EMD contracts have not yet been finalized. There are opportunities to realize great improvements too, based on the bargaining power and leverage that AFSOC has at the time of the competitive award for an EMD contract—but the stakes are high for industry as well, based on the long revenue streams that lie ahead at the time of the contract negotiation. If AFSOC wants to acquire more-expansive technical data rights so that it can create optionality in the future with respect to doing organic maintenance or using third-party contractors, OEMs will likely attempt to raise their prices for technical data to reflect the greater technical data rights being sold and potential lost future revenue streams.

Ultimately, AFSOC leadership must prioritize which of these challenges it deems to be most important—and which to pursue—given finite resources in terms of money, acquisition personnel time, and the imperative to constructively work with OEMs and other industry partners to continue production and support for the service. Legacy systems may offer the greatest near-term potential for cost savings because of the money currently spent there; however, there may be the least contractual latitude with legacy systems. Conversely, new systems offer a greater opportunity for future cost savings per dollar of AFSOC investment to get technical data. But the share of future O&S costs will always be much smaller than that for legacy systems.

How the Air Force's View of Technical Data Changed Following the Cold War

Air Force SPOs have shifted their perspectives on acquiring and maintaining technical data since the last days of the Cold War, during the 1990s.[23] Up until that time, the Air Force—and the rest of DoD—put a high premium on its in-house technological capability and its access to the technical data needed to sustain that capability. The end of the Cold War brought moves to downsize the U.S. defense industrial base and spending on defense acquisition. The defense industry reacted to this change in part by seeking a new workload in contractor support for major weapon systems. At about the same time, outsourcing was expanding rapidly in the commercial sector beyond the direct influence of defense acquisition. And influential management consultants argued that the hands-on production of goods and services should move to the organizations with the best core capabilities to produce these goods and services, whether those organizations were part of the users of these goods or services or in an external location.[24]

[23] For more detail, see Camm, 1996, and sources cited there.

[24] For example, see Prahalad and Hamel, 1990. DoD took notice. See, for example, Commission on Roles and Missions of the Armed Forces, 1995.

Defense firms proposed that they could maintain the core capabilities that DoD needed to sustain weapon systems over their lifetimes, which DoD then supported.

If an OEM designed, built, and supported a weapon system over its whole life cycle, then the need to transfer technical data to the Air Force lessened.[25] Even when an initial contract called for the delivery of technical data, trade-offs made during the EMD phase of acquisition often exchanged this delivery for other outcomes that the Air Force valued more. Over time, weapon systems were increasingly fielded without the technical data needed to sustain them internally, to modernize or upgrade them, or to renew their sources over time. The acquisition workforce received less and less exposure to managing technical data, and the related skills in the workforce atrophied. As the acquisition workforce downsized at this time, despite increasing contracting activity, program staffs turned over without passing on knowledge about existing technical data for legacy systems to the smaller, less experienced replacement staffs. Existing knowledge about technical data fell; the perceived lack of urgency to understand technical data reduced emphasis on relevant training. The culture that had once managed technical data effectively progressively faded away without much notice.

Investing Today to Yield Benefits Decades Later

Government agencies have long tended to favor short-term priorities over longer-term priorities.[26] Statutory rules, such as the Nunn-McCurdy Act, emphasize short-term achievement of cost and schedule goals in the procurement of major weapon systems.[27] Fiscal laws, such as the Antideficiency Act and Office of Management and Budget (OMB) rules for budgeting, also encourage this tendency by focusing attention on resource management during the budget year.[28] This tends to move resources toward activities that yield benefits now rather than in years beyond the budget year, when others will have the responsibility to manage any problems caused by reluctance to invest today.

This short-term bias can be stronger in spheres in which military personnel occupy key positions (instead of civilians). Military leaders in SPOs tend to rotate between assignments every two to three years. This results in a learning cycle with a short horizon for military leaders occupying key roles, as well as a short-term focus driven by the military personnel system and the ways it evaluates performance and makes decisions for selection and promotion. Although officers occupying these positions have great loyalty to their services, they are institutionally and personally incentivized to pursue short-term gains that manifest during their tours and can be

[25] This discussion documents a fairly broad consensus that we found among the offices that we interviewed.
[26] For a more complete discussion of the nature of this bias, see Camm, Carter, et al., forthcoming; Camm, Mayer, et al., forthcoming.

[27] The Nunn-McCurdy Act resulted from an amendment included in Pub. L. 97-86, 1981. It is now codified as 10 U.S.C. 2433.

[28] Pub. L. 97-258, 1982. The Antideficiency Act is now codified in 31 U.S.C. 1341, 1342, and 1517.

reflected in their evaluations.[29] Civilian personnel typically have greater longevity within SPOs, but they too operate within the broader parameters of the Nunn-McCurdy Act, fiscal law, OMB budgeting rules, and service culture, each of which emphasizes short-term performance.

This behavior is not an indictment of any individual. It is built into the way the government budgets. It leads to a short-term focus in decisions across the government. When such behavior shapes the creation and sustainment of technical data, or the contractual management of technical data during the procurement of a major weapon system, it amplifies a tendency to underinvest in such activities. In short, individuals lack incentives to acquire technical data that do not yield tangible benefits until far into the future. When institutional support for Air Force acquisition of technical data faded in the 1990s and beyond, this broader propensity of Air Force decisionmaking helped the change occur without objection. Proactive government policy is required to counter this near-term bias.

Efforts to revitalize interest in technical data face resistance from this short-term bias. For example, ensuring that the Air Force gets delivery of technical data identified in EMD contract data requirements lists (CDRLs) takes effort from a SPO staff with many tasks and limited resources. Without institutional encouragement, it is easy for them to prioritize other efforts that will yield tangible benefits for the SPO much sooner. The same can be said about efforts to ensure proper markings.

Conversely, OEMs place greater emphasis on achieving their long-term goals with regard to technical data than Air Force SPOs do. Unlike the Air Force, OEMs do not follow congressional budgetary rules that encourage resource decisions that prioritize benefits during the budget year. Rather, they have strong incentives to safeguard IP, including proprietary technical data, because they periodically report the estimated net present value of such property to shareholders. As a result, OEMs employ more personnel to address the technical data-related tasks described above. And, in particular, OEMs engage more IP lawyers early in a program.

Summary

Improved access to technical data and data rights can potentially improve AFSOC's operation and support of its fleets by facilitating organic O&S; third-party contractor support; upgrades, modernization, and service-life-extension programs; procurement of additional systems or subsystems; and replacement of diminished manufacturing sources. The Air Force's approach to managing technical data has changed since the end of the Cold War as the Air Force has become more reliant on contractor support. Increased reliance on support from OEMs reduced the Air Force's demand for technical data and, as a consequence, reduced the experience of its personnel and processes with the management of technical data. As AFSOC and the Air

[29] See Carter et al., 2017, which argues that frequent moves of military personnel affect unit and service effectiveness and "waste expertise and experience by transferring individual service members to new positions just as their expertise and experience peaks."

Force as a whole consider a return to expanded use of technical data, their leaders must confront their willingness to commit resources today, to acquire technical data and data rights, and to realize benefits that will come only decades in the future, potentially after these leaders have retired.

3. Data Rights in the Air Force Today

Although an understanding of the high-level legal and regulatory aspects of IP and data rights is key to any effort to improve DoD data rights outcomes, it is only part of the required background knowledge. In addition to legal issues, RAND examined the body of documented DoD policy regarding data rights, as well as historical experience and lessons learned from a variety of completed and ongoing acquisition programs. Information gathered during our assessment of completed and ongoing acquisition programs revealed the day-to-day responsibilities of personnel in SPOs who manage Air Force acquisition and use of technical data and data rights. Our interviews identified day-to-day SPO challenges and tasks that Air Force personnel believe are fairly well documented and understood but, practically speaking, are not equally addressed across the Air Force. These interviews also identified specific issues that have arisen as AFSOC has sought improved access to technical data to facilitate organic O&S; third-party contractor support; upgrades, modernization, and service-life extension programs; procurement of additional systems or subsystems; and replacement of diminished manufacturing sources. This chapter documents our findings and summarizes them for the support of new and ongoing system programs.

Program Office Tasks Associated with Access to Technical Data

Technical data raise issues for a SPO throughout the life cycle of any system.[30] We can see these issues in the tasks that a SPO should execute routinely and repeatedly to ensure that the Air Force acquires and maintains appropriate access to technical data. Table 3.1 summarizes tasks that a SPO should execute routinely and repeatedly to ensure that the Air Force acquires and maintains appropriate access to technical data and data rights. The first column identifies selected broad tasks that a SPO conducts over the course of a system program life cycle. The second column lists the tasks associated with government access to technical data that a SPO should carry out in each of these phases.

From the perspective of the formal requirements and acquisition processes in DoD, these tasks effectively begin in the technology maturation and risk-reduction phase, with requirements for government access to technical data defined in the Capability Development Document.[31] The

[30] The material reported here draws on official documents that describe appropriate management of technical data in a government setting, interviews with personnel in a variety of Air Force and joint program offices, and secondary literature on activity in these offices. See, for example, AFLCMC, 2018; Baker et al., 2015; Defense Contract Management Agency Instruction 3101, 2018; Defense Contract Management Agency Manual 3101-01, 2018; DeVecchio, 2018; Office of the Staff Judge Advocate, 2018; U.S. Army Product Data and Engineering Working Group, 2015; DoD, 2018; Department of Defense Instruction 5000.02, 2015; and Van Atta et al., 2017.

[31] For a simple overview of these DoD processes, see Department of Defense Instruction 5000.02, 2015, Figure 1.

document sets the stage for defining acquisition requirements that become the basis for deliverables in the EMD contract. These deliverables include technical data.

Table 3.1. Program Office Tasks Associated with Access to Technical Data

Broad Program Tasks	Tasks Associated with Access to Technical Data
Acquisition strategy	Assess the data the Air Force needs
Solicitation/RFP development	Clarify data needs in specific CDRLs
	Use DFARS clauses to preserve flexibility in contract to revisit data issues
RFP response evaluation and source selection	Review and challenge contractor assertions about rights
Post–contract award and early contract	Ensure timely delivery of data in CDRLs
	Review and challenge markings
	Document basis for assertions, markings, and funding split that the Air Force accepts
	Preserve data on assertions and markings for future use
Operations and sustainment	Preserve skills to discipline contractor over the life of weapon system
	Use leverage creatively to motivate contractor

NOTE: RFP = request for proposal.

For example, based on outside guidance or internal decisions, the SPO must decide what kind of system architecture to apply. A fully integrated architecture can tie the Air Force to a single provider with proprietary technical data. A federated or modular architecture requires a choice of interface standards that can potentially simplify efforts to modernize or upgrade a system without being "locked in" with a single vendor. In principle, acquisition of appropriate FFF data can allow a program to manage a system without access to technical data for modules of the system. Access to such data simplifies the application of a system integration laboratory to test potential modifications and to diagnose failures as they occur during operations. The SPO must determine what such a simplification is worth. A modular architecture can also simplify the integration of modules based on proprietary commercial designs. Commercial practice often limits the data that a buyer can access to data about interfaces, allowing the developers of modules to protect their IP by never transferring data or opening them to potential alteration by external parties.

An integral part of this initial phase is the collection of relevant information about how potential providers want to protect their IP and what forms of system integration they prefer. Much of the information about appropriate management of IP that the Air Force needs to make solid decisions comes from potential providers. The Air Force has outsourced much of its technical capability. At a minimum, it needs to retain enough technical understanding to assess which proposals from potential offerors do more to advance the offerors' relative advantages in

an upcoming source selection than to add value relevant to stated Air Force operational and sustainment requirements.

Information on such issues support the creation of an acquisition strategy that sets the stage for the EMD source selection for a new system. The development of and repeated adjustments to draft RFPs provide a natural bridge from the development of an acquisition strategy to a final solicitation. As an RFP crystalizes, it must provide precise language about what data the Air Force wants and in what format and medium those data are needed. The RFP must clarify what level of rights the Air Force expects and when a deliverable package of data is due. As a practical matter, careless oversight or changes in circumstances can lead to a demand for technical data following a source selection that differs from the data that were specified during the source selection and realized in the contract. The FAR provides clauses that help the Air Force recover gracefully from such realized needs to adjust data deliverables, for whatever reason. In preparation for a protest-free evaluation, an RFP must be clear about the risks source selection evaluation will associate with shortfalls in the content of data and rights to data that the RFP requests.

During a source selection, discussions and evaluation of the content of an offer lead progressively to an Air Force decision to choose a competition winner. Discussions and evaluation present a variety of challenges that affect data rights as much as other parts of a source selection. An issue specific to data rights is each offeror's assertions of data rights and the Air Force's responsibility to review assertions and verify that they are valid. In principle, contractors are responsible for asserting any rights they want and justifying their assertions—for example, with information about who paid for the development of subsystems relevant to the system in competition. In practice, an offeror often comes to a source selection with more resources to make assertions than the Air Force has to push back on the assertions. This is one of many places in which we see contractors investing more effort early in a system development than the Air Force does. This may be because the Air Force source selection teams work in an environment with limited resources, resources that the Air Force focuses toward resolving its immediate resource constraints rather than toward ensuring that the Air Force has the technical data packages it can use to upgrade or sustain a system 20 years later. We see this pattern repeatedly.

Data rights issues continue to motivate tasks as we shift from contract formation to contract execution. A contract uses CDRLs to define what technical data a contractor will deliver and when. A SPO must manage these deliverables as any other in a contract and verify that each meets the specifications stated in the relevant CDRL. The Air Force can lose the authority to demand delivery of a technical data if the EMD contract ends and the contract does not contain clauses to allow delivery after the close of the contract.

A particularly important attribute of every element of a technical data package is a clear marking indicating the level of the Air Force's rights to the contents of the data in every

technical drawing.[32] The FAR requires that one of a short list of allowable markings, described in Appendix A, appears on each drawing in a technical data: unlimited rights, government purpose rights, limited rights, or specially negotiated licenses (SNLs). Contractors often deliver technical data with a default marking of *proprietary*, which is technically not acceptable for technical data delivered to the Air Force. A SPO has limited calendar time and labor resources to review every drawing delivered after it arrives. If the SPO fails to reject an improperly marked drawing and the contract includes no clause to correct this error, it becomes much more difficult to correct in the future. Program staff unfamiliar with the markings required may simply accept that the government has no rights to drawings marked *proprietary*, effectively forfeiting the government's appropriate rights under the law. When program resources are short, this can occur without anyone noticing.

After a SPO has reviewed all assertions and markings, it needs to document the decisions it has made and the basis for each decision. In particular, the office must record what it knows about who paid for the development of each piece of technical data. This information will likely be important within the SPO when the Air Force chooses to act on the technical data it has acquired. This can occur decades after the program acquires a technical data package, long after the military staff and much of the civilian staff at the program have moved on. If routine procedures do not exist to document decisions about technical data and preserve them in a location and medium that future users can readily find and access, the documents may continue to exist, but no one will know where to find them or how to access them.

Documentation is likely to be relevant within a SPO. But if enough time passes, and office staff members today work in such a resource-constrained environment that they act as though their discount rate is high, they may have little incentive to preserve documents for future users. As Chapter 6 explains, if the real (adjusted for inflation) implicit annual discount rate is as high as 15 percent, SPO staff may be willing to expend only about $0.04 worth of effort today to document and store data that staff members working in the office 20 years from now would value at $1.00.

Documents created today easily can be just as important to future staff members in other SPOs. For example, if a SPO pays today for the technical data for an avionics device that another SPO will employ in a different system in 20 years, that new SPO would benefit from knowing about the technical data acquired today. But if a current SPO is so constrained that it fails to preserve data for its own use in the distant future, it is likely that it will care even less about expending extra effort today so that a different SPO can benefit from the technical data in the future.

As we move from the development to the operational deployment of a new system, execution moves from the development to the sustainment side of the SPO, which often operates at a

[32] In this setting, a "drawing" can be a visual rendering of a design or process, a numerical or textual description, or any other documentation or data relevant to the delivery of some item.

different location. The early decisions made to plan for, acquire, document, and store a technical data package with its supporting information can potentially come to fruition at this point. The SPO may now face the demand for a second sustainment source, for simple access to data to support the diagnosis of problems arising from use, and for the ability to replace an obsolete source. If the program manager sustaining an aging system does not have ready access to such data, the manager must decide whether the effort to recover it—from Air Force or contractor sources—is worthwhile relative to other SPO tasks. Some Air Force program managers have had success in making these decisions and at finding points of leverage they can use to manage an OEM if they are unable to recover the data. Today, they are exceptions. Better training for program personnel about the importance of technical data and about how to operate without them could be helpful.

Applications That Drive AFSOC Interest in Technical Data

Through our case studies and other interviews, we have identified five specific lines of effort in AFSOC acquisition activities that benefit from improved access to technical data:

- Upgrade or expand in-house maintenance capabilities (so-called organic capabilities).
- Access long-term contract sustainment alternatives to AFSOC's OEMs.
- Simplify the process of designing, prototyping, integrating, and testing system modifications and upgrades.
- Recompete system production when appropriate.
- Manage diminishing manufacturing sources for system subcomponents.

These functions are not necessarily completely independent, and each may build slightly on another. However, the data required for each function are sufficiently unique to merit a specific mention. For instance, the set of data required to have a third party manage a program's long-term sustainment will most likely be similar to the data set required to simplify organic maintenance. However, third-party sustainment activities also are required by law to involve nondisclosure agreements to ensure that OEM proprietary data are handled appropriately.

Some of these functions require similar technical data to be delivered to the Air Force. This overlap in lines of effort carries a key benefit. In the face of uncertain needs at the start of a program, SPOs may take advantage of this commonality to pursue data that may be needed for more than one of the above categories to increase program flexibility in the future.

In most cases, maintaining flexibility for potential unforeseen future program data needs is one method to avoid such data challenges as those seen in the case study programs. This management style stands in stark contrast to the philosophy of the 1990s described in Chapter 2, when a confident determination of the lack of need for data drove DoD to a narrowly inclusive mind-set regarding what technical data it might require in the future.

Such an approach must be carefully managed, however, as an overly inclusive mind-set can involve paying for more deliverables than may be required. As will be discussed in further detail

in Chapter 6 determining a "fair" price for technical data can be a challenging proposition, and other options may be more cost-effective than acquiring technical data in large quantities. Additionally, if the Air Force does not staff appropriate personnel to utilize, store, and maintain the acquired data, buying technical data may ultimately be an unnecessary and costly expense.

Below we discuss the five functions that require technical data in more detail.

Upgrade or Expand In-House Maintenance Capabilities

The Air Force relies on in-house maintenance at the organizational and intermediate levels and, less often, at the depot level. In-house maintenance gives Air Force personnel the flexibility required to perform primarily scheduled and unscheduled maintenance without constant reachback to the OEM. Technical data required to perform this function, for example, include maintenance manuals, system drawings, subcomponent drawings, and still-more-detailed documentation. Maintenance manuals and sufficient other data required to support replacement at the line replaceable unit (LRU) level are the baseline technical data typically pursued for most weapon systems. A common technical data challenge associated with simplifying organic maintenance is a late-established need for sufficient technical data to perform more-detailed maintenance on LRU subcomponents. Such data are likely not included in standard maintenance manual documentation.

As discussed in Appendix A, the government is entitled to unlimited rights to use maintenance data as part of allowances associated with OMIT data. However, the Air Force can exercise these rights only if appropriate OMIT data have been delivered to the Air Force as part of the initial contract. Should the Air Force decide to utilize an organic maintenance concept for a weapon system too long after completion of the EMD contract, it can expect to be required to pay for the generation of appropriate data to support the performance of maintenance by Air Force personnel.

