An Overview of Acquisition Reform Cost Savings Estimates

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SUMMARY

INTRODUCTION AND ACQUISITION REFORM MEASURES TAXONOMY

This report supports a larger RAND project entitled "The Cost of Future Military Aircraft: Historical Cost Estimating Relationships and Cost Reduction Initiatives." The purpose of the project is to update the technical cost models and cost estimating relationships (CERs) for fixed-wing combat aircraft in light of R&D, manufacturing, organizational, and programmatic advances and reforms that have taken place over the past decade. Taking into account the potential overlap of claimed savings resulting from new (post-1990) aircraft design and manufacturing initiatives (especially for advanced airframe materials), acquisition reform, and lean implementation, the RAND project divided the research effort into five areas:[1]

1. New fabrication and assembly processes related to advanced airframe materials;[2]
2. Government changes in acquisition processes or changes in the relationship between the government and Department of Defense (DoD) prime contractors, generally included under the rubric of "acquisition reform";

[1]See Appendix A for a listing of all military aircraft initiatives addressed in three of these reports.

[2]Obaid Younossi, Michael Kennedy, and John C. Graser, *Military Airframe Costs: The Effects of Advanced Materials and Manufacturing Processes,* Santa Monica: RAND, MR-1370-AF, 2001.

3. Lean implementation and other initiatives oriented primarily toward processes within a prime airframe manufacturer or relationships between these primes and their suppliers;[3]
4. Technology and process improvements in military avionics development and manufacturing, especially as they relate to the Joint Strike Fighter (JSF);[4] and
5. Technology and process improvements in military aircraft engines (research in progress).

This report covers research on acquisition reform (AR). Its purpose is to determine whether published estimates in the literature are sufficiently robust to contribute to the development of adjustment factors for use in predictive cost models that reflect the effects of AR on the costs of developing and producing fixed-wing combat aircraft. The report reviews a wide range of published estimates and projections of claimed savings that may arise from a variety of weapon system AR measures. However, no independent RAND estimates of potential AR cost savings have been generated, nor have any of the published estimates been analyzed. Rather, the existing estimates are grouped into logical categories and compared, and the variations, historical origins, and relative quality of these estimates are discussed. In addition, the report presents the views of numerous prime contractors on potential AR cost savings, all derived from a series of interviews conducted in 1998.[5]

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[3]Cynthia R. Cook and John C. Graser, *Military Airframe Acquisition Costs: The Effects of Lean Manufacturing,* Santa Monica: RAND, MR-1325-AF, 2001.

[4]Mel Eisman, Jon Grossman, Joel Kvitky, Mark Lorell, Phillip Feldman, Gail Halverson, and Andrea Mejia, *The Cost of Future Military Aircraft Avionics Systems: Cost Estimating Relationships and Cost Reduction Initiatives,* Santa Monica: RAND, limited document, not for public distribution, 2001.

[5]Industry sites visited by RAND include Boeing Military Aircraft and Commercial Aircraft, Seattle, Washington; Boeing McDonnell Military Aircraft and Missile Systems, St. Louis, Missouri; British Aerospace Military Aircraft and Aerostructures, Warton and Samlesbury, United Kingdom; DaimlerChrysler Aerospace Airbus GmbH, Bremen, Germany; DaimlerChrysler Aerospace AG Military Aircraft, Munich, Germany; Lockheed Martin Aeronautical Systems, Marietta, Georgia; Lockheed Martin Skunk Works, Palmdale, California; Lockheed Martin Tactical Aircraft Systems, Fort Worth, Texas; Northrop Grumman Electronic Sensors and Systems Sector, Baltimore, Maryland; Northrop Grumman Integrated Systems and Aerostructures, Air Combat Systems, El Segundo, California; Northrop Grumman Integrated Systems and Aerostructures, Dallas, Texas; Northrop Grumman Integrated Systems and

The report concludes that on the whole, there is insufficient evidence in the published literature to support the development of precise adjustment factors for AR cost savings that can be used with confidence in technical cost models for military combat aircraft. At the same time, our research suggests that at least in some categories of AR measures, rough order-of-magnitude (ROM) estimates or "rules of thumb" for potential AR cost savings can be developed that may be of use to cost estimators in limited circumstances.