For example, the AC-130J SPO believed that the small size of its fleet made it difficult to maintain the full attention of the OEM.[33] It believed that an ability to maintain its aircraft in an organic depot would reduce costs and increase responsiveness. But Lockheed Martin developed the C-130J as a commercial aircraft and has retained its effective control of the technical data for the portions of the AC-130J aircraft that Lockheed derived from its commercial design.[34] The MC-130J is derived from the same C-130J aircraft, giving Lockheed similar control over technical data for the MC-130J. AFSOC has unlimited or government purpose data rights for the

[33] This example and those that follow are the products of our interviews. Appendix B provides some additional background on these examples.

[34] This continues despite the fact that the government paid for the development of the original C-130 aircraft that formed the basis for the C-130J. In the course of creating multiple variations on that original design, Lockheed gained control over the data in newer versions, data that it controlled when it ultimately documented data for the C-130J.

sections of the AC-130J and MC-130J systems that were developed using government funds, including the precision-strike system and heads-up display.

A variation on this problem arose in the CV-22 program. The government paid for the design of the V-22 system that the CV-22 was derived from, suggesting that the Air Force should have unlimited rights to data associated with the V-22 portion of the design. But following the development of the V-22, Boeing and McDonnell Douglas merged. When this occurred, Boeing integrated both companies' process and material specifications into a single, streamlined system. The new system uniformly applied edits in technical specifications across the entire avionics system for the V-22. Boeing used its own overhead funds to develop this data system and therefore considered all data maintained on this system to be exclusive to Boeing, regardless of the avionics system's source of funding. This interpretation severely limits the Air Force's rights to technical data on the CV-22. In the meantime, the Air Force's ability to maintain the CV-22 organically is on hold, because Boeing and the Air Force also disagree about what data to include in OMIT data. Negotiations continue.

The SKR office faced a different problem. It had developed SKR using government funding for government use. Therefore, the government maintained unlimited or government purpose data rights for the SKR system and its subsystems. But it did not acquire data deliverables. Our interviewees told us that the OEM has indicated that the delivery of the technical data today would cost the government at least $50 million, about one-quarter of the $200 original development cost for the system. As a result, Raytheon provides all maintenance for SKR. Because of the mission-critical nature of the radar system, failure to repair the SKR system quickly and effectively when it fails has immediate effects on operational readiness. Therefore, it would be more convenient and timely for AFSOC to repair the system abroad instead of shipping the system back to Raytheon.

The KC-46 is based on a Boeing 747 commercial aircraft. Because the body of the airplane and the majority of the avionics on the KC-46 are from the 767, the Air Force has limited rights or restricted rights to most technical data for these commercial elements. Unlimited rights to use maintenance data as part of allowances associated with OMIT data could, in principle, allow organic maintenance. But Boeing and the Air Force differ on what data are included in OMIT data for the KC-64. Negotiations continue, but the Air Force's plan to bring maintenance of the KC-46 in-house at the end of interim contract support will fail unless negotiations turn in the Air Force's favor. The Air Force and Bell face a similar disagreement on what technical data are part of OMIT for the CV-22.

These programs have also suffered from the presence of restrictive markings that, given disagreements about OMIT definitions, limit the Air Force's ability to provide in-house maintenance. Restrictive markings on AC-130J software limit the Air Force's ability to maintain this software in house. The CV-22 SPO did not have sufficient resources to review the markings on all data deliverables as they arrived and therefore missed the deadline for this review to occur. After the fact, the SPO would have to use costly litigation to revisit and correct these markings.

Boeing placed overly restrictive markings on its software for the KC-46. In a twist, when Boeing received data deliverables from its subcontractors for the KC-46 program, those deliverables were often overly restrictively marked, despite flow-down requirements to use proper DoD-approved markings. Boeing passed these mismarked data on to the Air Force, saying that it did not have the authority to negotiate on behalf of its suppliers. Commercial transactions do not require markings of the kind required by the DFARS. After the fact, the opacity of Boeing's supply chain of more than 800 companies complicated any effort to set the markings right. The markings severely hampered the Air Force's ability to bring maintenance of the KC-46 in-house.

Our discussions with SPO and industry personnel revealed two additional reasons for high costs associated with the generation of this sort of maintenance data. First, if not specifically identified as required for delivery early in a contract, detailed maintenance data might not be generated during system development. This means that the OEM would need to pay the labor cost associated with the generation of these data after the fact.[35] Industry personnel we talked to identified this as a key reason for the high cost associated with data generated after the early phases of contracting. Second, the Air Force maintains detailed formatting requirements for maintenance documentation to be provided to military personnel, formatting that is not relevant to maintenance personnel outside the Air Force.

Our discussions also noted that the in-house depot workforce requires sufficient training to ensure familiarity with the systems being maintained. Without adequate training, acquiring detailed technical data is likely an inefficient use of resources. That is, appropriate management and preparation of government personnel must necessarily be coordinated with and precede any plan to acquire technical data and data rights relevant to in-house support of a system.

Access Long-Term Contract Sustainment Alternatives to AFSOC's OEMs

Providing third-party contractor sustainment alternatives is a similar concept to that of upgrading organic maintenance, but it focuses primarily on higher-level depot and intermediate-level maintenance activities, rather than organizational-level ones. To implement a third-party sustainment approach, government entities must first obtain the agreement of the OEM for such an arrangement and then institute nondisclosure agreements to ensure contractor access and control of OEM proprietary technical data. Although such agreements are highlighted in relevant law and regulation as allowable, obtaining OEM agreement can require costly and time-consuming negotiation between the OEM and the government.

In our case studies, the problems identified for relying more on in-house support are similar to those associated with moving to a third-party contractor. For example, in the AC-130J program—in which AFSOC had government purpose or unlimited rights, as it did for

[35] Further complicating matters: If the generation of these data was required many years after the program's development phase, personnel familiar enough with the system to quickly generate such data might not be readily available.

subsystems it funded, such as the precision-strike system and heads-up display—it could consider third-party contractor support. It was much more difficult for parts of the aircraft that Lockheed had developed with its own funds. And AFSOC had limited insight into the supply chain for the subsystems that AFSOC had not developed with its own funds. This made it difficult to work directly with the OEMs for these subsystems rather than taking contractor support from Lockheed. The MC-130J program faced the same problem with the opacity of Lockheed's supply chain.

Similarly, the lack of transparency into the Boeing supply chain for the KC-46 and the inappropriately restrictive markings on software from Boeing suppliers that complicated the Air Force's efforts to move toward in-house support also limited the Air Force's ability to consider direct relationships with contractors other than Boeing to support KC-46 subsystems.

Simplify the Process of Designing, Prototyping, Integrating, and Testing System Modifications and Upgrades

To perform required system modifications and upgrades, government or non-OEM entities often require access to certain OEM technical data to facilitate the integration of changes with an underlying legacy aircraft. For example, when a separately developed subsystem is connected to a system's interface connections, a thorough understanding of those interfaces is required. Additionally, when physically mounting equipment to aircraft bulkheads or cutting into bulkheads as part of modifications, structural design information underlying those bulkheads is key to ensure continued aircraft airworthiness, among other factors. Based on our discussions with Air Force acquisition personnel, unless modifications of the kind under consideration were planned for early in a program, sufficient interface data or other detailed manufacturing data are often not part of the baseline technical data package pursued by the Air Force.

For example, cutting an opening in the hull of the AC-130J to mount a 105 mm howitzer on the aircraft could potentially compromise the structural integrity of the hull. Lockheed's control of data on the hull required its participation in this modification. Its participation slowed the rate at which the modification could proceed. Lockheed has demanded approval review of other modifications that had much more limited effects on the integrity of the hull. And Lockheed controls access to technical data from its suppliers that are relevant to modifications in the AC-130J. Where AFSOC has been able to make modifications that do not affect portions of the aircraft that Lockheed developed with its own funds, the modifications have proceeded more quickly and at lower cost.

The CV-22 experienced similar effects on schedule and cost when its lack of access to appropriate technical data forced it to involve Bell in modifications. Even when the AC-130J program and Lockheed could agree on AFSOC's rights to OMIT data, Lockheed remained the source of these data whenever a modification occurred. As the sole source of these data, Lockheed could charge $900 a page for biannual upgrades in its maintenance manuals. Lockheed charged still more for more-frequent upgrades when they were required.

The Air Force paid to develop software for use on both the AC-130J and the MC-130J at the software integration laboratory at Robins Air Force Base in Warner Robins, Georgia. However, the Air Force did not take delivery of technical data that would allow it to test the new software's ability to integrate with C-130J software. As a result, the Air Force has had to send the newly developed software to Lockheed's software integration laboratory to be tested in conjunction with the existing software and systems used on the aircraft. This has delayed tests of software upgrades. AFSOC has had difficulty modifying software in the MC-130J because the Air Force failed to ask for relevant technical data as a deliverable when the program began.

Similarly, AFSOC and U.S. Special Operations Command (SOCOM) did not acquire all the technical data they needed to modify the SKR system. As a result, they have had to keep Raytheon engaged to support upgrades with more-specific technical data. This has added cost and complexity to the upgrades.

As with the other data-need cases, a key challenge with this sort of technical data is in ensuring data communicability among the multiple parties that might be involved in weapon system modification and upgrade. This issue is less complicated if the Air Force is the main modification design and installation activity, but in many cases identified during our study, third parties are often the source of weapon system modification designs and installation efforts. Fortunately, once delivered, system interface data are a legally protected class of data allowed to be shared by the Air Force with other entities, as required. Unfortunately, an OEM and the government can disagree about what interface data are included in FFF data. For example, the KC-46 program anticipated that disagreements with Boeing about what rights the Air Force had to FFF data would similarly compromise its ability to make modifications in the future. And, as discussed, appropriate data must be specified in deliverables submitted to the Air Force or they may not be freely shared.

Beyond technical data, a thoughtfully developed modular design concept is a key enabler for simple system modification and upgrade. In the absence of such a design concept, Air Force entities looking to design and install system modifications require either possession of significant available technical documentation or close engagement with OEM personnel to implement major design modifications. Without these, modification designers and installers will likely be required to carry out significant reverse engineering efforts to develop the required system understanding to implement planned modifications. Our discussions with SPO personnel revealed that, even when a SPO commits to reverse engineering activities, significant OEM involvement in modification development and installation can still be required.

Recompete System Production When Appropriate

Of the five functions we identify, recompeting system production is likely the least commonly executed activity. This is because recompeting system production involves a significant amount of technical data to be acquired from an OEM with sufficiently limited restrictions to allow another supplier to access and use the data to recreate the weapon system in

question. Even in cases of a high degree of Air Force investment in development of such a system, an OEM will be reluctant to share technical data that inadvertently reveal some aspect of its proprietary data or business practices. And the OEM is likely to retain latent understanding of the requirements for satisfactory system production that even a closely defined technical data package will not capture. If a third party cannot use the technical data provided to satisfactorily build a system, the OEM can argue that the third party lacks the technical skills that the OEM took for granted when it created the technical data. This can occur, for example, when a complex manufacturing process requires subtle application of proprietary methods, materials, and equipment. Unless explicitly planned for early in a program, gathering sufficient data to recompete production and providing those data to a third-party supplier appear to us to be highly unlikely.

Manage Diminishing Manufacturing Sources for System Subcomponents

Concerns regarding diminishing manufacturing sources involve ensuring that sufficient technical data remain in the possession of the appropriate maintenance authority to support a replacement subcomponent delivery entity if the primary manufacturer of a given part ceases to make that part.[36] This situation may occur, for example, if a supplier is no longer interested in doing business with the Air Force or if a supplier is going out of business. For many system subcomponents, SPOs are typically required to plan for obsolescence and second sourcing in the event of a diminishing manufacturing source. For example, the AC-130J and KC-46 programs both highlighted to us the importance of having technical data that would support planning against obsolescence. The AC-130J program has found that, without appropriate data, the cost of replacing a diminishing manufacturing source goes up and the performance of a replacement can go down. The KC-46 program is continuing to negotiate with Boeing to get access to data that will ameliorate the effects of obsolescence. The CV-22 program learned through experience that reverse engineering required when data are not available is costly. The greatest challenges arise from subcomponents planned to have long in-service lifetimes when obsolescence planning has been limited.

From a data perspective, relatively significant technical detail is required at a subsystem level to ensure that parts may be remanufactured by another entity. Ensuring the ability to provide the requisite technical data to a third-party supplier for part remanufacture complicates the issue of diminishing manufacturing sources. Fortunately, at the point that a subcomponent requires special management because of its manufacturer going out of business or ceasing to do business with the Air Force, initial supplier proprietary data concerns are largely irrelevant.

The primary challenge associated with diminishing manufacturing sources is that the Air Force rarely specifies contractual requirements for technical data that ultimately apply to subtier suppliers. OEMs rarely acquire more than FFF technical data from vendors in lower tiers, and

[36] The appropriate maintenance authority is the OEM, government depot, or appropriate third-party entity.

the Air Force has no direct contractual relationship with them. This often leaves the Air Force with only limited means to specify what it would want from a lower-tier provider if the initial provider is no longer available.

Technical Data Management Tasks in New and Ongoing Programs

Each of the five lines of effort above involves a different set of actions for programs at the start of their life cycle and for programs in the operations and sustainment phase. For example, at program initiation, program acquisition and contracting personnel can put in place special contractual terms to drive desired OEM performance throughout the execution of the contract and into later phases of the program. A competitive EMD source selection potentially gives the Air Force leverage to get the special terms it wants, including those that apply to technical data, at a reasonable price.

During the operations and sustainment phase, the often sole-source supplier might not be interested in cooperating with the Air Force to the same degree as it would be under competitive pressure and would thus be less willing to agree to more restrictive or challenging agreements or terms. This trade-off will be discussed in more detail in Chapter 6.

Table 3.2 describes considerations for new and ongoing programs related to each of the five lines of effort. We discuss these considerations below.

Considerations for New Programs

Across all types of data needed for new programs, a significant common thread exists: The Air Force should use the EMD source selection to ensure that the EMD contract includes appropriate terms for data rights and data delivery relevant to activities throughout the life cycle of any program. Although various statutory data-sharing and communicability protections exist for relevant data types,[37] these protections are not helpful unless the Air Force is in possession of the data in question. Identifying specific data needs in CDRLs is a challenging task for a program in its earliest stages, but it is a vital one to ensure sufficient long-term flexibility. Below, we discuss a few best practices used in the Air Force to accomplish this task.

[37] The relevant data types are OMIT, FFF, and interface data.

Table 3.2. Potential Technical Data Management Actions for New and Ongoing Programs

	Organic Maintenance	Third-Party Sustainment	System Upgrade	Production Recompete	Parts Obsolescence
New programs	• Government gets OMIT rights; must request CDRLs • Requirements put in place for prompt OEM deficiency adjudication • Requirements put in place for subtier DMSMS notifications and new part integration testing	• Government gets OMIT rights—correct CDRLs are key • Requirements put in place for OEM deficiency adjudication • Requirements put in place for subtier supplier parts • Agreements put in place between OEM and sustainment contractor	• Government gets FFF and interface data—correct CDRLs are key	• Recompetes require significant technical data and at least government purpose rights	• Government gets OMIT rights—correct CDRLs are key • Requirements put in place for subtier DMSMS notifications and new part integration testing • Configuration management roles are defined
Ongoing programs	• Government documents historical contracts • Government evaluates new maintenance contracts	• Government documents historical contracts • Government evaluates new maintenance agreements and new contracts	• Government documents historical contracts • Government considers architecture to enable replacements	• Recompetes are likely challenging for many existing programs	• Government documents historical contracts and configurations • Government assesses frequent part failures

SOURCE: These considerations and recommendations were derived from our discussions with Air Force SPOs as either identified best practices or the distillation of multiple initiatives or best practices discussed during these interviews.
NOTE: DMSMS = diminished manufacturing sources and material shortages.

It is important for the Air Force to have specified all data deliverables in initial contracts, but, beyond that, the Air Force should explore specialized agreements with OEMs to incentivize—or dictate, where required—specific performance to ensure adequate technical support over a weapon system's lifetime. One SPO we interviewed was concerned about the OEM's insufficient responsiveness to component deficiencies affecting an operationally deployed aircraft as they became apparent. The C-17 SPO offered itself as an exemplary demonstration of a potential resolution to this issue: a long-term, tight connection between an Air Force SPO and its industry partner. Though expensive, this resolution involves embedded OEM points of contact at various Air Force facilities that provide full-time support for a variety of sustainment activities, akin to those of interest to AFSOC. To effectively incentivize a high degree of responsiveness, contract payments in such an arrangement are closely tied to issue-resolution timelines. In specific situations with especially time-sensitive operational needs, the high cost associated with such an approach may be worth pursuing for system maintenance, obsolescence management, and system configuration management. Such an arrangement is likely to be most cost-effective if

addressed early in a program's acquisition phase, when the Air Force has the most competitive leverage.

More generally, Air Force SPOs should pursue clear definitions of assertions of vendor technical data ownership at the start of programs and adjudicate OEM assertions as early as possible. As discussed, overly restrictive data markings are a pervasive issue throughout DoD acquisition and are best resolved early in program life cycles. Standing up sufficiently trained and knowledgeable technical personnel early in SPOs is a key aspect of accepting technical data for DoD acquisition programs—regardless of specific technical data need.

Considerations for Ongoing Programs

The Air Force's flexibility to request the delivery of additional technical data to support an ongoing program is more limited than for a new program. An OEM can argue that additional effort is required to produce technical data for a previously developed system after the completion of the EMD contract. Even if this is not the case, an OEM may be unwilling to sell such data or may exploit its sole-source status to charge the Air Force a high price. OEMs may reasonably view sole custody of that technical information as an income source that could disappear if the Air Force were to use its access to the data to access a source of sustainment services other than the OEM.

Before requesting further data delivery, our interviews suggest that Air Force offices with ongoing programs should conduct an inventory of information relevant to the technical data they might want to acquire. This is because historical contract documentation may demonstrate whether the contractor's asserted rights are appropriate. Unfortunately, many programs' historical information on their contracts and their modifications is relatively poorly documented, and technical data rights questions that arise many years after initial contract signing are often deemed too hard to resolve because of this lack of available historical information. Additionally, technical data delivered to the Air Force early in the program EMD phase are often poorly tracked and managed many years after initial delivery. It can be difficult for a SPO to determine whether, at some point in the past, some Air Force office contracted for delivery of technical data that could be relevant to sustainment issues that have only recently become apparent. And if it did, it can be difficult to find such data in the Air Force's possession today. Developing a relatively complete, modern documentation of existing data could help the Air Force develop an improved picture of what it already has and what is still necessary to get.

Summary

Interviews helped us identify a series of tasks in SPOs today that supports effective acquisition and use of technical data and data rights. A SPO begins during the development of an acquisition strategy for the EMD phase by assessing the data the Air Force should acquire in the EMD. During the development of a solicitation and an RFP, the SPO clarifies the data needs in

CDRLs and applies DFARS clauses to preserve flexibility to revisit data issues. During the source election itself, the SPO reviews and challenges contract assertions about data rights. Following the award, the SPO ensures timely delivery of data, reviews and challenges markings on data delivered, and documents and then preserves the basis for its decisions. The quality of data and data rights acquired during the EMD phase depend directly on how well a SPO executes each of these tasks. Finally, during operations and sustainment, the SPO must work with the data and data rights it has to motivate and discipline the contractor over the life of its weapon system.

The interviews showed how the data and data rights that the SPO acquire can affect its ability to upgrade or expand in-house maintenance capabilities; access long-term contract sustainment alternatives to its OEM; simplify the designing, prototyping, integrating, and testing of system modifications and upgrades; recompete system production when appropriate; and manage diminishing manufacturing sources for system subcomponents.

The types of data and data rights worth making an effort to acquire differ systematically in new and ongoing programs.

4. Three Tools to Help Manage Technical Data

Our interviews identified a variety of tools currently in use around the Air Force to carry out the management of program life-cycle technical data. Three tools show particular potential to improve AFSOC or broader Air Force management of technical data relevant to the sustainment activities discussed previously. A combined implementation of these approaches could improve the abilities of AFSOC and the Air Force to highlight, track, and manage technical data needs at all stages of acquisition programs.