There is a vast body of literature on AR that covers a wide variety of measures. As a result, our first task was to develop a taxonomy of AR measures that would provide a rational ordering and coherent linkage between these various measures. Table S.1 presents our taxonomy of current major AR measures and initiatives, which was developed for the purpose of assigning published cost savings estimates to specific elements. As indicated in Table S.1, we suggest three major AR categories: (1) reducing regulatory and oversight burden; (2) commercial-like program structure; and (3) multiyear procurement. Table S.1 also presents subelements of the second category together with suggestions on how these subelements might be linked to the main category.

The tables that follow summarize the data presented in this report on published AR cost savings estimates and projections. The many assumptions underlying each estimate and the numerous caveats included in the body of this report are not repeated here. It is important to note, however, that these estimates vary considerably in both quality and methodology and must therefore be used with caution. A detailed reading of the main text of this report is necessary to clarify the many limitations and caveats that must be applied in their use.

Most of the following tables have a column labeled "estimate quality." This column distinguishes between three types of estimates. The highest-quality estimate, labeled "actuals," signifies that the estimate of AR savings was based on actual R&D and production cost data from the specific item under consideration, compared to earlier actuals for the program prior to the imposition of acquisition re-

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Aerostructures, Hawthorne, California; Raytheon Aircraft, Wichita, Kansas; Raytheon Sensors and Electronic Systems, El Segundo, California; and Scaled Composites, Inc., Mojave, California.

forms. Virtually none of the estimates available during the course of this research effort was of this type.[6] The second-highest-quality estimate, labeled "forecast," refers primarily to a narrow set of cases in which actual production costs for the specific article are well known but the program is being restructured in a way that is expected to reduce costs. This applies mainly to estimates of multiyear production contract savings. The third-highest-quality estimates, labeled "analysis," are made in situations where no actual costs are available for the specific item. In such cases, the anticipated pre-AR cost of a specific item, which has not yet been fully developed or entered into production, is compared to the expected cost of that item after the imposition of AR—in other words, neither the actual cost of the item under the old system nor the actual cost of the item after the imposition of AR is known. This type of estimate is based on rational analysis, past experience, data from analogous military or commercial programs adjusted to the system under examination, expert opinion, or similar methods.

Almost all the AR cost savings estimates collected in this report fall into the category of "analysis." That is, they are not based on actual data for the specific system or program structure in question, either before or after AR. This is another key reason these estimates must be treated with extreme care.

SUMMARY OF THE DoD REGULATORY AND OVERSIGHT COMPLIANCE COST PREMIUM ESTIMATES

The DoD regulatory and oversight compliance cost premium refers to the additional costs that the DoD is alleged to pay to contractors to cover the added cost of complying with the vast array of regulations and requirements imposed on the contractor by the government. This cost is alleged to be over and above what the same item would

[6]See the subsequent discussion on actuals.

Table S.1

A Taxonomy of AR Measures

1. **Reducing Regulatory and Oversight Compliance Cost Premium**
2. **Commercial-Like Program Structure**
   - A. Emphasis on CAIV[a] through the use of:
     - (1) Unit price thresholds, unit price targets
     - (2) Production price requirement and commitment curves + carrots/sticks in final down-select and in production contract (including warranties, etc.)
     - (3) Competition
   - B. Enable CAIV through emphasis on:
     - (1) Requirements reform
       - (a) No "overdesigning"[b]
       - (b) Prioritized tradable performance/mission requirements (threshold requirements, etc.)
     - (2) Contractor configuration control, design flexibility
     - (3) Commercial insertion/dual use,[c] which is made possible by
       - (a) Mil spec reform[d]
       - (b) Government-industry IPTs[e]
3. **Multiyear Procurement**[f]

[a]CAIV is an acronym for "cost as an independent variable." The basic concept of CAIV is that it raises rigorous production-unit cost goals to the same priority level as performance and other key system goals during the design and development phases of a weapon system. As such, it is similar to the "must cost" goals that commercial aircraft transport developers and other commercial firms impose on their designers, engineers, and subcontractors when they initiate the development of a new system. More is said on the CAIV concept in subsequent sections of this report.