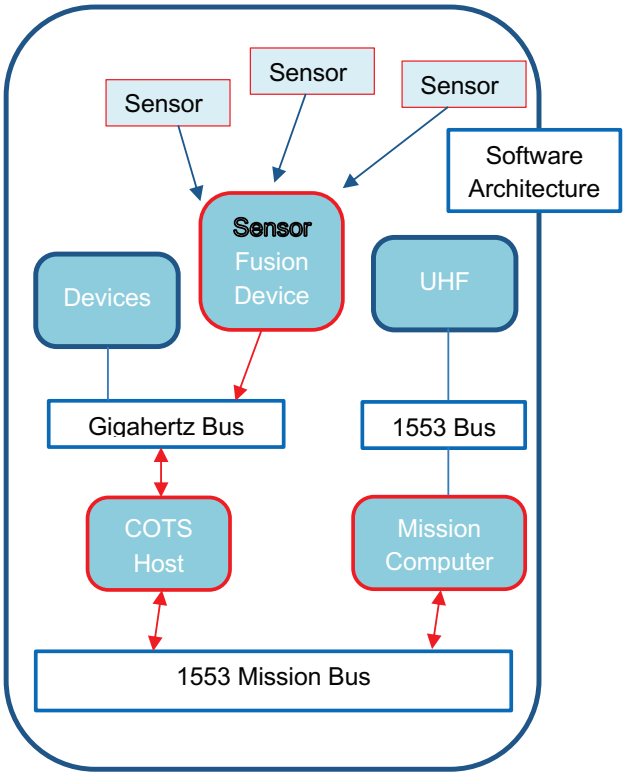
AFLCMC Software Data Acquisition Process

AFLCMC is currently rolling out a pair of processes to manage technical data for hardware and software systems. The purpose of these processes is to provide a standardized approach to technical data acquisition and tracking across the Air Force. This process is designed to be implemented early in a program's life cycle, during initial systems engineering. We spoke with the team responsible for the development and implementation of the software-focused process.

A key premise of the software data management process is that today's software systems often include commercial off-the-shelf (COTS), government-funded, and privately funded subsystems. Technical data needs for each type of system are likely not the same. For example, the Air Force is likely to perform less maintenance for a fully COTS system than for a government-developed system, because Air Force wholesale replacement of the COTS subcomponent may be more cost-effective than maintaining the subsystem in question. AFLCMC's process serves to encourage a more nuanced consideration for technical data needs throughout the Air Force and stands in opposition to historical data approaches that often involved Air Force attempts to acquire broad swaths of technical data with significant flexibility to share those data with external parties. Such a nuanced approach will likely reduce overall costs associated with technical data acquisitions. It may also help demonstrate to OEMs that the Air Force is not interested in broadly owning technical data primarily to exclude OEMs from the sustainment market.

Figure 4.1 displays an example of such a component-based work breakdown structure (WBS) for a generic software system using various COTS subcomponents with external interfaces to various sensors. The modified system diagram on the left of the figure shows multiple system subcomponents with interfaces to a mission bus, likely part of a larger weapon system, such as an aircraft. For relevant subcomponents, a series of data rights considerations is made in the table to the right: the expected need to change (modify or upgrade) the subsystem in question, the degree to which the Air Force funded development of the system, the rights seen as necessary to accomplish the functions required by the Air Force, and any other relevant considerations.

Figure 4.1. AFLCMC Software Data Acquisition Process Example



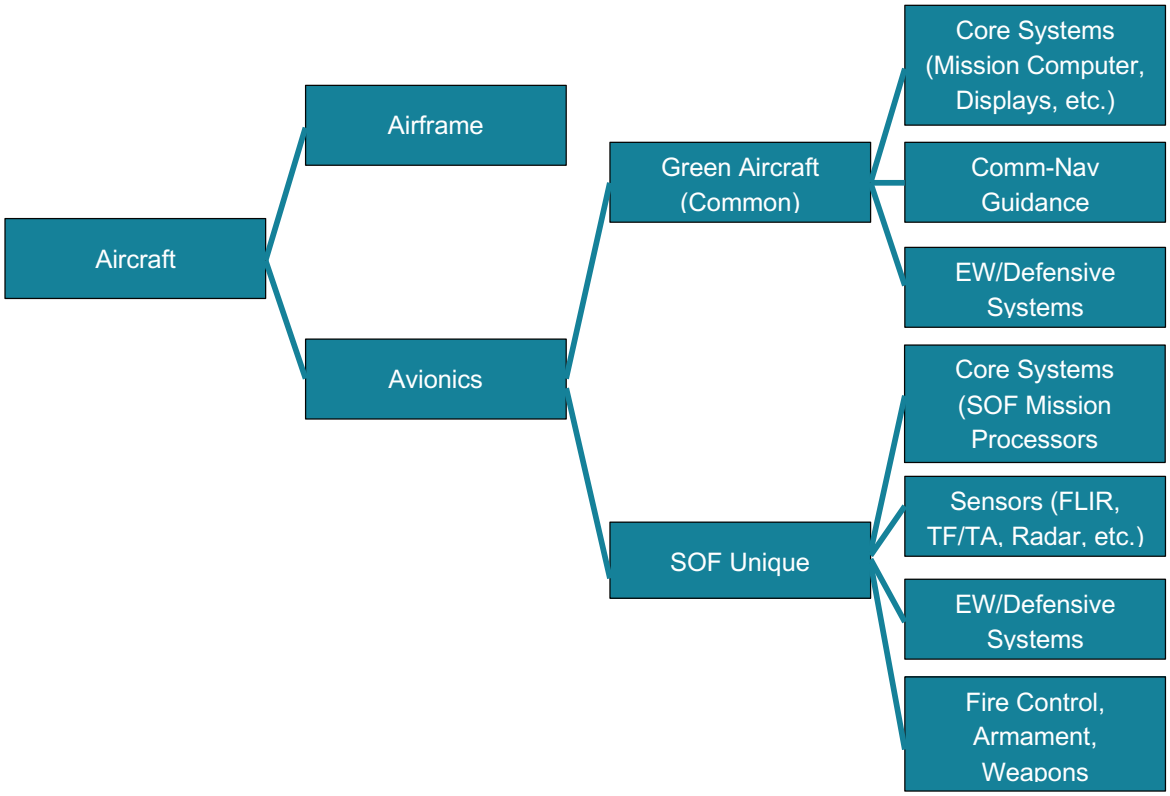
LRU/ICD	Sensor Fusion Device	COTS Host	Mission Computer	. . .
Expected Change Rate	Low	Low	High	
% Gov't Funded	0%	0%	100%	
Needed Rights	Limited or GPR	COTS SW	GPR	
. . .				

SOURCE: Modified from AFLCMC, 2018.
NOTES: Relevant subcomponents are outlined in red. UHF = ultra high frequency; ICD = interface control document; GPR = general purpose rights; SW = software.

The table in Figure 4.1 helps highlight the program management functions focused on technical data that are identified earlier in this chapter. A "low" expected subsystem change rate suggests that the Air Force could likely acquire a less detailed technical data package, because modifications or upgrades to the subcomponent in question are planned to be unlikely. Similarly, if the Air Force did not pay for a large fraction of a particular subsystem's development, the service can expect a relatively high cost associated with the acquisition of technical data for that subsystem, causing it to be an unattractive candidate for data acquisition. Such high cost can be attributed to OEM unwillingness to share technical data developed with internal funding for fear of inadvertent disclosure to a third party.

Although the process illustrated in Figure 4.1 is designed around software-based systems, we have extrapolated a similar approach for a large combined hardware-software system: an AFSOC aircraft. This is demonstrated in Figure 4.2.

Figure 4.2. Modified AFLCMC Software Data Acquisition Process Breakdown Structure for a Generic AFSOC Aircraft Program



NOTE: SOF = special operation forces; Comm-Nav = communication-navigation; EW = electronic warfare; FLIR = forward-looking infrared; TF/TA = terrain following/terrain avoidance.

Figure 4.2 breaks an AFSOC aircraft acquisition program into major subcomponents, each of which may be developed or maintained by different entities. Modular design and management of weapon system subcomponents can facilitate a nuanced data strategy, such as that developed by AFLCMC. By doing so, AFSOC—and the Air Force—can focus data acquisition activities on the information most relevant to systems of specific concern. This should help limit the cost of acquiring technical data.

C-5 Communications, Navigation, Surveillance/Air Traffic Management Software Program

The recent C-5 Communications, Navigation, Surveillance/Air Traffic Management (C-5 CNS/ATM) software upgrade effort independently used a WBS similar to the AFLCMC WBS shown in Figure 4.1 to characterize and track data deliveries. Using various management

matrices developed early in the program, the C-5 CNS/ATM program identified information related to technical data deliverables, including the following:

- all required deliverables by contract WBS level
- system component status as COTS, government funded, or partially government funded
- data rights requested by the Air Force for a data deliverable as part of the initial contract
- OEM data rights assertions back to the Air Force
- gaps between identified data needs and data assertions, as well as resolutions to those gaps
- which parties within the Air Force require access to specific data
- the medium and format for technical data to be delivered to the Air Force
- how and where relevant technical data would be stored and managed throughout the program's life cycle.

As noted, all these items are currently poorly tracked in many Air Force acquisitions. This tool provides a systematic way to track information relevant to technical data rights and deliverables throughout a program's life cycle. Excerpts of the C-5 CNS/ATM data management matrices may be found in Figures 4.3 and 4.4.

Although understanding the specific data deliverable requirements of each WBS element is challenging early in a program's life cycle, the C-5 CNS/ATM program leveraged historical examples of aircraft avionics upgrades to determine what technical data might be required at the sub-WBS-item level. Such an approach could prove beneficial for AFSOC and broader Air Force acquisition programs. By combining technical data planning with early systems engineering to highlight data needs and gaps as early as possible in a program, the Air Force can systematize and simplify efforts to request and adjudicate data concerns with OEMs. Tracking all data deliveries, rights assertions, and storage locations in a single document should streamline a SPO's technical data management efforts over a system's life cycle.

The Space and Missile Systems Center's RFP Template in the Data Rights Handbook

The Air Force SMC Data Rights Handbook contains selections from historical RFPs to highlight the organization's data rights guidance and best practices.[38] One practice clearly ties supplier data rights assertions and costs to specific data deliverables. Table 4.1 displays selected extracts from a document used to implement this approach in a GPS RFP.

[38] Office of the Staff Judge Advocate, 2018.

Figure 4.3. Program Data Management Matrix for a C-5 Avionics Upgrade—Data Rights Strategy

C-5 Communications, Navigation, Surveillance and Air Traffic Management Software (CNS/ATM) Data Rights Strategy

Product Breakdown Structure			Item Type	Product Definition Information			Product Operation Information			Requiring Activity		
				Requested Rights	Asserted Rights	Is There a Gap?	Requested Rights	Asserted Rights	Is There a Gap?	MX	OP	ENG
1.1	HD-710 High Speed Data Unit		COTS									
1.1.1		Outline Drawing		UL	LR	GAP	UL	LR	GAP	X		X
1.1.2		Detailed Assembly Drawings		LR	LR		LR	LR		X		X
1.1.3		Associated Parts Lists		LR	LR		LR	LR		X		X
1.1.4		Qualification Test Procedures		LR	LR		LR	LR				X
1.1.5		Acceptance Test Procedures		LR	LR		LR	LR		X		X
1.1.6		Integration Test Procedures		UL	UL		UL	UL		X		X
1.1.7		Computer Software and Documentation		RR	RR		RR	RR		X		X
1.1.8		Installation Manual		UL	LR	GAP	UL	LR	GAP	X		X
1.1.9		Maintenance Documents		UL	LR	GAP	UL	LR	GAP	X		X
1.1.10		Interface Control Document		UL	LR	GAP	UL	LR	GAP	X		X
1.1.11		Operator's Manual		LR	LR		LR	LR		X	X	X

SOURCE: Selection from C-5 avionics data management matrices that the C-5 SPO provided to RAND.
NOTE: UL = unlimited rights; LR = limited rights; RR = restricted rights; SLR = special license rights; MX = maintenance; OP = operations; ENG = engineering.

Figure 4.4. Program Data Management Matrix for a C-5 Avionics Upgrade—Data Usage Management

Data Usage Management

Product Breakdown Structure	Need?	Org Lifecycle Product Data Needs							Data Acquisition					Lifecycle Data Management, Use				
		Program Management Office	AFSC/DLA	OEM	Production Contractors	Government Depots	Field Maintenance personnel	Other	Data Content Standard	Data Format Standard	Data Item Descriptions Available?	Data Delivery Method Defined	Data Verification Method Defined	Data Storage IT System Defined?	Data Configuration Control Defined?	Identify Who Needs Data	Data Exchange Standard	Data Archive Plan
1.1.1. Product Design	YES																	
Technical Data Package—General	YES	X		X	X	X			YES	NO	NO	[text]	[text]	[text]	[text]	[text]	[text]	[text]
Drawing Tree	YES	X		X	X	X							[text]	[text]	[text]	[text]	[text]	[text]
Specification Tree	YES	X		X	X	X							[text]	[text]	[text]	[text]	[text]	[text]

SOURCE: Selection from C-5 avionics data management matrices that the C-5 SPO provided to RAND.
NOTE: AFSC/DLA = Air Force Sustainment Command or Defense Logistics Agency.

Table 4.1. SMC Data Rights Handbook RFP Data Acquisition Template

CDRL Number	Data Item Title	Asserted Rights Category	Price
A017	Electromagnetic Environmental Effects (E3) Integration and Analysis Report (E3IAR)	Unlimited	[offeror to insert]
A018	Nuclear Hardness and Survivability Design Analysis Report	Offeror to complete	[offeror to insert]
A023	Operational Concept Description	Unlimited	[offeror to insert]
A024	System/Subsystem Specification (SSS)	Unlimited	[offeror to insert]
A025	Software Requirements Specification (SRS)	Unlimited	[offeror to insert]
A033	Software Version Description	Unlimited	[offeror to insert]
A035	Orbital Operations Handbook	Unlimited	[offeror to insert]
A036	Program Plan (New Technology Insertion Plan)	Offeror to complete	[offeror to insert]
A037	System Engineering Management Plan (SEMP)	Offeror to complete	[offeror to insert]

NOTE: The table lists selected CDRLs from a GPS RFP contained in the SMC Data Rights Handbook (Office of the Staff Judge Advocate, 2018). It excludes Contract Line Item Numbers (CLINs).

SMC recommends specifically requesting responses from offerors during source selection that the Air Force can use to negotiate the terms of a final proposal relevant to technical data, using an early-established, relatively comprehensive list of required technical deliverables, as recommended in the previous section. Such documentation would improve the posture of Air Force acquisition programs later in their life cycles. It summarizes in one place all data deliverables expected, thereby simplifying the oversight of delivery during and potentially following EMD. And it summarizes in one place the rights associated with each data package. Over the life of the program, this summary can help future program personnel verify what rights were assigned in the initial agreement. And, if preserved in an easily accessible form, it offers a useful reference that personnel in future programs can use to clarify the rights to data generated in the instant program that might be relevant to the future programs.

Summary

Once it has clarified its data needs and program circumstances, an Air Force SPO should pursue a tailored data acquisition approach based on subsystem-level management functions. We identified three tools currently in use in the Air Force that would likely improve the management of technical data if AFSOC and other Air Force programs applied them more broadly.

AFLCMC offers a work breakdown structure that provides a systematic way to apply criteria relevant to future demand for technical data to key elements of a system. The C-5 program provides an alternative work breakdown structure that provides a systematic way to identify gaps

between government-requested and contractor-asserted data rights associated with the data needed to support a system. It also offers a systematic way to track and document the basis for each government request. The SMC Data Rights Handbook provides a complementary way to organize a contractor's offer against a request for proposal at the CDRL and CLIN levels.[39]

Taken together, these tools can help a SPO with a limited number of personnel, with limited experience with data rights, organize its efforts to acquire the technical data and data rights that AFSOC and other parts of the Air Force need. Integration of these tools could benefit Air Force acquisition programs of all sizes.

[39] Office of the Staff Judge Advocate, 2018.

5. Three Potential New Contracting Strategies

There may be potential to use existing legal authorities to acquire data rights in innovative ways that support Air Force ends. Two such authorities are the creative use of *options* and the use of Other Transaction Authority (OTA) contracting, each of which may enable the Air Force to set the future price for IP at the moment of competitive selection or to structure contracts in innovative ways (with mutual agreement of the contractor) such that the Air Force can have access to data rights at some future point. If the Air Force concludes that its best option is not to buy technical data from a sole-source OEM, it may seek to incentivize the OEM to reduce the price it charges the Air Force or to improve the performance of the services that it provides to the Air Force, or perhaps both. This chapter addresses these strategies.

Contract Options

Notwithstanding the limitations in federal procurement law on the lengths of service contracts (and some contracts for supplies or goods too),[40] it may be possible to use contract options to extend the life of a contract beyond the traditional five-year period used for many government contracts. This approach has been considered and recommended by previous studies of this issue,[41] and this approach is even included in DoD guidance for acquisition and contracting professionals developing IP strategies for procurements.[42] Both Department of Defense Instruction 5000.02 and the DFARS address this as well, with DFARS 207.106 stating that "acquisition plans for major weapon systems and subsystems of major weapon systems shall . . . [a]ddress the merits of including a priced contract option for the future delivery of technical data and computer software, and associated license rights, that were not acquired upon initial contract award."[43]

An option is a "unilateral right in a contract by which, for a specified time, the Government may elect to purchase additional supplies or services called for by the contract, or may elect to extend the term of the contract."[44] In commercial and government contracts, it gives the buyer the ability to purchase some good or service at a future date, at its discretion, with the price and other terms set by earlier mutual agreement. An option for data rights might allow the Air Force

[40] See 41 U.S.C. 3903 and 10 U.S.C. 2306b; see also 41 U.S.C. 6707(d) and FAR 22.1002-1 (limiting contracts falling under the SCA to five years in length).

[41] See Van Atta et al., 2017.

[42] Van Atta et al., 2017, p. 26.

[43] DFARS 207.106; see also Department of Defense Instruction 5000.02, 2015.

[44] FAR 17.201.

to decide at some future point during (or even after) the EMD contract that it needs certain data rights and then purchase such rights according to the terms and pricing of the previous contract.

It is fairly clear from existing government contracts law that such options could be used during the pendency of a typical five-year production contract, provided they were included as part of the base contract that was competitively awarded.[45] Options may even allow the service to extend a contract for years beyond its projected delivery date, enabling it to take delivery of data rights after production of an aircraft has ended.[46] To add such an option to the contract for data rights, the government would need to add a separately priced option CLIN to the contract for the data rights it wanted the option to acquire and also include FAR clause 52.217-7 (Option for Increased Quantity—Separately Priced Line Item) in the contract as well. That FAR clause allows a contracting officer to "require the delivery of the numbered line item, identified in the Schedule as an option item, in the quantity and at the price stated in the Schedule."[47]

However, it is unclear how long a production contract could be kept in force by the government through the exercise of options. Several court decisions suggest that the parties could mutually agree to contract extensions, or the exercise of options, for longer than five years, provided there is mutual agreement of the parties.[48] Federal procurement regulations and court decisions regarding multiyear procurements and services contracts suggest there may be an outer limit to the length of a government contract (whether for goods or services).[49] Such a limit may relate in some way to commercial practice, particularly if the goods or services are being procured as commercial items or services, or if contractual language requires the government to adhere to common commercial practices.[50] Similarly, it is unclear that options could constructively extend the length of a government contract, with no other funding or activity occurring under the contract, without running afoul of the Antideficiency Act,[51] and other statutes requiring that "funds are available and obligated for the contract.[52] In addition, the FAR subpart governing options contains language that disfavors the use of options when "prices for

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[45] See Major Contracting Services, Inc., Comp. Gen. B-401472, September 14, 2009.

[46] See Delco Elec. Corp., B-244559, October 29, 1991, 91-2 Comptroller General Published Decisions [CPD] Para. 391 (use of options with delivery dates seven and half years later does not violate FAR 17.204[e], because the five-year limit applies to five years' requirements in a supply contract); see also Freightliner, Armed Services Board of Contract Appeals [ASBCA] No. 42982, 94-1 Board of Contract Appeals [BCA] Para. 26,538 (option valid if exercised within five years of award); see, generally, Edwards, 2003.

[47] FAR 52.217-7.

[48] See, e.g., *Arko Exec. Servs., Inc. v. United States*, 553 F.3d 1375, 1380–81, Fed. Cir. 2009.

[49] See FAR 16.505(c)(1) (limiting task order contracts for advisory and assistance services); FAR 17.104(a) (limiting multiyear contracts); FAR 17.204(e) (limiting the length of contracts with options); and FAR 22.1002-1 (imposing five-year limitation on contracts covered by the McNamara-O'Hara Service Contract Act of 1965 [41 U.S.C. 6701–6707]); see also Freightliner Corporation, 94-1 BCA 26,538, November 26, 1993.

[50] *CW Gov't Travel, Inc. v. United States*, 99 Fed. Cl. 666, 679–80, 2011.

[51] 31 U.S.C. 1341.

[52] 41 U.S.C. 3903; 10 U.S.C. 2306c.

the supplies or services involved are likely to change substantially,"[53] as may occur for technical data over the length of an aircraft's service life.

OTA

OTA gives DoD the authority to pursue certain projects without having to use procurement contracts, grants, or cooperative agreements. This allows development efforts that are not subject to the federal laws and regulations governing procurement contracts, including the FAR. It may enable the Air Force to structure future research and development efforts—and possibly production too—in such a way that allows the future purchase of data rights on terms advantageous to the Air Force. OTA agreements are generally used for research and development purposes by agencies that have been granted OTA power by Congress. Eleven federal agencies currently have OTA, beginning with NASA, which received the authority from Congress in 1958.[54] Notably, a significant force in the evolution of OTA has been the private sector's reluctance to agree to standard government contract language regarding rights in technical data, with the private sector preferring more-permissive language that enabled firms to retain more data rights than was customary in government contracts.[55] This history suggests that OTA may be an awkward vehicle for the Air Force to use in acquiring more IP.

Congress first granted OTA to DoD's research arm, the Defense Advanced Research Projects Agency (DARPA), in 1989 and has modified this authority over the years in significant ways.[56] Most recently, in the fiscal year (FY) 2016 National Defense Authorization Act (NDAA),[57] Congress eliminated the old OTA for DoD and codified two new ones: 10 U.S.C. 2371 authority to use OTA for "basic, applied, and advanced research projects" and 10 U.S.C. 2371b authority to use OTAs for "prototype projects that are directly relevant to enhancing the mission effectiveness of military personnel and the supporting platforms, systems, components, or materials proposed to be acquired or developed by the Department of Defense, or to improvement of platforms, systems, components, or materials in use by the armed forces."[58] The FY 2018 NDAA gave the Secretary of Defense additional authority to decide on the use of OTAs in circumstances she or he determined appropriate.[59] Notably, the 2371b authority for OTA use in prototype procurement allows DoD to award a "follow-on production contract or transaction .

[53] FAR, 17.202(a).

[54] Pub. L. 85-568, 1958, Section 203(c).

[55] Hatchin, 2011, p. 4.

[56] GAO, 2016, p. 8.

[57] Pub. L. 114-92, 2015.

[58] For information on the Air Force's experience to date with this new authority, see Mayer et al., 2020.

[59] Pub. L. No. 115-91, 2017, Section 867.

. . without the use of competitive procedures" if the original OTA was competitively awarded and the prototype was successful.[60]

Agreements executed using OTA may be advantageous for agencies to the extent they can deviate from both statutory and regulatory requirements applicable to other types of government contracts or grants. With some exceptions, OTA agreements are not subject to the Competition in Contracting Act (CICA),[61] nor does the Government Accountability Office (GAO) or the Court of Federal Claims have jurisdiction to hear most types of bid protests involving the award of OTA agreements.[62] OTA agreements also need not comply with domestic preference statutes, such as the Buy American Act,[63] nor with the FAR's cost principles or the Cost Accounting Standards, nor with such federal procurement statutes as the Bayh-Dole Act governing patent rights,[64] nor FAR and DFARS provisions regarding rights in technical data.[65] The general rule of OTA agreements is that agencies may structure the agreements however they choose, provided they reach mutual agreement with their counterparty (or parties) and do not run afoul of congressional oversight committees in doing so. Historically, there has been congressional resistance to the use of OTA for large-scale production work, as evidenced by the Army's experience with its Future Combat Systems.[66]

In practice, the Air Force likely could not use the OTA of 10 U.S.C. 2371 for the purposes of an EMD contract, nor could it use this authority for the acquisition of technical data, because such objectives do not fit within the statute's purpose of "basic, applied, and advanced research projects."

However, the Air Force may be able to use the OTA of 10 U.S.C. 2371b in certain situations. This broader statutory authority enables DARPA, the head of a service, or other designated DoD officials to use OTA to "carry out prototype projects that are directly relevant to enhancing the mission effectiveness of military personnel and the supporting platforms, systems, components, or materials proposed to be acquired or developed by the Department of Defense, or to improvement of platforms, systems, components, or materials in use by the armed forces."[67]

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[60] This statutory authority to award production contracts without competition was recently the subject of a GAO protest by Oracle, which challenged the Army's award of a follow-on production contract to REAN Cloud, LLC. In its protest decision, GAO both affirmed its authority to hear protests involving OTA deals and sustained the protest on the basis that the Army did not comply with its statutory OTA when opting not to use competition. See Oracle America, Inc., B-416061, May 31, 2018.

[61] 41 U.S.C. 253.

[62] See Rocketplane Kistler, B-310741, January 28, 2008, 2008 CPD ¶ 22 at 3; see also MorphoTrust USA, LLC, B-412711, May 16, 2016, 2016 CPD Para. 133 at 7–8.

[63] Pub. L. 72–428, 1933.

[64] Pub. L. 96-517, 1980.

[65] Hatchin, 2011, pp. 20–21, citing American Bar Association, 2000, p. 26.

[66] See Williams, 2018.

[67] 10 U.S.C. 2371b(a).

Subject to the approval of specified officials and notice to Congress, this OTA may be used for transactions of any amount. For the use of this OTA to be appropriate, the statute requires one of the following factors to exist:

- There is at least one nontraditional defense contractor or nonprofit research institution participating to a significant extent in the prototype project.
- All significant participants in the transaction other than the federal government are small businesses or nontraditional defense contractors.
- At least one-third of the total cost of the prototype project is to be paid out of funds provided by sources other than the federal government.
- The senior procurement executive for the agency determines in writing that exceptional circumstances justify the use of a transaction that provides for innovative business arrangements or structures that would not be feasible or appropriate under a contract, or would provide an opportunity to expand the defense supply base in a manner that would not be practical or feasible under a contract.[68]

It is possible to imagine a scenario in which the Air Force develops a "prototype" program under the 10 U.S.C. 2371b OTA that is "directly relevant . . . to improvement of platforms, systems, components, or materials in use." This prototype program could be for the design or initial production of prototypes that would improve on existing aircraft, such as is often done by AFSOC for existing military or commercial aircraft. Such an agreement would need to be reached with either nontraditional defense contractors or small businesses, require some type of cost-sharing, or require the certification by a senior defense official that "exceptional circumstances justify the use of a transaction that provides for innovative business arrangements or structures that would not be feasible or appropriate under a contract." This would free the Air Force to enter into an OTA transaction for the prototype. And, if the Air Force used competitive selection in some way for the prototype phase of the OTA, it could then skip competitive selection for the award of a follow-on production OTA transaction.[69]

In the OTA agreement, the Air Force could agree with the contractor on whatever data rights provisions, licenses, or options that the parties were able to agree on, notwithstanding any statutory or regulatory requirements applicable to conventional government contracts. The potential permutations of data rights could include additional OMIT or FFF data for the Air Force up front, less data up front in exchange for options to purchase such data in the future, or greater rights for the Air Force to share what is commonly understood as "limited rights" data with third parties, such as in the event the Air Force wants to share proprietary data with future logistics contractors for sustainment. In essence, the Air Force would be freer under an OTA agreement to negotiate special licenses for data and structure payment terms and periods of performance for those licenses, without regard for conventional FAR and DFARS requirements.

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[68] 10 U.S.C. 2371b(d).

[69] Compare Oracle America, Inc., B-416061, May 31, 2018.

Incentivizing Sole-Source OEMs

Suppose the Air Force concludes that its best option is not to buy technical data from a sole-source OEM but to incentivize the OEM to reduce the price it charges the Air Force, to improve the performance of the services that it provides to the Air Force, or perhaps both. As explained in Chapter 6, over the term of the new relationship, the OEM will demand that it earn at least the profit it would have earned under current arrangements. Under these circumstances, holding the level of service constant, the OEM can improve the price it offers the Air Force only by reducing the cost of the services it provides. It must presumably change the processes that it uses to make this happen. Holding the price of services constant, the OEM can improve its level of performance only by reducing its costs to free resources to pay for the costs of a higher level of service. Or it must find a way to raise performance with the resources available. Either way, it presumably must change the processes it uses to deliver services.

Performance-based contracting is designed to achieve precisely such process improvements. Depending the Air Force's priorities, it can design a contract that increases the OEM's profits only if the OEM reduces the price or increases the level of performance that it offers the Air Force over the term of the new agreement. A cost-plus-incentive fee (CPIF) contract does precisely this within individual periods of performance; profit within a period of performance depends directly on cost or performance improvements during that period. It sets a target level of cost or performance and uses a simple formula to increase fee during any planned performance period in which the OEM achieves a lower cost or higher performance level than the target. Such a mechanism typically places minimum and maximum levels on the fee allowed to limit risk to the Air Force and OEM. The opportunity for the contractor to cover the costs of its improvement efforts increases as the length of the period of performance increases.

A more aggressive version of such a mechanism is a price cap, which price regulators of public utilities use.[70] Something analogous could be applied in an Air Force setting. In a utility setting, a regulator and a service provider negotiate a fixed price that will apply for, say, three years for the delivery of service with specific performance attributes—for example, for electric power, reliability, and quality of power. The service provider receives the fixed price regardless of what cost it achieves during the period. Meanwhile, the regulator monitors the actual costs and performance achieved. When they meet to negotiate the price for the next three-year period, the regulator and service provider review the costs and performance achieved and reduce the price or increase the performance level for the next period with a goal, over time, of allowing the company to earn a "reasonable" return on investment. Under such an arrangement, the service provider benefits aggressively in the short term; the regulator benefits over the longer term; over time, both share the gains created by the service provider's process improvements. The length of

[70] For overviews of this approach and how it compares with alternative forms of public utility price regulation, see Vogelsang, 2002; Sappington, 2002; Crew and Kleindorfer, 2002; Armstrong and Sappington, 2007; Hauge and Sappington, 2010.

time the price cap remains in place affects this split—the longer it remains in place, the earlier (and, so, the more) the service provider benefits. This arrangement is more aggressive than a CPIF contract, because it allows the service provider to earn a broader range of fee and gives the service provider longer to recover the cost of its improvement efforts.

Could such an arrangement work in a DoD setting? Suppose the Air Force and a contractor were to accept that, in the setting of a legacy system where the contractor has retained full control over its technical data, the contractor is effectively a monopolist. The Air Force could in effect assume the role of the regulator and use the power of the regulation available to it today—the FAR—to manage the profit that the contractor receives.[71]

The Air Force does something like this today when it writes a cost-based contract, in which a contractor can earn a prescribed profit rate tied to the allowable costs it incurs during any period of performance. Alternatively, the Air Force and contractor negotiate a fixed price based on costs that would be allowable under a cost-based contract and the profits that would be allowed based on allowable cost. In such contracts, the Air Force typically tells the contractor what tasks it wants the contractor to perform and then applies a price designed to allow the contractor to earn an acceptable profit when it performs these tasks. Such an approach creates no incentives for process improvement. Properly designed and implemented, a CPIF contract can induce such improvements. A price cap essentially increases the intensity of the incentive to pursue continuous improvement.

With a higher intensity of incentives comes higher risk. The larger the size of the potential mutual gain and the larger the contractor's share of that gain, the larger the variance of potential outcome relative to expected outcome for the contractor. Because most observers accept that private companies are more loss averse than the federal government, it can to argued that the government should bear more risk than contractors.[72] But if a contractor has more ability to improve processes relevant to the government and the contractor, a high-intensity incentive can induce the contractor to pursue improvement despite this higher level of loss aversion.[73] The government must understand that, when a contract design increases risk to a contractor, the government can expect the contractor to demand a higher return on its effort to improve processes.

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[71] A seminal article in the economics literature on contact design to regulate a monopolist public utility, Averch and Johnson, 1962, began as a study of how DoD could manage the profits of a defense contractor. Bringing ideas from public utility regulation into defense contracting simply reverses the flow of ideas.

[72] At a minimum, a defense contractor can in principle go bankrupt; for practical purposes, the federal government cannot. This induces an asymmetric reaction to variation in profit that places more emphasis on potential negative outcomes than on potential positive outcomes—loss aversion. In addition, any amount of money at risk accounts for a larger share of the contractor's value than of the government's. That is, a given absolute value of loss is a more serious problem for a contractor than for the government.

[73] For a discussion of how to balance such considerations in contract design, see Camm, Bartis, and Bushman, 2008.

Standard defense acquisition guidance recommends that the government bear risk in transactions with high risk and that a contractor bear relatively more risk as the level of risk in a transaction falls. For example, EMD activities typically involve more risk than production activities. As a result, a cost-based contract is more appropriate for EMD than for production activities. Risk falls as production accumulates without major modifications, suggesting that the emphasis on price relative to cost should increase as production accumulates without major modifications in design. Similarly, risk falls as experience with O&S accumulates, suggesting again that emphasis on price relative to cost should increase as O&S experience accumulates without major modifications in design. Over the course of decades, defense acquisition policy has swung like a pendulum between emphasis on cost and price in contracts, but through all of this time, general consensus has favored placing more risk on the contractor over the life of a program as risk inherent in the program falls.[74]

In our setting, that suggests that, once the Air Force accepts that it will deal with a contractor as a monopolist, it will seek ways to shift an increasing amount of risk to the contractor as O&S experience accumulates. Before experience has accumulated with a new subsystem, the Air Force could use a cost-based contract in which the Air Force bore all risk. As O&S experience accumulated, the Air Force could move more risk progressively to the contractor, moving from a CPIF contract to one closer to a price cap. If this occurs, the Air Force would need to accept that the contractor would demand a higher return on investment to justify the increased risk it faced. The Air Force should continue to move risk to the contractor if incremental contractor effort yields large enough improvements to offset the cost of these efforts and benefit the Air Force and contractor.

This discussion implicitly assumes that the contractor will invest in improvement efforts if the Air Force and contractor continue to share the gains of this effort in a way that covers the cost of the contractor's effort. That is, for such an effort to yield improvements that will ultimately benefit the Air Force, Air Force contracting officials must allow a contractor to benefit from its effort. They cannot behave as though they are involved in a zero-sum game in which the contractor's gain is the Air Force's loss.

Summary

New forms of contracting can potentially help AFSOC and other parts of the Air Force acquire technical data and data rights more easily than current practices allow. Options could help AFSOC and other parts of the Air Force acquire only the technical data they need, when they can verify that need, at prices negotiated in the EMD source selection when the Air Force has the most leverage with an OEM. OTA, where it is available, simplifies efforts to tailor the

[74] For a concrete example of how this reasoning shaped the negotiations behind a sole-source contract for material support of the F/A-18E/F, see Camm, Blickstein, and Venzor, 2004.

terms for acquiring technical data to reflect Air Force needs as closely as possible. It is consistent with new guidance to prefer specially negotiated licenses in new contracts. And where the Air Force must negotiate new arrangements with a sole-source OEM, incentive-based contracting can clarify the contractor behavior that the Air Force wants to induce and motivate the OEM to generate benefits that it can then share with the Air Force.

6. What Should the Air Force Pay for Technical Data?

When the Air Force considers acquiring technical data, it needs to consider a series of questions:

- What benefits would the Air Force accrue if it bought technical data? These benefits can be monetary (say, lower sustainment costs) or nonmonetary (say, more-responsive support for deployed systems).
- What is the party that can sell the technical data to the Air Force likely to charge for the technical data?
- What alternatives does the Air Force have to buying the technical data? What are the costs and benefits associated with these alternatives relative to those of buying the technical data?
- Which of these alternatives yields the best mix of benefits and costs for the Air Force?

If one of the alternatives yields a better mix of life-cycle benefits and costs to the Air Force than buying the technical data, the Air Force should decide not to buy the technical data and instead pursue this option. There is no price it should be willing to pay. If buying the technical data yields the best mix of benefits and costs to the Air Force, the Air Force should buy the data and pay the price that the seller demands. Stated this way, the more the Air Force can do to reduce the price of the technical data, the more likely it will prefer to buy it and the lower the price it should pay will be.

This chapter offers a way to think conceptually about the questions above. And it offers a simple accounting framework to calculate relevant costs and benefits. Finally, it considers a specific alternative—an option to buy a technical data in the future if the Air Force determines that it will want a technical data package—and uses the framework offered here to assess that option.

A Framework for Comparing Costs and Benefits

Suppose the Air Force can buy technical data from the OEM for the system the Air Force wants to support. Consider the following alternatives that the Air Force has today:

1. It can rely on the OEM to provide support and pay what this monopolist provider demands for the level of service that it is willing to provide without transferring the technical data.
2. It can buy the technical data. If Air Force ownership of the technical data reduces a monopolist OEM's profits, the OEM will demand a high enough price for the technical data to pay for at least its anticipated loss of profit. If the Air Force buys the technical data as a deliverable in the initial EMD competition, the pressure of the competition should force the price of the technical data down, potentially to the level of the cost of transferring the technical data to the Air Force once they are created.

3. The Air Force can negotiate a contract with a monopolist OEM that rewards the OEM for reducing the cost of providing service or increasing the quality of the service. Doing this must give the OEM at least as much profit as it earns today, so for the Air Force to get a lower price for the service, the OEM must reduce its cost of service more than the agreement increases its profit.
4. The Air Force can work around the items associated with the technical data so that the Air Force need not deal with the OEM to get the services it needs. Such a work-around could increase the cost of service or reduce its quality, but these negative effects could be acceptable if the work-around allows the Air Force to stop paying the OEM profits.
5. If the technical data applies to a single item and the Air Force has FFF interface data for the item, the Air Force can pay to develop a new version of the item and acquire a technical data package for this new item in a competitive setting. The development will cost the Air Force money, but it could be worth the cost if the investment allows the Air Force to avoid paying the OEM profits in the future.
6. If the existing agreement on the use of IP allows it, the Air Force can reverse engineer an item or some portion of a larger system and create the technical data for its own use. Again, the reverse engineering will cost the Air Force money, but it could be worth the cost if the investment allows the Air Force to avoid paying the OEM profits in the future.

Clearly, if the Air Force knows that it will need technical data, it is likely to pay the least for the data if it buys the technical data in the initial EMD competition for the system in question. If the Air Force does not do this, alternatives 1 and 2 make the OEM better off by increasing the OEM's profits when it transfers the technical data to the Air Force or improves its costs or performance. Alternatives 3–6 make the OEM worse off by reducing its anticipated profits. To the extent that the Air Force can plausibly threaten to reduce the OEM's profits, it has leverage to demand either a lower price for the technical data or a performance-based contract in which the OEM retains the technical data. This is the environment in which the Air Force approaches potential purchase of technical data.

Best practice in the commercial sector recognizes these pressures when parties attempt to value IP. Potential buyers and sellers of IP use three approaches to value the IP in question. Table 6.1 summarizes these three approaches.[75] The first column provides a one-word description of each approach. The second column expands this description. The third column describes what value each approach would identify in a negotiation between two parties—in our case, the Air Force and the OEM. The fourth column describes the maximum value the Air Force would be willing to pay for technical data. If the price is higher than this reservation price, the Air Force will refuse to buy the technical data.