[b]A more familiar term that could have been used in this context is "gold plating." This term was rejected, however, because some observers associate it with less-than-objective journalistic critiques of the defense acquisition process. The term "overdesigning" as used here means to design into a weapon system capabilities or attributes that may not be worth the extra expense or that are not essential to meeting the mission requirements.

[c]"Commercial insertion" refers to the use of commercial off-the-shelf (COTS) technologies, processes, parts, components, subsystems, and/or systems in weapon systems. The term also refers to the use of "ruggedized" or "militarized" COTS products. "Ruggedization" signifies the special packaging or other hardening of COTS products to permit them to function in harsh military environments. "Dual use" refers to technologies, manufacturing facilities, and products that are known to have or may have both commercial and military applications.

[d]"Mil spec" is an acronym for military specifications and standards.

[e]IPT = Integrated Product Team.

[f]"Multiyear procurement" refers to government authorization for the procurement of specific numbers of production systems beyond the normal single-year government procurement funding cycle. Multiyear procurement requires special congressional approval.

cost were it acquired in a purely commercial environment by a civilian customer. Table S.2 summarizes several late-1980s and early-1990s DoD cost premium estimates that typify those used by early advocates of AR.

As Table S.2 indicates, early estimates vary considerably in quality and methodology, and none are directly comparable. Most are based on expert opinion, anecdotal information, or projections derived from commercial analogies that may or may not be appropriate. For the most part, such estimates could thus be characterized as informed guesses. Some of these estimates include potential cost savings from factors other than the reduction in compliance costs, such as cost benefits gained from using commercial technologies and parts. However, it is not always clear whether such factors are included in the estimates.

Table S.3 summarizes the most important estimates of the DoD regulatory and oversight compliance cost premium. These estimates are based on actual data derived from Coopers & Lybrand (C&L) and other studies conducted during the initial phases of the current AR reform effort. It should be noted, however, that these estimates are based on limited data and on varying methodologies. In addition, the methodologies they employ are not always fully transparent and may be open to criticism. Moreover, the raw data on which the estimates are based are seldom available. To be fully understood, this table thus requires a full reading of the main text of this report.

We believe that the most reliable of the studies outlined in Table S.3 suggest potential savings from DoD regulatory and oversight relief in the range of 1 to 6 percent. We further suggest that this range, with an average of 3.5 percent, is a reasonable ROM or "rule-of-thumb" estimate for potential savings from eliminating the DoD regulatory and oversight compliance cost premium. If one is to obtain the full benefit of savings from regulatory and oversight relief, however, the consensus view is that virtually all burdensome regulations and

Table S.2

Early Subjective Estimates of the DoD Regulatory and Oversight Compliance Cost Premium[a]

Study	Date	Estimated DoD Cost Premium/Potential Cost Savings (%)
Honeywell defense acquisition study (20 programs, contractor costs)	1986	13
RAND OSD regulatory cost study (total program costs)	1988	5–10
OTA industrial base study (total DoD acquisition budget)	1989	10–50
CSIS CMI study[b] (cost premium on identical items)	1991	30
Carnegie Commission (total DoD acquisition budget)	1992	40
ADPA cost premium study (product cost)	1992	30–50

[a]The full titles of these studies are as follows: *Defense Acquisition Improvement Study*, Honeywell, May 1986; G. K. Smith et al., *A Preliminary Perspective on Regulatory Activities and Effects in Weapons Acquisition*, Santa Monica: RAND, R-3578-ACQ, March 1988; Office of Technology Assessment, *Holding the Edge: Maintaining the Defense Technology Base*, Vol. II Appendix, Washington, D.C.: USGPO, April 1989; *Integrating Commercial and Military Technologies for National Security: An Agenda for Change*, Washington, D.C.: Center for Strategic and International Studies, April 1991; *A Radical Reform of the Defense Acquisition System*, Carnegie Commission on Science, Technology, and Government, December 1, 1992; and *Doing Business with DoD—The Cost Premium*, Washington, D.C.: American Defense Preparedness Association, 1992.

[b]CMI = Civil-military integration.

oversight must be removed from all programs and by all government customers for each major government contractor or contractor facility. Because of these limitations and caveats, it is probably not appropriate to use 3.5 percent as a technical adjustment factor in mathematical models that employ empirically tested CERs.[7]

[7]See Concluding Observations in Chapter Seven of this report.

Table S.3

Data-Based Estimates of the DoD Regulatory and Oversight Compliance Cost Premium

Study or Program and Date[a]	C&L Top 10 Cost Drivers (%)	C&L Top 24 Cost Drivers (%)	Overall Cost Premium or Savings Potential (%)	Estimate Quality
C&L (1994)	8.5	13.4	18	Forecast
NORCOM (1994)			27	Forecast
DoD Regulatory Cost Premium Working Group (1996)		6.3		Forecast
DoD Reinvention Lab (1996)	1.2–6.1			Forecast
SPI (1998)			0.5	Limited actuals
WCMD (1996) (CDRLs only)			3.5 (R&D)	Analysis
FSCATT (1995)			2	Analysis
B-2 Upgrade (CDRLs only)			2.3	Forecast

[a]SPI = Single-Process Initiative; WCMD = Wind-Corrected Munitions Dispenser; CDRL = Contractor Data Requirements List; FSCATT = Fire Support Combined Arms Tactical Trainer.

This report also examines nongovernment and General Accounting Office (GAO) estimates of overall DoD AR program savings from the early stages of the Clinton administration reform efforts (see Table S.4). These studies are based largely on comparisons of overall program budget data and on projections from different fiscal years or periods. For the most part, they offer little or no breakout of specific AR measures or of how and to what extent such measures might have contributed to the changes in estimates. It is not unreasonable to assume that most of the reported actual savings (as opposed to the reported future cost avoidance beyond FY01) was due to reductions in

the DoD regulatory and oversight burden.[8] We conclude this for two reasons:

- Most of the programs examined for these estimates and projections had been under way for some time as traditional programs before AR; and
- More radical programmatic acquisition reforms had not been fully implemented at the time the studies collected data.

Although these estimates are not directly comparable either to each other or to earlier estimates of the potential DoD regulatory and oversight reform cost savings, we believe that they add some support to the notion that the DoD regulatory and oversight cost burden is in the range of 1 to 6 percent.

Table S.4

Summary of Initial Assessments of Overall DoD AR Savings (in percentages)

Study and Date	FY95–FY01	1996	FY95–FY02	Estimate Quality
RAND (1996)	4.4			Forecast
MIT (1997) (average of 23 MDAPs)[a]		4.3		Forecast
GAO (1997) (average of 33 MDAPs)			–2[b]	Forecast
GAO (1997) (average of 10 MDAPs with cost savings)			4	Forecast

[a]MDAP = Major Defense Acquisition Program.

[b]This estimate does not dispute the existence of cost savings from AR for these programs. Rather, it suggests that on average, cost savings are often offset by cost increases elsewhere or by reinvestment.

[8]The projections of future cost avoidance are obviously just estimates based on past experience.

Given the uncertainties and ambiguities inherent in the data available on DoD regulatory and oversight cost savings, how should cost estimators use this information? We have concluded that it is reasonable to assume program savings of 3 to 4 percent due to reductions in the regulatory and oversight burden. In other words, if one is using a pre-AR (pre-1994) program as an estimating analogy for a similar new program, it is reasonable to assume cost reductions at the program acquisition level of 3 to 4 percent due to reductions in the regulatory and oversight burden. However, if the cost analysis is developed using prior program direct or indirect labor hours, most of the AR savings from reductions in regulatory and oversight burdens should already be reflected in the negotiated forward pricing rate agreements (wrap rates), so no further adjustment would be warranted in the rates themselves. This is because most regulatory burden cost savings are in the area of indirect costs and should thus show up in overhead cost savings. Because AR has been in existence since 1995, most of the realizable reductions in regulatory and oversight burdens should already have been calculated between the contractor and the Defense Contract Management Agency (DCMA). This assumes, however, that a comprehensive program of relief from DoD regulatory and reporting requirements has been applied to all the programs of a specific contractor or to all the programs at a specific facility. This, of course, is not actually the case.