Consider each of the approaches first. The cost approach considers the cost of creating the technical data in the first place and depreciates this cost for the time that has passed since the creation of the technical data. For example, suppose the creator of the technical data believes that the technical data will provide a basis for earning profits over 20 years and uses straight-line

[75] Our primary source is Office of the Staff Judge Advocate, 2018, pp. 80–86. It also recommends Reilly and Schweihs, 2013; Anson, 2010; American Institute of Certified Public Accountants, 2007.

depreciation in its management accounting to spread the cost of creating the technical data over the period in which it will yield profits. Then, five years after the technical data were created, the book value would be equal to 75 percent of its original creation cost, because 25 percent of this cost had already been depreciated.

Table 6.1. Three Ways to Assess the Cost or Value of IP

Approach Label	Approach Description	To Set a Negotiated Price[a]	To Determine the Air Force's Willingness to Pay[b]
"Cost" (formal cost estimate)	Assess the original cost of creating technical data, less depreciation	Collect certified data generated when an offeror created the technical data	Assess the cost to the Air Force of the best alternative (e.g., reverse engineering, work-around, new acquisition)
"Market" (reflects cost and value)	Use market benchmarks to assess the cost of creating technical data today	Break technical data into pieces; seek cost data on close analogs of pieces from open market sources	Use market benchmarks to assess the cost of the Air Force's best alternative, as above
"Income" (estimate of value)	Assess future net present value of income streams associated with technical data	Determine the offeror's likely future income flows; discount them to the present at private rate	Determine the Air Force's likely future cost savings; discount them to the present at OMB rate

[a] This approach provides an *analytic framework* for computing a mutually satisfactory price.
[b] This approach yields the Air Force's *reservation price*—the most it will pay for a technical data package.

The market approach seeks to determine what it would cost to create the technical data right now. To do this, it breaks the technical data into pieces that have close analogs in the commercial sector. It looks at the current market price—which in a competitive market also equals its cost—of each piece of the technical data. It sums the prices of each piece across all the pieces in the technical data. This sum defines the current cost of creating the technical data. This approach is widely used in the commercial sector, where commercial analogs are ubiquitous. It is similar to the methods used to value derivatives in financial markets. It could be helpful if the Air Force buys a system with commercial content. Its usefulness is likely to be limited for systems with uniquely military applications and no commercial analogs for comparison.

The income approach focuses on value rather than cost. It asks what the values of the anticipated cash flows for a buyer and seller are before the transfer of technical data and the anticipated cash flows afterward. The difference between the discounted value of the flows for the buyer captures the benefit that the buyer anticipates getting if it buys the technical data. This is the, presumably positive, value the buyer is potentially willing to pay for the technical data. The difference for the seller is negative and represents the amount the seller will demand to be paid before it will transfer the technical data.

Now consider a situation in which the Air Force and the OEM sit down to reach a mutual agreement on a price for the technical data in the absence of competition. Which of these three approaches is likely to prevail? The third column of Table 6.1 offers three potential solutions. The cost approach effectively seeks an estimate of what the OEM spent to create the technical

data. By the time of negotiation, this is a sunk cost and is of little interest to the OEM. The market approach requires commercial analogs. If these cannot be identified, this approach will not be helpful. If analogs can be identified, the approach might help if the buyer and seller had made some prior agreement to use this approach to determine a value when a value was needed. The Air Force has not made such agreements with OEMs in the past but might consider them in the future in new competitions when the Air Force has favorable leverage. This leaves the income approach. In a mutual agreement in which the OEM has the right to deny any sale, the OEM will demand to be compensated for the full value of its loss if it transfers the technical data to the Air Force. This is the approach most likely to prevail. The OEM will use its corporate cost of capital to discount the values of future negative cash flows that it associates with the transfer.

The Air Force may be able to use leverage to reduce the value of the OEM's cash flows if the OEM refuses to transfer the technical data. For example, if the contract allows it, the Air Force could delay the payment of fee. Or the Air Force could impose pressure on some other part of the its relationship with the OEM, perhaps even on some other program. The Air Force has had some success doing this in the past, but it requires a proactive program manager seeking the technical data, a program manager willing to accept delays, if necessary, to apply as much pressure as possible. Few programs have displayed a willingness to provoke an OEM in this way, as the Air Force relies on longer-term cooperation with the OEM to make programs run smoothly. If the Air Force succeeds in applying this pressure, it can reduce the price the OEM demands for the technical data by reducing the discounted value of the loss in cash flows that the OEM associates with the transfer.

Should the Air Force accept the OEM offer based on the income approach? As we noted, it should if and only if the costs and benefits the Air Force associates with this offer dominate the costs and benefits it associates with the other alternatives available—for example, accepting the status quo, implementing a work-around, or reverse engineering. The fourth column of Table 6.1 describes approaches that the Air Force should use to pursue this comparison.

The cost approach is now forward-looking. It can assess the costs of each investment and the cost savings expected from making each investment. The market approach is no longer needed because the Air Force is considering concrete actions it might take. If those actions involve commercial technology, commercial benchmarks may help inform the Air Force of the cash flows it could expect from taking various actions. But these benchmarks inform internal Air Force decisions and need not be shared with or negotiated with the OEM. The income approach now looks at the alternatives from the Air Force's perspective. The Air Force now has the initiative and needs to consider the effects of its actions on its own cash flows. In this setting, the Air Force examines the cash flows over time that it associates with each alternative and discounts them using the appropriate OMB discount rate. To determine these cash flows, the Air Force can use tools commonly associated with the cost and market approaches. But the income approach guides the Air Force's analysis and brings in elements from the cost and market approaches only as needed.

The discount rate raises two important issues in this context. First, the OEM's cost of capital is higher than the OMB's cost of capital and can be significantly higher. The prescribed real (adjusted for inflation) annual discount rate for a 20-year investment, as those discussed here, is 0.6.[76] A similar discount rate for an OEM is likely to be in the range of 7 to 10 percent—more than ten times higher. Under such discount rates, the Air Force is willing to pay about $0.89 today to get $1.00 of benefits 20 years from now (all adjusted for inflation). The OEM is willing to accept about $0.12 to $0.23 today to compensate it for an expected loss of $1.00 20 years from now (all adjusted for inflation).

When this comparison applies, the OEM values the near-term relative to the long term more than the Air Force does. If this applies, it becomes easier to find a price that will satisfy both the Air Force and OEM. For example, suppose as a base case that, in each year in the future, the annual gains the Air Force associates with receiving technical data are exactly equal to the losses the OEM associates with such a transfer. If this base case applies, the Air Force will always place a higher value on the gains from the transfer than the OEM places on the losses. This points to mutual gains from the transfer that the Air Force and OEM can presumably bargain over to see who gets what share of the gains. All else equal, the size of these mutual gains increases as the difference between the discount rates of the Air Force and the OEM increases.

The second issue that the discount rate raises presses in the opposite direction. The economic reasoning underlying the application of the OMB discount rate assumes that the government can borrow as much as it chooses to in any year at the stated discount rate. Politics aside, that might be feasible for the government as a whole, but it is precisely an inappropriate assumption for any agency. In any budget year, an agency faces a fixed budget. The programs within the agency, traced down indenture by indenture, face similar fixed budgets. In each year, each program must consider the various ways it can use its constrained budget. In such a setting, the effective discount rate that optimizes resource decisions within the program is the marginal return on the least productive investment the program can make within its budget. Practically, that marginal return typically far exceeds the OMB discount rate in Air Force programs and other programs around the government. Under these circumstances, effective program managers use an implicit discount rate above the OMB discount rate to guide decisions, and this implicit rate is often well above the OEM's cost of capital.[77] If, for example, the implicit real rate were 15 percent, the

[76] See OMB, 1992; OMB, 2016. The reason is simple. In assessments of this kind, the OMB rate equals the average cost of government borrowing for the horizon associated with any investment. The government can borrow at a lower rate than an OEM can because the OEM must pay corporate income taxes and, at least in principle, must pay a higher-risk premium for borrowed funds than the government.

[77] We are not suggesting that program managers do this consciously. Rather, across many agencies and years, government decisionmakers allocate their resources as if they were doing this. They recognize the high opportunity cost of committing the funds available within their budgets and consider that opportunity cost when consider what to prioritize.

program manager would be willing to pay only $0.04 today to achieve a $1.00 benefit 20 years from now.

If program managers use an implicit discount rate that is higher than the OEM's cost of capital, the argument above reverses itself. Now, if we posit a base case in which the gain that the Air Force expects from a technical data transfer is exactly equal to the loss the OEM expects, the OEM will always demand more for the transfer than the Air Force is willing to pay. No room exists for mutual gains from such a transfer. In effect, the Air Force must value the gains from such a transfer more than the OEM does for mutual gains to exist. Put another way, the greater the difference between the implicit discount rate that an Air Force program manager uses to make decisions and the OEM's cost of capital, the more the Air Force must value the gains of a technical data transfer than the OEM values its losses for mutual gains to exist.

A Simple Set of Accounts

The Air Force can use a set of simple equations to calculate the values of the costs and benefits discussed above. The equations are easy to state. Selecting values for the parameters and variables in the equations is not. For now, we will assume that all benefits can be monetized. After we understand the equations, we will discuss the more realistic situation in which it is not reasonable to monetize benefits.

Net Present Values of Cash Flows

Equation (6.1) states the net present value that the Air Force places on receiving technical data for its use:

$$B = -D + \sum_{t=1}^{T}\sum_{i=1}^{N}\delta_t^A p_{it}^A V_{it}^A . \qquad \text{Eq. (6.1)}$$

In this equation,

- t is an index for time measured in years, extending from $t = t_0$ to T, the last year within the planning horizon
- i is an index for uses to which the Air Force might apply technical data; N potential uses exist
- B = the Air Force buyer's subjective perception of the net present value of transferring technical data from the OEM to the Air Force
- D = the mutually agreed price of the technical data package, paid in year t_0, in t_0 dollars
- δ_t^a = the discount factor for year t for party a, where A = the Air Force and O = the OEM
- p_{it}^a = Subjective probability for party a, where A = the Air Force and O = the OEM, that the Air Force will use the technical data in the ith manner in year t
- V_{it}^a = the subjective value that party a associates with the Air Force's use of the technical data in the ith manner in year t, where A = the Air Force, and O = the OEM.

Equation (6.1) reflects the following assumptions. The technical data transfer occurs in year t_0. If this transfer is tied to the source selection for EMD, competition gives the Air Force the leverage to get the best price for each piece of technical data that it seeks at this time. At the time of transfer, the Air Force expects to use the technical data in manner *i* in every year for which p_{it}^{a} is positive and to derive an annual value, V_{it}^{a}, from that use. The Air Force uses net present value to value the set of cash flows displayed. To calculate this net present value, we use a set of discount factors presented in Equation (6.2):

$$\delta_t^a = \left(1 + r_a\right)^{-t}, \qquad \text{Eq. (6.2)}$$

where r_a is the real discount rate (the discount rate adjusted for inflation) of party *a*, *A* = the Air Force, and *O* = the OEM.

Employing the definitions above, Equation (6.3) presents the OEM or seller's valuation of the transfer of the technical data:

$$S = D + \sum_{1}^{T}\sum_{1}^{N}\delta_t^O p_{it}^O V_{it}^O, \qquad \text{Eq. (6.3)}$$

where *S* is the OEM seller's subjective perception of the net present value of transferring technical data from the OEM to the Air Force. Although V_{it}^{A} is positive for the Air Force, V_{it}^{O} is negative for the OEM. This is what the OEM expects to lose if the Air Force uses the technical data in the *i*th manner in year *t*. Note that p_{it}^{O} refers to the OEM's subjective probability that the Air Force applies the technical data in the *i*th manner in year *t*. The equations allow the Air Force and OEM to use different planning horizons.[78]

Using the Equations to Improve Insight

The equations present the factors relevant to calculating the net present values that the Air Force and OEM associate with any potential transfer of technical data. Air Force planners should not expect to use equations like these to calculate exact estimates of net present values that most observers will agree on. Rather, Air Force planners should use similar equations to organize their professional judgment about potential values for p_{it}^{a}, V_{it}^{a}, and r_a. In this section we present a series of sample questions that the planners might use such equations to address.

What is the likelihood that the Air Force would use technical data, for example, to access a second source of sustainment, to simplify integration of modernized or upgraded subsystems, or to replace sources that are no longer available? By setting the value of p_{it}^{a} at 0 or 1, planners can

[78] Suppose the planning horizon used to consider the price for technical data for party *A* is T_A and that for party *B* is T_B. Then, if $T_A > T_B$, $p_{it}^{B} = 0$ for all $t > T_B$ and $T = T_A$. Mutually satisfactory negotiation will work better if T_A and T_B are closer to one another.

construct and explore different scenarios about capabilities they want to use technical data to acquire.

Or planners can posit expectations about how fast the Air Force's need for, say, a second source of sustainment, simplified integration capability, or replacement of a source will grow. For example, it is reasonable to expect that sustainment costs and challenges will increase as a system ages, making a second source more desirable. It is reasonable to expect the desirability of upgrades and modernization to rise as the threat environment and available technologies change over time. And more sources will surely disappear as time passes. The equations provide a set of accounts that planners can use to state their subjective beliefs about such trends in a format that simplifies assessment of the policy implications of these beliefs.

How much are technical data worth if they allow each of these applications? For example, what savings would the planners expect if they had access to a second source? The empirical evidence on this value is mixed at best, in part because DoD has dramatically reduced its access to second sources of sustainment over the past 30 years. The equations allow the exploration of the implications of subjective professional judgments about such savings. What would the Air Force save if it did not have to return the system to the OEM to integrate any significant modernization or upgrade? Again, the evidence is mixed. The equations allow planners to ask how much they would have to save to make it worthwhile to pursue technical data for this purpose at any point in a system's life cycle.

Note that the Air Force can expect to receive the value it derives from technical data many years—perhaps decades—in the future. As noted above, any significant discount rate will lead the Air Force to be willing to pay far less in the initial EMD competition than the value it derives from technical data, say, 20 years in the future. To achieve $1.00 of benefits 20 years from now, a program manager would be willing to spend $0.89 today if the current OMB rate guided real decisionmaking but only $0.04 to $0.12 if a constrained program budget induced a real discount rate of 10 to 15 percent.

How much authority does the Air Force want over the use of the information in an technical data package? The equations make it clear that broadening that authority is likely to increase the price the OEM demands even as it increases the value of the data to the Air Force. What rights does the Air Force really need to pursue its specific goals? What commercial opportunities is the OEM likely to lose if the Air Force asks for broader licenses? When is it worthwhile for the Air Force to ask for broader rights when the OEM (appropriately) places a high price on giving the Air Force such rights?

This last set of questions suggests what may be the most useful application of these equations. Because they can in principle assess the values that the Air Force and the OEM place on transferring technical data with rights to the Air Force, they can potentially provide a set of accounts that the Air Force and OEM can use to discuss any particular transfer in a way that identifies the potential for shared gains from trade. The case studies we examine suggest that OEMs often propose a price for technical data without clear justification, a price that appears to

be designed to end the discussion. The equations above could in principle help structure a discussion that identifies places where an OEM might be willing to offer a price for technical data that allowed the Air Force to understand the basis for the offer and thereby help the Air Force make better-informed decisions about how much it would be willing to pay for technical data.

Such an approach can only be productive if both sides approach the discussion with an expectation that the negotiation is not being conducted in a zero-sum setting. That is, if the two parties can identify mutual gains, the Air Force contracting culture needs to allow the OEM to retain a portion of the gains identified. If the OEM cannot reasonably expect this to happen as it enters such negotiations, it is hardly worth the OEM's effort to help identify the potential for such mutual gains.

Benefits That the Air Force Prefers Not to State in Monetary Terms

In all likelihood, in the analysis described above, the OEM can focus in its analysis on the monetary values of benefits—or losses. If the Air Force chooses to simulate OEM thinking, it can take a similar approach. But some benefits that technical data yield to the Air Force are hard to monetize. For example, the Air Force seeks an ability conduct normal maintenance or to integrate new capabilities without waiting for input from the OEM. It seeks more-responsive support of deployed aircraft. The value of such benefits is hard to monetize, particularly with missions that involve small numbers of aircraft and a fleet of aircraft in which each aircraft has a different configuration. In such circumstances, it is difficult to add aircraft—and their commensurate monetary costs—to a mission to ensure the availability of a suitable number of aircraft.

When the Air Force is unwilling to monetize a benefit, it should use the equations above to track a parallel record of appropriate benefits. It can use the same probabilities discussed above; they do not depend on dollar values. It should also use the same discount factors described above. These capture the intuition that the Air Force values a benefit more if it receives the benefit earlier. The discount factors discussed above are well suited to capture this intuition.[79] Planners will pursue an assessment of net dollar value and value associated with each nondollar source of value for each alternative the Air Force might consider—for example, sticking with the status quo, buying a technical data, or seeking a work-around. Decisionmakers must now weigh the monetary and nonmonetary measures of value to determine which alternative offers the Air Force the best mix of these values.

[79] This argument has been a point of contention in the cost-benefit literature. For a useful discussion, see Keeler and Cretin, 1983.

An Option to Buy Technical Data in the Future

Equations (5.1) and (5.3) include probabilities that the Air Force will take advantage of such technical data at various points in the future. If the Air Force buys technical data as a formal CDRL in the EMD contract, the equations assume that the Air Force pays a fixed price in year t_0 to take delivery of technical data that it can use in the future if it ever needs it. In an alternative approach, described in Chapter Five, the EMD contract could include an option to buy technical data in the future if the Air Force in fact decides to use the technical data to do something. A CLIN in the EMD contract can define that option and specify a price that the Air Force will pay *in the future only if* it decides to exercise the option. The price is specified in advance as part of the EMD competition. The CLIN can in principle define a formula that escalates the price in response to realized inflation or realized change in some other price index. The key to the option is that it clearly defines what technical data the Air Force can buy in the future, when it can exercise such options, and what it will pay if it does.

Such an option significantly simplifies the assessment described in Equations (6.1) to (6.3). We no longer need to consider probabilities, because the Air Force buys—and pays for—technical data in the year that it first needs them. We no longer need discount rates, because the Air Force pays no money up front. It pays only when it exercises the option. This removes considerations discussed above that result from differences in the discount rates of the Air Force and OEM. And the Air Force is able to apply its maximum leverage over the price of technical data in the EMD competition.

These considerations make the option sound attractive to the Air Force. Current federal policy encourages the use of such options "when it is in the Government's interest."[80] But two problems complicate the use of such options.

First, there are legal limitations on the length of options in government contracts. If an EMD contract includes an option for a CDRL, the Air Force must exercise the option within two or three years of the end of the EMD contract, depending on language included in the contract. If the Air Force does not exercise the option by then, it must negotiate a new agreement with the OEM to extend the life of the option. By this time, the OEM is effectively a sole source; the Air Force has lost the leverage it sought when it acquired an option to buy the technical data as part of the initial EMD. There are also certain limits on multiyear and multiple-year contracts, as well as limits on the overall duration of contracts, that may preclude the creative use of options to give the Air Force an ability to purchase technical data.[81]

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[80] For details, see FAR 17.201.

[81] See FAR 16.505(c)(1) (limiting task order contracts for advisory and assistance services); FAR 17.104(a) (limiting multiyear contracts); FAR 17.204(e) (limiting the length of contracts with options); and FAR 22.1002-1 (imposing a five-year limitation on contracts covered by the McNamara-O'Hara Service Contract Act of 1965 [41 U.S.C. 6701–6707]); see also Freightliner Corporation, 94-1 BCA 26,538, November 26, 1993.

Second, in any year that the Air Force might exercise an option, it must have obligation authority available to fund the option. That is, the Air Force must score the cost of the options against its budget in any year to preserve the authority to exercise the option. If in any year the Air Force does not exercise the option, it can use that obligation authority elsewhere on activities that can use similar funding. But such end-of-year spending is harder to optimize than spending planned as part of the total Air Force budget. And the need to renew obligation authority each year over the life of an option imposes an administrative burden that a SPO can seek to avoid to use the affected funds elsewhere within its constrained budget each year. This complicates efforts to preserve a SPO's option to buy technical data until it determines that it needs them.

Until the Air Force develops validated ways to extend an option well beyond the EMD contract and to preserve the obligational authority to use the option at an acceptable administrative cost, we recommend that the Air Force not pursue options for technical data.

Summary

When the Air Force considers acquiring technical data, it must ask what the value of those data will be, what the owner of the data is likely to demand for the data, what alternatives the Air Force has if it decides not to acquire the data, and what alternative yields the best mix of benefits and costs from the Air Force's perspective. This chapter offered a simple framework for structuring and answering these questions. The framework was presented with mathematical precision. But the numbers in the framework are necessarily subjective—products of professional military judgment. Therefore, the framework will be most useful as a mechanism for improving the insight and judgment of decisionmakers when they ask whether it is worthwhile to acquire technical data.

The Air Force has the most leverage it will have if it acquires the data as part of the EMD source selection. This requires making an investment early with the expectation of gaining benefits decades in the future. Because the OEM's discount rate is likely to significantly exceed the OMB-mandated discount rate for the Air Force, this framework suggests potential gains from trade that the Air Force and OEM can share if the Air Force acquires technical data that it believes it will need. The senior leadership, however, may conclude that limits on its budgets demand that it achieve a rate of return on its current investments well above the OEM's discount rate. If this perspective prevails, the framework suggests that the Air Force and OEM are not likely to reach a mutual agreement on government acquisition of technical data.

If the Air Force pursues an option to buy technical data in the future, as described in this chapter, the framework becomes simpler. Less information is needed about the probability that the Air Force will need technical data in the future. And the Air Force is likely to have much better information about what data are worth to it when it reaches the date when it needs the data.

7. Findings and Recommendations

In this final chapter, we consolidate our findings and the resulting recommendations. We begin by addressing the complexity of data rights and deliverables. Air Force personnel would benefit from a better understanding of the distinction between data rights and deliverables. Air Force personnel can potentially benefit from exploiting nontraditional approaches to contracting that can make it easier to acquire technical data and data rights at an acceptable price. We strongly suggest that the Air Force needs more specialists in technical data rights and deliverables but accept that the Air Force will probably continue to rely on the full-time staff in SPOs to address day-to-day issues associated with data rights and deliverables. Further, Air Force staff needs to be provided better access to training than is currently available on these topics.

We then consider issues that the Air Force addresses in new programs and in legacy programs where the decisions of past policymakers have severely limited the options available to acquire more-advantageous data rights and deliverables.

General Findings

Treat Data Rights and Data Deliverables as Distinct

Subject-matter experts both in the Air Force and writing the trade literature tend to agree that the management of data rights and deliverables in DoD is complex. The parts of the DFARS that address these topics are technical and have changed periodically over time to reflect efforts to remove unintended consequences of rules used in the past. This process of refinement continues today because of active debate and advocacy in affected government and contractor communities.

For example, arrangements are similar but subtly different for technical data and for software. Data rights depend on who has funded the development of systems and subsystems, but there is considerable disagreement between OEMs and SPOs on what funding is operational in determining the Air Force's data rights. Disagreement also exists on what basic sustainment activities, such as OMIT, mean in practice. Within the programs we examined, these disagreements tend to be resolved without lawyers in the course of day-to-day interaction between Air Force and contractor personnel. But Air Force–wide, large differences persist and will ultimately be resolved only by new regulatory language or decisions in court. The cost and delays associated with both have discouraged action in individual programs to resolve many persistent differences.

In the midst of such disagreement, we found one central distinction surfacing over and over—that between data rights and data deliverables. Confusion about these has kept many Air Force programs from taking full advantage of their rights and pursuing actions that ensure that they will have the technical data they expect to need in the future.

A data right is a license to use data that the OEM created and continues to own. The license dictates what the Air Force can do with the data it possesses. The Air Force must have a license to use any technical data it wants to use in its sustainment program for a system. The extent of Air Force funding for the subsystem associated with technical data provides a baseline for what the Air Force's rights are for these data. The Air Force can negotiate with the owner of any technical data to adjust these rights within limits carefully defined in the DFARS.

A data deliverable is part of what the Air Force buys when it buys a system. The RFP lists CDRLs for all the technical data the Air Force wants and organizes these CDRLs into CLINs that organize negotiation of what rights the Air Force will get, exactly what data the Air Force will get, when it will get them, in what format and medium, and for what price. Before the Air Force can use data that it has a right to use, it must take delivery of a closely defined technical data package and potentially pay for this package. The Air Force has the best leverage it will ever have to buy these packages in a competitive source selection for EMD. If the Air Force fails to take delivery of such a package during the EMD program, it can lose its access to the data in the package, even if it has rights to the data and funding to pay for them.

In the Air Force programs that we examined, we saw examples of the Air Force not properly asserting the data rights that past funding provided, because the Air Force was unaware of this funding. Elsewhere, the Air Force asserted appropriate rights but failed to specify technical data as a deliverable in an RFP. Or the Air Force included an appropriate data deliverable in an RFP but failed to take delivery until the EMD contract had lapsed and no contractual authority remained to make a delivery.

Technical data rights and deliverables are complicated. As a first step toward improving Air Force management of data rights and deliverables, the Air Force should ensure that all personnel associated with a program understand some basics about data rights and deliverables, how they interact, and what the Air Force's roles, rights, and authorities are with regard to each of these.

Consider Using Nontraditional Approaches to Contracting for Technical Data

Options could help AFSOC and other parts of the Air Force acquire only the technical data they need, when they can verify that need, at prices negotiated in the EMD source selection when the Air Force has the most leverage with an OEM. OTA, where it is available, simplifies efforts to tailor the terms for acquiring technical data to reflect Air Force needs as closely as possible. It is consistent with new guidance to prefer specially negotiated licenses in new contracts. And when the Air Force must negotiate new arrangements with a sole-source OEM, incentive-based contracting can clarify the contractor behavior that the Air Force wants to induce and motivate the OEM to generate benefits that it can then share with the Air Force.

Expand Training on Data Rights and Deliverables and Access to Such Training

The Air Force has a small community of lawyers and acquisition specialists who understand the complexities associated with data rights and deliverables in exquisite detail. But they are outnumbered by the specialists maintained by defense contractors. Such Air Force lawyers rarely interact with individual Air Force programs over the course of their life cycles. The Air Force does not have enough specialists to allow regular interaction. In the programs we examined, the immediate presence of lawyers was often taken as evidence that something had not gone properly. A lawyer was present mainly if litigation was a serious possibility, and litigation meant delay and conflict in programs that sought to maintain good relationships with contractors to keep programs on schedule.

Meanwhile, when Air Force data rights specialists found themselves drawn into a specific program, they commonly encountered language from contractors that had clearly been drafted by lawyers with expertise in data rights. On the Air Force side, programs rely on in-house program staff to manage day-to-day interaction with contractor staff. Programs do not have in-house counsel or experts in data rights issues. Conversely, contractors appear to involve legal experts on technical data much earlier and more intimately and routinely. Perhaps contractors are willing to invest in programs early, by committing lawyers to them early in their lives, in a way that the Air Force is not willing to invest. The result is that, in the day-to-day activity so important to the execution of data-related tasks in a program, Air Force program personnel can find themselves overmatched by contractor teams with legal expertise. Therefore, contractors can often take the initiative on data issues that Air Force program staffers have difficulty countering.

Given the above challenges, the Air Force would benefit from additional expertise on data rights and deliverables (e.g., lawyers with data rights as a specialty who play an active role during program planning and contract negotiations), possibly in the form of the IP "cadre" directed by Section 802 of the FY 2018 NDAA.[82] The lawyers could be embedded in programs or serve as part of centers of excellence available to programs on demand. Expanding the number and availability of such lawyers is not likely to induce the Air Force to abandon its historical reliance on the full-time members of program staff to manage day-to-day responsibilities in a SPO, even technical responsibilities similar to those associated with data rights and deliverables. If the Air Force will continue to rely on its acquisition staff to manage day-to-day technical data issues, these staff members will need more training.

The Defense Acquisition University and the Air Force Institute of Technology have courses that cover the issues discussed here for this audience. They are accessible online so that individuals can pursue knowledge on their own time about data rights and deliverables as part of their ongoing professional development. But the personnel who designed and teach these courses make it clear that the materials online are not adequate to convey the knowledge that program

[82] Pub. L. 115-91, 2017.

staff need to address the data issues the Air Force currently asks them to address on a regular basis. Students benefit most from attending classes in person and asking teachers for advice on specific issues. In effect, program staff are seeking mentors who can help them address the issues they face as they arise from day to day, which suggests that they would benefit equally from on-call experts who could provide similar advice.

Recommendations for New Programs

Air Force programs have more opportunities to improve their management of technical data rights and deliverables in new programs than in legacy programs, where past decisionmakers have foreclosed many options for current managers.

During the Requirements Process, Clarify the Role of Technical Data in the Expected Life-Cycle Management of a System

Joint Capabilities Integration and Development System (JCIDS) guidance currently requires the Air Force to identify a key performance parameter associated with reliability, maintainability, availability, and operating and support cost (RMA-C).[83] This opens the door to consider the sustainability of a new system and the role of technical data in that sustainability. The demands for technical data flow mainly from sustainment—OMIT, diagnosis of failures in urgent circumstances, availability of a third-party sustainment source, integration of upgrades and modernization, ability to replace lower-tier sources, and so on. This is mainly the business of logisticians. A5 offices responsible for developing and refining requirements will benefit from close coordination with acquisition logisticians from relevant A4 offices.

Technical data play such a central role in RMA-C issues that it may be appropriate to extend current JCIDS guidance beyond developing metrics for operational availability, material availability, and O&S costs. A technical data package is technically a tool available to address such dimensions of requirements. But technical data tend to cut across such dimensions of sustainability. More broadly, they can preserve options for the Air Force, even if planners envision a sustainment plan today that can meet its operational and material availability and O&S costs without Air Force access to detailed technical data. Our experience today, looking back on the then-well-informed decisions the Air Force made during the 1990s and after, should remind us that good planners can make errors with consequences that persist for decades. Placing an explicit focus on the role of technical data in sustaining options and flexibility in future Air Force system sustainment could help better define a requirement for robustness and resilience that is separable from the requirements that derive from the current JCIDS interpretation of RMA-C concerns. The Air Force can do this on its own as it develops requirements for JCIDS review.

[83] Chairman of the Joint Chiefs of Staff, 2018; Chairman of the Joint Chiefs of Staff Instruction 5123.01H, 2018.

Maintain Regular Order to Ensure That SPO Tasks Relevant to Data Rights and Deliverables Are Executed Properly

By *regular order*, we mean the tasks that Air Force guidance associates with the acquisition and management of technical data rights and deliverables. The tasks are simple to list and can sound obvious. But as a practical matter, most Air Force programs that we examined do not commit enough resources, with the right experience and skills, to satisfactorily execute these tasks. Why this occurs today is unclear. But these tasks are classic examples of investments the Air Force should make today that will likely generate the most benefits far in the future—too far, perhaps, for personnel in current individual SPOs to give them as much priority as they deserve from the perspective of the Air Force as an enterprise.

As Chapter 4 explains in greater depth, these tasks include the following:

- Assess a program's needs for data rights and deliverables during the development of the acquisition strategy for a source selection.
- Translate data needs into detailed CDRLs that define the depth and breadth of data and the format and medium in which they will be delivered.
- Review OEM assertions about data rights in a thorough, informed, and timely manner.
- Track delivery of data deliverables, verifying that they arrive on schedule and match specifications properly.
- Review OEM markings about data rights in a thorough, informed, and timely manner.
- Include DFARS clauses in an RFP that will allow the Air Force to recover as easily as possible from failures over the course of a program life to manage the definitions of deliverables, ascertains, markings, and funding as planned.
- Document agreements on assertions, markings, and funding thoroughly and ensure that the Air Force preserves this documentation in a format and medium that future programs can easily access.
- Build and preserve the skills required to execute these tasks in future programs.

Use a Formal WBS to Manage a Systematic Review of Technical Data Requirements and the Execution of a Plan to Meet Those Requirements

Chapter 4 presents examples of tools available in the Air Force today that offer alternative ways to work through relevant subsystems associated with a new program and tailor data rights and data deliverables to those programs in a way that facilitates the tasks listed above.

An AFLCMC approach, for example, considers how often a subsystem is likely to change in the future and seeks more-complete rights and data deliverables when more change is expected.[84] The approach also looks at who initially paid for the subsystems in question and anticipates that more-complete data rights and deliverables are likely to be more cost-effective as the share of development that the Air Force paid for increases.

[84] AFLCMC, 2018.

A C-5 program office approach builds on this approach and uses it to create an administrative control system that ensures the proper examination of data rights and deliverables relevant to each subsystem. For each subsystem, this system tracks the funding source, the CDRL that defines the data deliverables, OEM assertions about rights, gaps between Air Force program and OEM positions on rights, names of parties that should be engaged to resolve gaps, details about the technical data finally negotiated, and information about how and where these technical data will be stored and managed. SMC offers a similar approach that tracks CDRLs to CLINs in the RFP, the rights the OEM asserts, and the price the OEM demands for the associated technical data.[85]

Recommendations for Legacy Programs

Legacy systems have already addressed the issues discussed above, potentially decades ago when the programs for the systems began. What remains today is to decide whether the Air Force should pursue data rights or deliverables that differ from those acquired in the past. Certain cases may require aggressive actions to change the status quo. These could involve going to court or using what leverage a program can identify to induce a contractor to change its current position. The Air Force will need to give careful attention to whether acquiring additional data rights or deliverables is worth the cost and disruption. In particular, the Air Force should weigh its options and the costs and benefits associated with them.

Organize and Review Relevant Historical Documents to Determine What Legal Basis the Air Force Might Have for a Change

Relevant documents include past agreements on rights and deliverables, the current status of deliverables planned in the past, the documentary evidence available to support contractor assertions about Air Force rights, evidence from Air Force sources about the funding for development activities associated with data, the validity of markings on technical drawings, and the contractual options the Air Force still has available to change rights, deliverables, and markings in place today. The administrative tools based on a sustainment WBS, described above, can help the Air Force organize the documents that it has and identify places where they might support different data rights or deliverables. In the absence of contractual authority, the Air Force can look forward to negotiating with a sole-source contractor that will demand that, following any changes, it will still receive at least the monopoly profits it associates with the data rights and deliverables as they stand today.

Assess the Benefits and Costs Associated with Alternative Approaches

As explained in Chapter 5, the Air Force has choices. It can

[85] Office of the Staff Judge Advocate, 2018.

- accept the status quo
- pay the price that the OEM demands for new rights or deliverables
- write a new contract with the OEM to incentivize lower prices or higher levels of sustainment service
- work around the data that the OEM controls so that the Air Force no longer needs these data
- invest to develop a replacement, complete with appropriate technical data rights and documentation, if only a few items are involved and the Air Force has effective FFF data for an item
- reverse engineer an OEM process so that the Air Force has a source of technical data independent of the OEM's, if contracts allow it.

These options involve a variety of costs and benefits. We observed variations on all these options in the programs that we examined. If the Air Force decides to buy additional data rights or documentation, it can potentially use the existence of these options to provide leverage it can apply to reduce the price the OEM will demand. As the Air Force negotiates with the OEM, it can potentially use the equations in Chapter 6 as a set of accounts to explore the potential for mutual gains from trade with the OEM.

Appendix A. A Legal Primer on the Use of Technical Data and Data Rights in a Defense Setting

Technical data consist of "recorded information (regardless of the form or method of the recording) of a scientific or technical nature . . . relating to supplies procure by an agency" from a contractor.[86] This includes engineering drawings, designs, manuals, and blueprints of a weapon system. But "the term does not include computer software,"[87] which is defined separately as "computer programs, source code, source code listings, object code listings, design details, algorithms, processes, flow charts, formulae and related material that would enable the software to be reproduced, recreated, or recompiled."[88] The legal framework governing computer software is similar but not identical to the framework governing technical data. This chapter focuses on the technical data legal framework but highlights key differences with respect to computer software.

Technical data and computer software developed in the performance of a weapon system EMD contract are IP that belongs to the contractor. The government has an interest in using such data and software for sustainment proposes—i.e., maintaining and upgrading those systems through their life cycles. In particular, without the underlying data, the government is unable to develop an organic sustainment capability. Furthermore, it is impossible to compete sustainment contracts if the government lacks the ability to share required data with potential third-party bidders. Thus, when the government is unable to use or disclose technical data, it must enter into a sole-source sustainment contract with the OEM. Such arrangements may be extremely expensive in comparison with organic or competitive options.[89] And being forced to contract with the OEM may undermine the ability to satisfy certain statutory organic sustainment requirements.[90]

To make use of a contractor's technical data (or computer software), the government must satisfy two conditions. First, the government must have the appropriate license rights. Federal procurement law and regulations grant the government standardized data rights based on the

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[86] 10 U.S.C. 2302(4); see also DFARS 225.227-7013(15).

[87] 10 U.S.C. 2302(4). Technical data also do not include data incidental to contract administration, such as cost, pricing, wages rates, and management policies.

[88] DFARS 252.227-7014(3).

[89] By *organic*, we mean maintenance work performed at government facilities by government employees. This category includes depot-level maintenance at government facilities.

[90] Congress has mandated that at least 50 percent of depot maintenance work must be organic, and maintenance on certain "core" weapon systems must be performed by government employees at government facilities. 10 U.S.C. 2464 and 2466.

source of funding for the creation of the data. The government obtains unlimited rights if the item was developed exclusively with government funding, government purpose rights if the item was developed using mixed funding, and limited rights if the item was developed exclusively with private funding.[91] Limited rights are sufficient to establish an organic sustainment capability wherein data are used by and disclosed to only government employees.[92] But if the government seeks to disclose data to third-party maintenance contractors or to compete spare-parts, upgrade, or modification services, government purpose rights are required.[93]

Second, the government must actually possess the data it seeks to use. Even if the government had a license right to use and disclose data in an unrestricted manner—for instance, when development was fully government funded—it could not exercise that right to develop an organic or third-party sustainment plan where it does not physically possess the data. Thus, securing the data themselves through the actual delivery of the data, which conveys actual possession to the government, is as important—if not more so—as having the appropriate data rights.

The next sections present at a high level the legal frameworks governing the way the government (1) licenses rights and (2) obtains the data themselves, respectively.

Legal Framework Governing Data Rights

This section proceeds in four parts. The first part discusses the legal framework governing entitlement to license rights to technical data. The second part highlights differences in the framework governing entitlements in computer software rights. The third part examines mechanisms that contractors use to restrict government rights. The fourth looks at factors that limit the government's ability to protect its appropriate rights.

Data Rights Licenses

Federal law and regulations prescribe three standard types of licensing rights that the government may acquire with respect to technical data: (1) unlimited rights, (2) government purpose rights, and (3) limited rights.

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[91] If DoD obtains unlimited rights, it may provide the data to anyone for any reason. However, if DoD obtains government purpose rights, it may provide the data to third-party contractors only for activities in which DoD is involved, including competitive reprocurement, but not including commercial purposes. If DoD obtains limited rights, it may use the data only internally and may provide the data to third parties in a limited number of circumstances. See DFARS 252.227-7013.

[92] Office of Staff Judge Advocate, 2018, p. 22.

[93] Office of Staff Judge Advocate, 2018, p. 22.

The government obtains unlimited rights to use or disclose technical data "in any manner" if the data pertain to an item or process that was developed exclusively with government funding.[94] Additionally, the government receives unlimited rights regardless of the source of funding with respect to the following categories of technical data:

- technical data produced under "study, analysis, test, or similar work [that] was specified as an element of performance"[95]
- FFF data[96]
- data necessary for OMIT
- corrections or changes to technical data furnished by the government
- publicly available information
- data with expired restrictions.[97]

Among these categories, FFF and OMIT data warrant additional discussion. FFF data are defined as "technical data that describes the required overall physical, functional, and performance characteristics . . . of an item, component, or process to the extent necessary to permit identification of physically and functionally interchangeable items."[98] Neither laws nor regulations define what is precisely encompassed by OMIT data. But DFARS clarifies that OMIT data do not include "detailed manufacturing or process data," which consists of "technical data that describe the steps, sequences, and conditions of manufacturing, processing or assembly used by the manufacturer to produce an item or component or to perform a process."[99]

DoD acquires government purpose rights when the underlying item or process was developed using a mix of government and private funds.[100] The degree of relative funding does not matter. Government purpose rights can also be granted when the data were developed exclusively with

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[94] DFARS 252.227-7013(a)(16) (granting the government "rights to use, modify, reproduce, perform, display, release, or disclose technical data in whole or in part, in any manner, and for any purpose whatsoever, and to have or authorize others to do so"). The term *developed* requires that the item "ha[s] been constructed or the process practiced." DFARS 252.227-7013(a)(6). But the item or process need not "be at the stage where it could be offered for sale or sold on the commercial market." DFARS 252.227-7013(a)(6).

If the contract at issue does not involve development of an item or process, the government receives *unlimited rights* with respect to technical data "[c]reated exclusively with Government funds." DFARS 252.227-7013(b)(1)(ii).

[95] DFARS 252.227-7013(b)(1)(ii). In *Varian Associates*, B-236238, June 28, 1990, GAO concluded that "even where mixed funding is involved, . . . the government will have unlimited data rights derived from . . . 'experimental, developmental, or research work' which is also specified as an 'element of performance' under a government contract" (quoting 1988 DFARS 227.472-3[a][1][ii]).

[96] DFARS 252.227-7013(a)(11).

[97] See 10 U.S.C. 2320(a)(2)(A) and (a)(2)(C).

[98] DFARS 252.227-7013(a)(11).

[99] DFARS 252.227-7013(a)(6).

[100] 10 U.S.C. 2320(E).

private funds but pertain to a "major system interface."[101] As the name suggests, government purpose rights permits the government to use or disclose the technical data for "any activity in which the United States Government is a party, including cooperative agreements with international or multi-national defense organizations, or sales or transfers by the United States Government to foreign governments or international organizations."[102]

Furthermore, "[g]overnment purposes include competitive procurement, but do not include the rights to use, modify, . . . or disclose technical data for commercial purposes."[103] Government purpose rights thus enable DoD to disclose technical data to a third-party contractor for an alternative sustainment contract or even to remanufacture the weapon system, provided that the recipient is subject to a nondisclosure agreement.[104] The only distinction between government purpose rights and unlimited rights is that the department shall not provide data for a third party's private use under government purpose rights. Government purpose rights should therefore satisfy any conceivable sustainment option.[105] By default, government purpose rights transform into unlimited rights after five years, but the parties may vary this period by negotiation.[106]

The final type of standard licenses to use technical data is limited rights, which apply to technical data for items developed exclusively through the use of private funds. This requires development to have been "accomplished entirely with costs charged to indirect cost pools, costs not allocated to a government contract, or any combination thereof."[107] Commercial items are generally presumed to have been developed exclusively at private expense; therefore, the government will usually have limited rights to related technical data—other than FFF data, OMIT data, or modifications to government-provided data.[108]

Limited rights enable the government to use data within the government for any purpose other than manufacturing the underlying item.[109] But the government is prohibited from

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[101] The term *major system interface* is defined in the FY 2017 NDAA as "a shared boundary between a major system platform and a major system component, between major system components, or between major system platforms, defined by various physical, logical, and functional characteristics, such as electrical, mechanical, fluidic, optical, radio frequency, data, networking, or software elements." 10 U.S.C. 2446a(b)(4). Such interfaces are further "characterized clearly in terms of form, function, and the content that flows across the interface in order to enable technological innovation, incremental improvements, integration, and interoperability." 10 U.S.C. 2446a(b)(4).

[102] DFARS 252.227-7013(a)(12).

[103] DFARS 252.227-7013(a)(12).

[104] DFARS 227.7103-5(b)(4).

[105] Unlimited rights may still be required in certain situations in which the government seeks to make data publicly available, without the need for a nondisclosure agreement—for instance, publishing environmental impact data.

[106] DFARS 252.227-7013(b)(2).

[107] DFARS 252.227-7013(a)(8).

[108] DFARS 252.227-7015 and 7102-2(a).

[109] DFARS 252.227-7013(a)(14).

disclosing the information to any outside party (or permit the use of data by such persons) except when accompanied by a nondisclosure agreement under the following circumstances:

- when disclosure and third-party use are necessary for emergency repair or overhaul[110]
- when disclosure and third-party use "[pertain] to an interface between an item or process and other items or processes necessary for the segregation of an item or process from, or the reintegration of that item or process"[111]
- when disclosure of nonmanufacturing data to a foreign government is necessary for evaluation or information purposes[112]
- when disclosure to a "covered Government support contractor" is necessary for obtaining program-management advice.[113]

Thus, limited rights enable the government to establish an organic maintenance capability in which all data usage would be limited to government employees. But only the OEM can provide sustainment contractor services, because other contractors cannot be given access to the required technical data.

In addition to the three above-mentioned standardized licenses, the contracting parties—i.e., DoD and the contractors—may set aside these options in favor of SNLs.[114] Although the parties are flexible in defining the specific terms of SNLs, the government "may not accept less than limited rights."[115] Furthermore, a contractor cannot be compelled to sell or relinquish rights to technical data as a condition of award of the contract.[116] Thus, the government cannot require contractors to enter into restrictive SNLs as a source selection criterion. In practice, SNLs are rarely used, in comparison to default licenses. This may change because the FY 2018 NDAA requires DoD to rely on SNLs "to the maximum extent practicable" with respect to the technical data needed to support major weapon systems and subsystems.[117]

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[110] 10 U.S.C. 2320(a)(2)(D)(i)(I); see also DFARS 252.227-7013(a)(14)(i) and 7103(5)(c)(2).

[111] 10 U.S.C. 2320(a)(2)(D)(i)(II). It is unclear what constitutes *segregation* and *reintegration* data beyond FFF data to which the government already has unlimited rights. In June 2016, DoD proposed to define *segregation or reintegration data* as "technical data or computer software that is more detailed than form, fit, and function data and that is necessary for the segregation of an item or process from, or the reintegration of that item or process (or physically or functionally equivalent item or process) with, other items or processes." 81 Fed. Reg. 39481, June 16, 2016.

[112] DFARS 227-7103(5)(c)(2).

[113] DFARS 227-7103(5)(c)(2); see also DFARS 252.227-7013(a)(5) (defining what is a covered government support contractor).

[114] DFARS 227.7103(5)(d) permits the parties to "[n]egotiate specific licenses when [they] agree to modify the standard license rights granted to the Government or when the Government wants to obtain rights in data in which it does not have rights."

[115] DFARS 227.7103(5)(d).

[116] 10 U.S.C. 2320(a)(2)(H).

[117] Pub. L. 114-328, 2016, Section 2196.

Computer Software Licenses

For computer software, federal regulations provide for a similar three-part licensing scheme that largely depends on the source of funding, with some notable differences from the technical data regime. The most fundamental difference is that the funding source does not apply with respect to commercial software. Rather the government takes the commercial license "customarily provided to the public."[118]

With respect to noncommercial software, the government acquires unlimited rights when the software was developed exclusively with government funds—i.e., it was "materially develop[ed] or design[ed]" under a government contract.[119] As in the technical data context, such rights permit the government to use or disclose the software without restrictions.[120] Whereas the government acquires unlimited rights with respect to certain technical data regardless of funding source, such as OMIT data, that is not the case in the software context. Thus, even though certain software may be necessary for the operation of, maintenance on, installation on, or training on a weapon system, the government's default entitlement to software licensing is based on funding.

Where software was developed with mixed government and private funds, the government acquires a government purpose right that permits (1) unrestricted use or disclosure within the government and (2) use or disclosure outside the government for a government purpose, provided that the recipient is subject to an appropriate nondisclosure agreement or provision.[121]

The scope of unlimited rights and government purpose rights in noncommercial computer software essentially mirrors the terms as used in the technical data context. But, in a significant departure, restricted rights instead of limited rights apply to software developed exclusively with private funds.[122] Such rights limit the government's use of software to one computer or terminal at a time, though backups may be maintained.[123] And any time the government transfers the software to another terminal, the first copy must be deleted.[124] Although third-party contractors may be hired to maintain restricted software, the contractor must agree to an appropriate nondisclosure agreement.[125]

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[118] DFARS 227-7202-1(a).

[119] *Ship Analytics Int'l Inc.*, ASBCA No. 50914, January 11, 2001, p. 15.

[120] DFARS 227.7203-5(a).

[121] DFARS 227.7203-5(b).

[122] This situation needs to be distinguished from limited rights in the technical data context.

[123] DFARS 227-7014(a)(15).

[124] DFARS 227-7014(a)(15).

[125] DFARS 227-7014(a)(15).

Finally, just as in the technical data context, the government and the OEM may set aside the standard computer software licenses and negotiate an SNL, provided that the SNL "shall not provide the Government lesser rights in computer software than [restricted rights]."[126]

Determining Restrictions to Technical Data and Computer Software Rights

The scope of the government's right to technical data and computer software generally depends on the funding source. Even when the parties rely on SNLs, the default funding-based licenses shape the course of negotiation. However, the government has limited visibility into contractors' funding streams and is therefore often incapable of determining by itself the standard licensing rights to which it is entitled. Conversely, the contractor has superior information regarding what funds were used to develop acquisition items.

Regulations respond to this information asymmetry by requiring the contractor to assert data rights restrictions to technical data and computer software and support such assertions with documentation. Otherwise, the government acquires unlimited rights to the data. Specifically, during source selection, the contractor must identify technical data listed in the CDRL to which the government is entitled to less than unlimited rights and provide the basis for that assertion—e.g., that the item was developed with mixed funding.[127] Upon award, the contractor is obligated to convey any technical data deliverables not included in this initial assertion with unlimited rights unless it can assert new restrictions "based on new information or inadvertent omissions" and show that such restrictions "would [not] have materially affected the source selection decision."[128]

Furthermore, the contractor must mark any data or software it delivers with markings designating the specific right to which the government is entitled—e.g., limited right or government purpose right—and maintain records to justify such restrictive markings.[129] Failure to provide timely markings may result in the forfeiture of the ability to assert restrictions in the future.[130] Contracting officers may challenge markings within six years of the completion of the contract. If the markings are challenged during this time frame, the contractor must provide records proving the grounds for the asserted restrictions. The contracting officer may deem the contractor's response inadequate and invalidate the markings—in which case the government

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[126] DFARS 227-7014(b)(4).

[127] DFARS 252.227-7013(e)(2) ("The Contractor shall not deliver any data with restrictive markings unless the data are listed on the Attachment").

[128] DFARS 252.227-7013(e)(3).

[129] See, e.g., DFARS 252.227-7017.

[130] See *General Atronics*, ASBCA No. 49196, March 19, 2002 (The contractor failed to timely provide proper markings and its "belated attempt to place restrictive legends . . . is unavailing. By this point in time, all of the [data terminals] had been delivered and the Navy had gained unlimited rights").

obtains unlimited rights.[131] The contractor may file suit in court or with an administrative body following the rejection of an asserted restriction.

This process is designed to encourage contractors to assert valid and well-documented restrictions and to provide a procedure by which contracting officers may invalidate meritless assertions.

Gaps in the IP Rights-Determination Process

In practice, however, contractors tend to safeguard their IP by asserting restrictions to the maximum extent, while program officials often lack training and resources to review and challenge these assertions. According to lawyers from a leading government-contract law firm, "[h]istorically, when a contractor asserted 'limited rights,' 'restricted rights,' or even 'commercial' license rights in its technical data and computer software, the government rarely asked questions."[132] The recent *Cubic Defense Applications* decision highlights this phenomenon.[133] In this case, Cubic asserted limited rights with respect to 16 technical data items connected with a Navy contract to design, produce, and support a data link system.[134] Remarkably, Cubic's sole proffered justification for each assertion was "mixed funding."[135] Even though federal regulations clearly state that the government is entitled to government purpose rights with respect to mixed-funding data, the Navy did not question the improper limited rights assertions when awarding the contract and only caught the oversight years later when Cubic was bidding for a follow-on contract.[136]

Aggressively asserting restrictions to IP is a practical business strategy for contractors that seek to protect future income streams based on their IP. Even when assertions are challenged, the contractor typically enjoys the asserted restrictions for a period. If a SPO invalidates a restriction, the contractor may file suit in the Board of Contract Appeal or Court of Federal Claims to defend the asserted restriction.[137] The government is generally prohibited from using the disputed technical data in a manner that is inconsistent with the asserted restriction until a final decision is reached, which could take years.[138] The FY 2019 NDAA, however, authorizes such use of

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[131] See 10 U.S.C. 2321 (providing challenge procedures).

[132] Baker et al., 2015, p. 22.

[133] ASBCA No. 58519, 2018, pp. 2–3.

[134] ASBCA No. 58519, 2018, pp. 2–3.

[135] ASBCA No. 58519, 2018, pp. 2–3.

[136] ASBCA No. 58519, 2018, pp. 2–3.

[137] See 10 U.S.C. 2321.

[138] See 10 U.S.C. 2321.

disputed data if the Secretary of Defense finds in writing that mission readiness requirements will not permit waiting for a final decision.[139]

Although some program officials are beginning to apply greater scrutiny, a wide disparity remains on an individual basis. Many contracting officials are unaware of the process for challenging contractor assertions and rarely turn to legal counsel for advice on matters relating to data rights. For instance, it is commonplace for contractors to mark data as *proprietary*—a term that has no meaning within the data rights framework. Nonetheless, SPOs frequently restrict the use of data marked *proprietary*, as if the government had limited rights.[140]

Legal Framework Concerning Securing the Delivery of Technical Data and Computer Software

At the end of the day, if the government does not receive technical data or computer software, either because it did not require the delivery of such items or because delivery did not take place, what rights it may be entitled to under the funding rules do not matter. This is because even the broadest license to use technical data or software is meaningless without actual possession of the underlying data or software. And any government entitlement to data rights arguably remains incomplete until the contractor delivers the data with markings. Thus, contractors may safeguard their IP by avoiding delivery. Indeed, attorneys at a leading Washington, D.C., law firm advise clients to "carefully vet any potential [data] deliverable to confirm that delivery is required under the contract" because such clients "may avoid conveying to the government unlimited rights in data—even if that data was developed exclusively with government funds or in performance of the contract—if the contract does not call for delivery of the data."[141]

The government typically takes possession of technical data or computer software by making the delivery of such items a requirement of the contract, and in some cases by making payment contingent on such delivery. DoD policy requires the SPOs to identify data deliverables before source selection and to specify those deliverables in the solicitation.[142] Specifically, the solicitation must include a CDRL that lists data deliverables and a data item description (DID) that defines the data content, format, and intended use.[143] Unlike in the data rights context, the government *is* permitted to require as a solicitation condition the delivery of technical data or

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[139] Pub. L. 115-232, 2018, amending 10 U.S.C. 2321(i). The government may still be held liable for damage where a court or administrative body later determines that the use of dispute data was improper.

[140] Proprietary markings may properly designate data as Controlled Unclassified Information. See, generally, McKernan et al., 2016. But the marking is inappropriate when asserting restrictions to the government's data rights.

[141] Cassidy, Hastings, and Plitsch, 2017.

[142] Defense Acquisition University, undated.

[143] DFARS 215.470.

computer software, even if the solicitations might not require offerors to deliver such items with certain rights.[144]

Certain contract clauses may enable the government to defer delivery. Specifically, DFARS 252.227-7026 contains a contract clause that enables the government to defer the delivery of predesignated technical data and computer software for up to two years after the contract ends.[145] And DFARS 252.227-7027 permits the government to defer ordering data or software generated in the performance of the contract for three years after accepting all other contract deliverables.[146] It is incumbent on the SPO to ensure that all items on the CDRL are delivered and to order additional items that were generated under the contract if necessary.

[144] 10 U.S.C. 2320(a)(2)(H).

[145] DFARS 252.227-7026 (the time period is two years after all items other than data and software have been delivered or the termination of the contract, whichever is later).

[146] DFARS 252.227-7027.

Appendix B. Background Information on Five Case Studies

Our research effort included an examination of five case studies of Air Force weapon system development programs with prominent IP considerations. Although most of the considered case studies were AFSOC systems, we also considered a program of broader applicability and interest, the KC-46 tanker program.

For each case study, we present some background information about the program in question, a snapshot of current and required data rights for each program, and a deeper dive into a discussion of data rights challenges associated with each program. Discussion of methods to solve the below challenges may be found earlier in this report.

CV-22

Program Background

The CV-22 Osprey is the variant of the V-22 Osprey that was developed for use in Air Force and Marine Corps special operations. The aircraft replaces the MH-53M helicopter on long-distance missions, with the initial contract of $490 million approved in 1997. Currently, the CV-22 fleet consists of 53 aircraft.[147]

Like the V-22, the CV-22 is a tiltrotor aircraft, a feature that increases versatility. The CV-22 has the takeoff and landing flexibility of a helicopter combined with the range, speed, and efficiency of a propeller plane.[148] This unique style of aviation makes the CV-22 ideal for special operations as it streamlines different aerial capabilities needed for a special operations mission into a single aircraft.

The CV-22 has other features that enhance its performance as a special operations aircraft. These features include the SKR system, developed by Raytheon, which allows the CV-22 to better visualize flight conditions and terrain.[149] The aircraft is also equipped with a defense system developed by Bell Helicopter, one of the joint partners on the V-22 Osprey project.[150] These features improve the CV-22's stealth and defense functions, which are necessary for the successful completion of special operations.

[147] Jane's IHS, 2018a.

[148] Naval Air Systems Command, 2018.

[149] Jane's IHS, 2018d.

[150] Jane's IHS, 2018a.

Technical Data and Software Issues

Currently, AFSOC has limited rights to most technical data for the CV-22 but unlimited rights to the FFF and OMIT data for the aircraft. However, Bell Boeing and the military currently disagree about what technical data should be considered FFF or OMIT data. This issue will be discussed further.

To effectively utilize the CV-22, the Air Force needs to have access to the technical data that would allow for the aircraft to receive both routine and emergency repairs. Access to these rights would allow for organic maintenance of the CV-22, allowing the Air Force to repair the aircraft at military depots. However, some of the aircraft's repairs and maintenance would still be completed by the OEM because of the sensitivity and critical nature of some sections of the CV-22.

The Air Force also needs the data rights that would allow for a modification of the CV-22 that improves the aircraft's ability to compete special operations missions. These modifications may include mission-specific elements or general system upgrades. Without the proper data rights, the process for approving and integrating changes into the CV-22 system is slow. The additional time needed to complete the necessary alterations also increases the costs associated with the project. Therefore, having data rights that would allow the Air Force to modify the CV-22 internally would create a more efficient, less expensive process for completing alterations. Furthermore, having access to these data rights would help prevent obsolescence within the fleet by allowing for outdated or unsupported parts to be replaced.

The Air Force is faced with several data rights challenges related to the technical data for the CV-22 Osprey. First, as mentioned, Bell Boeing and the military do not agree on what should be considered FFF or OMIT data. The Air Force is entitled to FFF and OMIT data for systems it has purchased, regardless of whether the product was developed with Air Force funding.[151] Although it is clear that the Air Force has a right to both the FFF and the OMIT data for the CV-22, it is less clear what data these rights encompass. Second, some of the software data have been delivered with inappropriate restrictive markings. Third, the Air Force's current data rights do not protect the CV-22 from obsolescence. The data rights issues have delayed system upgrades and modifications and prevented the proper maintenance of the CV-22.

Boeing's system for storing and editing technical data is a major point of contention between Boeing and the Air Force. Following the consolidation of Boeing and McDonnell Douglas, Boeing integrated both companies' process and material specifications into a single, streamlined system. The new system uniformly applies edits in technical specifications across the entire avionics system. Boeing used overhead to develop this data system and therefore considers all data maintained on this system to be exclusive to Boeing, regardless of the avionics systems' source of funding. Because the technical data for the CV-22 are maintained exclusively on

[151] U.S. Army Product Data and Engineering Working Group, 2015, p. 15.

Boeing's proprietary system, Boeing claims that it should not have to distribute this information to AFSOC. Therefore, Boeing contests the Air Force's rights to FFF and OMIT data for the CV-22, even though the CV-22 was developed using government funds.

AFSOC has also faced problems regarding incorrect markings that Bell Boeing has placed on software deliverables. Restrictive data markings can be applied only to software that was developed without government funding.[152] However, Bell Boeing has incorrectly placed restrictive markings on some software, severely limiting AFSOC's ability to utilize and maintain the CV-22. Furthermore, because of the vast number of data associated with the CV-22 system, AFSOC has had problems reviewing and disputing the incorrect markings within the provided time frame. As a result, some software is still incorrectly marked as restricted following the review period. To protest these markings, AFSOC would have to litigate against Bell Boeing, a time-consuming and expensive process. This makes the inaccurate placement of restrictive data markings on software a particularly difficult data rights issue to resolve.

Finally, AFSOC's current technical data package has not successfully prevented system obsolescence within the CV-22. Many of the parts that are used on the aircraft are no longer in production, and AFSOC does not have the associated rights for the obsolete parts that would allow it to provide the technical specifications to another manufacturer. The small size of the CV-22 fleet also provides additional challenges regarding the prevention of obsolescence. Although Boeing has access to the technical specifications for the parts on the CV-22, the limited number of aircraft makes the production of obsolete parts by the OEM prohibitively expensive. Similarly, AFSOC's measures to reverse engineer obsolete parts on the CV-22 have also proved to be very costly. Therefore, the Air Force needs to pursue additional data rights to prevent the obsolescence of the CV-22 fleet.

AC-130J

Program Background

The AC-130J Ghostrider was developed as a replacement for the AC-130U Spooky and AC-130W Stinger II gunships.[153] All these aircraft are modifications of the C-130 Hercules, a gunship that was developed by Lockheed in 1954 and used as both a transport plane and a gunship.[154] However, several generations of aircraft separate the AC-130J from the C-130. Currently, the MC-130J serves as the donor aircraft from which the AC-130J is modified.[155] The

[152] U.S. Army Product Data and Engineering Working Group, 2015, p. 15.

[153] U.S. Air Force, 2013.

[154] Lockheed Martin, undated.

[155] Jane's IHS, 2018c.

Air Force, in conjunction with Lockheed Martin, started to develop the AC-130J in 2012, with deliveries of aircraft beginning in 2017 and projected to end in 2021.[156]

The AC-130J is primarily used for strikes on enemy targets and is equipped with multiple weapons, including a 30-mm gun, a 105-mm howitzer, and guided munitions.[157] The Ghostrider is also equipped with features that improve versatility and allow for deployment in a wide range of combat situations. These features include GPS navigation and a color weather radar system.[158]

Technical Data and Software Issues

The Air Force has different data rights for different sections of the AC-130J. What rights the Air Force has access to depends on whether a particular component or system on the aircraft was developed with government funds.

Because the AC-130J is a modified version of the C-130J Super Hercules, it is considered to be a commercially derived aircraft. Until 1996, the C-130 was considered a commercial aircraft as Lockheed developed the craft using internal funding. After 1996, the government provided the funding used to develop the new systems on the aircraft. Although the C-130J was developed following the change in the C-130's status, it shares many of its basic elements with the C-130.[159] Those elements have limited data rights associated with them because they were developed with Lockheed's funds.

The Air Force has government purpose or unlimited data rights for the aspects of the AC-130J, which were developed specifically for AFSOC. These elements are typically modifications to the existing aircraft that allow for the aircraft to better complete special operations. The systems to which the government has unlimited data rights include the precision strike package, the weapon system, and the heads-up display.

The Air Force needs access to the data rights for the AC-130J that allow for maintenance of the aircraft and prevent system obsolescence. Access to these data rights would allow the AC-130J to be maintained at Air Force depots. Furthermore, parts that are no longer supported by suppliers could be outsourced and replaced. Access to data relevant to these two goals would decrease the total cost of maintenance for the AC-130J and would allow for improved sustainment and support of the gunship.

The Air Force faces several problems with regard to the AC-130J's data rights. These issues limit the Air Force's ability to easily and organically implement its goals of maintaining and modifying its fleet of AC-130J gunships.

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[156] Jennings, 2012; U.S. Air Force, 2013.

[157] U.S. Air Force, 2013.

[158] U.S. Air Force, 2013.

[159] Jane's IHS, 2018c.

First, the Air Force has limited rights to some of the elements of the AC-130J, as it is considered to be a modified commercial airplane. As a result, the maintenance technical manuals for the AC-130J are written for the commercial support of the C-130, not for the military's support of the AC-130J. Lockheed is responsible for the revision and modification of the aircraft's maintenance technical manuals and charges $900 per page for biannual updates. More-frequent modifications to the technical manual are more expensive. Therefore, any modification to the AC-130J leads to significant costs associated with editing the technical manual, as multiple pages must be modified to accommodate for the change to the aircraft. The commercial nature of the C-130 therefore creates issues in the modification and maintenance of the airplane by creating additional costs with regard to approved modifications.

Lockheed Martin has heavily integrated itself into the production process of the AC-130J, making it difficult to modify or repair the aircraft without Lockheed's direct permission. Subsystems that are not produced by Lockheed are frequently integrated into subsystems that were developed by Lockheed. This means that virtually all modifications and repairs to the AC-130J require information on Lockheed's systems. In particular, systematic integration affects the Air Force's ability to modify the AC-130J to better meet AFSOC's needs on special operations.

For example, the Air Force has difficulties modifying the displays on the mission operation pallet, as any changes to the display system must be approved by Lockheed. This delays the implementation of the updated display system.

The hull modification needed to mount the 105-mm howitzer onto the AC-130J is another example of Lockheed's system integration leading to delays in the implementation of modifications. Lockheed stipulates that it must approve any hull modification to the AC-130J as it has been modified from a commercial aircraft and therefore uses commercial hull strength standards. Therefore, the Air Force must send the aircraft back to Lockheed for recertification of the hull strength. Although Lockheed's integration throughout the AC-130J may not prevent the Air Force from modifying or maintaining the aircraft, it may delay the implementation of these procedures.

Furthermore, the software data that have been provided by Lockheed have proprietary markings on them that restrict the Air Force's ability to effectively utilize the software. The Air Force is in the process of negotiating for software data that do not have restrictive markings on them, but the process is slow. As a result, the government still has relatively restricted access to Lockheed's software on the AC-130J and must either negotiate with Lockheed or the supplier for access to the data.

The supply chain for the AC-130J is very opaque and tightly controlled by Lockheed Martin, so it is difficult for the Air Force to negotiate for data rights down the supply chain. Therefore, AFSOC remains heavily dependent on the OEM approval to modify or repair the aircraft. More transparency within the supply chain could allow the Air Force to negotiate for data rights with the individual suppliers and could lead to more-flexible maintenance and upgrade regimes for the AC-130J.

MC-130J

Program Background

The MC-130J Commando II is an update of the MC-130P Combat Shadow II that serves to refuel AFSOC's fleet of vertical and tiltrotor aircraft. The aircraft can also deliver troops and supplies into areas that are inaccessible to conventional aircraft.[160] This duality increases the MC-130J's versatility during special operations.

The Air Force awarded Lockheed Martin the contract for the production of the MC-130J in 2008.[161] Delivery of the aircraft began in 2011 and was projected to end in 2017 with a planned total of 37 MC-130J aircraft to be produced during this time frame.[162] However, the contract for the MC-130J was modified to allow for the production of additional aircraft. As of the end of FY 2017, 57 MC-130J aircraft had been produced, with additional aircraft in production.[163] The Air Force plans to receive a total of 97 aircraft by 2023.

The MC-130J is modified from the C-130J Super Hercules, itself modified from the C-130 Hercules, and serves as the base aircraft from which the AC-130J is modified. The Air Force plans to modify part of its fleet of MC-130Js into AC-130Js, a process that involves modifying the aircraft's hull to support the 105-mm howitzer used on the AC-130J. The additional alterations are scheduled to be completed by 2030.

Technical Data and Software Issues

The MC-130J has data rights and needs similar to those of the AC-130J, as they are both derivatives of the C-130J Super Hercules, itself a derivative of the C-130 Hercules. As with the AC-130J, the Air Force needs access to the MC-130J's technical data in order to maintain the fleet, to modify the fleet, and to prevent the obsolescence of the aircraft.

Both the MC-130J and the AC-130J are modifications of the C-130 that Lockheed Martin considers to be a commercially derived aircraft. As a result, AFSOC has limited data rights to the sections of the MC-130J that were exclusively developed using Lockheed funds. This includes the structural data for the MC-130J, which means that any modifications to the airframe requires Lockheed approval.

The Air Force has unlimited or government purpose data rights for the sections of the MC-130J system that were developed using government funds. Because the majority of the modifications that turned the C-130J system into the MC-130J system were funded by the

[160] U.S. Air Force, 2011.

[161] *Air Force Technology*, 2018.

[162] *Air Force Technology*, 2018.

[163] Jane's IHS, 2018c; meeting with AFSOC AC-130J team, January 17, 2018.

government, the Air Force has unlimited or government purpose data rights for the majority of the system-specific features of this aircraft.

Many of the data rights challenges that face the AC-130J are applicable to the MC-130J, as they are both derivatives of the C-130 Hercules. Some common data rights issues shared by both aircraft are the lack of access to systems developed by Lockheed Martin, the opacity of Lockheed's supply chain, and the plurality of applications for the aircraft.

AFSOC also has problems updating or modifying the software used on the MC-130J, as the Air Force did not ask for delivery of documentation for the C-130J's software, which Lockheed funded with its own corporate money. The Air Force paid to develop software for use on both the AC-130J and the MC-130J at the software integration lab at Robins Air Force Base in Warner Robins, Georgia. However, the Air Force lacks the documentation that would allow it to test the new software's ability to integrate with C-130J software. As a result, the Air Force must send the newly developed software to Lockheed's software integration laboratory to be tested in conjunction with the existing software and systems used on the aircraft. The lack of data rights therefore increases the time it takes to develop a new software program for the MC-130J.

SKR

Program Background

SKR is a radar system developed by Raytheon for SOCOM. SOCOM provided a sole-source contract to Raytheon for the development of the SKR system. As initially awarded in 2006, the contract provided $164 million to Raytheon for the development of SKR, but the amount awarded increased to $200 million in 2015.[164] Raytheon received a $97 million contract in June 2019 for initial production of the SKR. Low-rate initial production is expected to be completed by October 2022.[165]

SKR was developed for use on specific aircraft within SOCOM's fleet. These aircraft are the Lockheed Martin MC-130J, the Boeing MH-47G, the Sikorsky MH-60M, and the Bell Boeing CV-22.[166] However, as AFSOC also flies these aircraft, SKR can be applied to both AFSOC's and SOCOM's fleets of special operations aircraft.

The radar system provides the aircraft a better image of the terrain and aerial space surrounding the aircraft. In particular, the SKR system allows for aircraft to fly close to the ground in otherwise unfavorable conditions, increasing the stealth of the aircraft and decreasing

[164] Jane's IHS, 2018d.

[165] *Defense Industry Daily*, 2020.

[166] Keller, 2017.

the aircraft's risk of interception.[167] These capabilities provide SOCOM and AFSOC aircraft with more flexibility regarding the conditions in which they can fly.

Technical Data and Software Issues

SKR was developed using government funding and for government use. Therefore, the government maintains unlimited or government purpose data rights for the SKR system.[168]

To properly implement SKR, SOCOM and AFSOC need to have control of the data rights that would allow for internal sustainment of the radar and prevent obsolescence. In theory, the government's unlimited and government purpose rights would allow for these functions to be fulfilled. However, as discussed in the following section, the military faces several barriers, in part, because it did not acquire data deliverables.

Because SKR was developed using exclusively government funds, AFSOC is entitled to either government purpose or unlimited data rights for the system's technical data.[169] However, technical data were not included as a deliverable in the contract for SKR, and Raytheon has not complied with requests to provide technical data to the government. In particular, Raytheon expects the government to provide additional funds in order to receive the technical drawings and other specific technical data for the system. The additional data provided would be sufficient to maintain the radar and prevent system obsolescence. The OEM has indicated that the delivery of the technical data would cost the government at least $50 million. Given that the original contract with Raytheon totaled $200 million, the addition of technical data as a deliverable would increase the total cost of development for the project by a minimum of 25 percent.

Both AFSOC and SOCOM require additional technical data for the SKR system to maintain or modify it. In general, this means that Raytheon needs to provide more-specific technical information to the military. However, different data are needed for the two commands because of each command's distinct applications for the radar, so it is unlikely that this information could be provided as a cohesive unit. Currently, AFSOC and SOCOM are both using money provided to SOCOM for the sustainment of SKR to bargain with Raytheon for the needed technical data. Ideally, both units would be able to receive the necessary information without further payment.

AFSOC and SOCOM are also particularly interested in technical data that would allow for organic maintenance of the SKR system. Currently, all repairs must be completed by Raytheon. However, organic maintenance would allow the Air Force to modify or repair the radar system without returning it to Raytheon. Because the radar system will be deployed globally in various theaters of action, it will be difficult to return deployed SKR systems to Raytheon facilities, which are located within the United States, for repair or routine maintenance. Because of the mission-critical nature of the radar system, it is imperative to fix the SKR system quickly and

[167] Keller, 2017.

[168] U.S. Army Product Data and Engineering Working Group, 2015, p. 15.

[169] U.S. Army Product Data and Engineering Working Group, 2015, p. 15.

effectively when broken. Therefore, it would be more convenient and timely for AFSOC and SOCOM to fix the system abroad instead of shipping the system back to Raytheon. However, the Air Force needs additional technical data to properly implement this maintenance system.

KC-46

Program Background

In February 2011, the Air Force awarded Boeing a contract to develop the KC-46 Pegasus as a replacement for the aging KC-135 refueling tanker.[170] Boeing was provided with a conditional contract to produce up to 179 tankers, allowing for continued, incremental purchase of these aircraft by the Air Force.[171] This provided the Air Force with flexibility regarding the implementation of the new KC-46 refueling tankers, as the new tankers could gradually replace the KC-135 Stratotanker.

The new aircraft create a more modern and versatile fleet of refueling tankers within the Air Force. In particular, the Pegasus integrates both hose and drogue and boom refueling technology into its refueling systems.[172] Therefore, planes with either type of refueling system can use the same tanker to refuel, allowing for the KC-46 to better service aircraft in need of refueling.

The KC-46 also attempts to integrate modern computing technology into its aerial refueling systems. For example, the plane uses high-resolution cameras in its boom refueling system.[173] These advanced features help the tankers refuel a diverse array of aircraft. However, these changes also increase the complexity of the aircraft, which translates into higher overall costs and a greater volume of technical data.

Technical Data and Software Issues

Currently, the Air Force has limited or restricted rights to most of the items on the Pegasus due to the aircraft's commercial nature. Boeing modified the 767, a commercial airplane, to produce the KC-46. Therefore, the body of the airplane and the majority of the avionics on the KC-46 are from the 767, and Air Force should have limited rights to most technical data for these commercial elements.[174] However, the Air Force has unlimited rights to OMIT and FFF data and negotiated with Boeing to receive such data.[175]

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[170] Drelling, 2012.

[171] GAO, 2018.

[172] GAO, 2018.

[173] Boeing, undated.

[174] Jane's IHS, 2018b; U.S. Army Product Data and Engineering Working Group, 2015, p. 15.

[175] KC-46 Modernization Directorate, 2017, slide 3.

To effectively utilize the KC-46, the Air Force needs to have technical data and rights that allow for routine maintenance and the prevention of parts obsolescence. This would allow the Air Force to repair the aircraft at Air Force depots. Currently, the Air Force does not need technical data or rights that would allow for the modification of the KC-46.

The Air Force faces several challenges regarding its ability to negotiate further data rights for the KC-46. These challenges fall into two main categories. First, Boeing placed restrictive markings on the software for the KC-46 tanker. This means that the Air Force currently has only limited rights to the technical data package on the KC-46. Second, because of the opacity of Boeing's supply chain for the tankers, it is unclear what data rights the Air Force has down the supply chain. This leads to problems regarding the maintenance of the KC-46 and the prevention of system obsolescence.

The KC-46 Pegasus's status as a modified commercial aircraft affects the data rights to which the Air Force is entitled. For commercial aircraft developed using private funds, the Air Force is guaranteed a minimum of limited rights for acquisitions and further has unlimited rights to OMIT data. However, Boeing and the Air Force disagree about what should be considered OMIT data. It is currently unclear how this dispute will be resolved. This causes continued uncertainty regarding the ability of the Air Force to maintain the KC-46 fleet.[176]

Another challenge associated with the Air Force's acquisition of additional data rights for the KC-46 is the opacity of Boeing's supply chain. According to Boeing, the KC-46 will have more than 800 suppliers, most of whom are unnamed.[177] This makes negotiating for data and data rights through the tiers of suppliers difficult, as the majority of the suppliers are anonymous. Because of the size of Boeing's supply chain, it would be nearly impossible for the Air Force to locate the producer of a particular part or program. Instead, the Air Force must negotiate with Boeing.

The complexity of Boeing's supply chain for the KC-46 also affects the software rights that the Air Force receives from Boeing. Subcontractors frequently provide Boeing with software with restrictive markings. Boeing then passes these restrictive markings on to the Air Force. This affects the Air Force's ability to negotiate for software rights, as neither the Air Force nor Boeing has unrestricted access to the software.[178] However, the contract for the KC-46 states that the software provided to the Air Force by Boeing should not include restrictive data markings.[179] Therefore, the restrictive markings on the KC-46 software are in violation of the contract and should be removed. Boeing needs to work with its suppliers to remove the unsupported restrictive markings from the software.

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[176] KC-46 Modernization Directorate, 2017, slide 3.

[177] Barksdale, 2011.

[178] KC-46 Modernization Directorate, 2017, slide 8.

[179] KC-46 Modernization Directorate, 2017, slide 8.

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PROJECT AIR FORCE

The small fleets of specialized aircraft operated by Air Force Special Operations Command (AFSOC) need to be modified quickly to address new threats as they arise. To do this, AFSOC depends heavily on the original equipment manufacturers (OEMs) of its core military aircraft assets and their subsystems for life-cycle support. But AFSOC has grown dissatisfied with the support it is getting from the OEMs in terms of technical data. AFSOC believes that better access to technical data could improve competition for sustainment services or enable the U.S. Air Force to establish organic maintenance capabilities.

To make use of a contractor's technical data, the U.S. government must satisfy two conditions. First, the government must have the appropriate license rights. Standardized data rights are based on the source of funding used to create the data. Second, the government must actually possess the data it seeks to use. Securing the data themselves is as important—if not more so—as having the appropriate data rights.

In the programs the authors examined, they found limited understanding of the role of data rights and deliverables. In some cases, government personnel inappropriately acceded to contractor claims about what rights the government could acquire. In others, personnel acquired the appropriate data rights but failed to list technical data as deliverables or failed to take delivery of technical data before relevant contract authority expired. Still in other cases there were disputes between the government and contractors over rights. Lack of access to relevant technical data complicated these programs' abilities to sustain their weapon systems.

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