AR reductions between suppliers and the prime may have to be assessed separately, as factors such as regulatory flow-down and the cost effects of strategic supplier relationships must be taken into account. Although AR has focused mainly on interactions between the government and the primes, there may be areas between primes, subcontractors, and suppliers that result in further savings due to reductions in regulatory and oversight burdens.

SUMMARY OF SAVINGS FROM COMMERCIAL-LIKE AR PILOT PROGRAMS

Commercial-like AR pilot programs exhibit a complex mixture of the numerous reform measures that are outlined in Table S.1 and discussed in detail in the body of this report. The purpose of these measures is to structure weapon system acquisition programs so that the incentives provided to contractors are more like those found in

commercial R&D and production programs. These measures seek to incentivize the contractor to focus on cost as a primary objective and to use commercial standards, technology, parts, and components.

It is critical to note that the claimed savings from these programs are based on comparing estimated projected costs before the imposition of AR measures with estimated projections following the imposition of AR measures. Few are based on hard data. That is, few of the estimates contain actuals, or actual cost data based on real work undertaken during product development and production. Most of the estimates were made before the beginning of system development or in the early phases of development. Even in cases where actuals were used in order to show claimed AR savings, the actuals were compared to an earlier estimate that was only a forecast and that itself was not based on actuals (i.e., on the actual pre-AR costs of the item). These estimates must therefore be viewed with extreme caution. Table S.5 summarizes the cost savings estimates from these programs.

The data in Table S.5 suggest that R&D savings in the range of 15 to 35 percent may be possible in programs that are fully restructured in a commercial-like manner in accordance with the concepts of cost as an independent variable (CAIV), as discussed in great detail in the body of this report. The likely scale of anticipated production savings is much more uncertain. However, the three best-documented cases—Joint Direct Attack Munition (JDAM), Wind-Corrected Munitions Dispenser (WCMD), and Joint Air-to-Surface Standoff Missile (JASSM)—suggest that savings of up to 65 percent are possible, at least in programs for less complex systems with high production runs.

Some additional qualifications must be noted in discussing these outcomes. First, the reforms used in these pilot programs have not been widely used as an integrated package outside these AR demonstration programs. Furthermore, many AR pilot programs are relatively small and are characterized by low technological risk, commercial derivative items, and large production runs. Thus, the scale of potential cost benefits for a large, complex weapon system that employs high-risk, cutting-edge technology remains uncertain. Finally and most significantly, several of these programs have only

Table S.5

Summary of Savings from AR Pilot and Demonstration Programs[a] (in percentages)

Program[b]	Program Savings (%)	R&D Savings (%)	Production Savings (%)	Estimate Quality
JDAM		15	60	Forecast
WCMD		35	64	Forecast
JASSM	44[b]	29	31	Analysis
EELV		20–33	25–50	Analysis
SBIRS		15		Analysis
FSCATT	13.5	16–34	7	Analysis
JPATS	18.9[c]	13.6	–26.6[d]	Analysis
Tier III-		20		Analysis
Tier II+		3		Analysis
ASP		30		Analysis
AAAV			10–20	Analysis

[a]Note the important qualifications explained in main text.

[b]EELV = Evolved Expendable Launch Vehicle; SBIRS = Space-Based Infrared System; JPATS = Joint Primary Aircraft Training System; ASP = Arsenal Ship Program, AAAV = Advanced Amphibious Assault Vehicle.

[c]Overall program cost savings claimed by the DoD, March 1999.

[d]Despite a large increase in production costs, overall program costs declined significantly because of a large anticipated reduction in operations and support (O&S) costs. In March 1999, the DoD claimed an overall JPATS contract cost savings of 49 percent.

recently entered the low-rate initial production (LRIP) stage; the majority have not even completed engineering and manufacturing development (EMD).

Our detailed review of several AR pilot programs, as well as the consensus views we gleaned from extensive RAND interviews with industry and government representatives, provided additional insights regarding cost savings from the commercial-style program structures discussed above:

- Requirements reform (performance-based specifications) and CAIV ("must-cost" objectives used during EMD in the down-select decision) are crucial for cost savings. CAIV essentially entails a trade-off of technical capabilities against cost. The key to CAIV is avoiding "overdesigning" and retaining only mission-essential capabilities.

- Maximizing the use of commercial parts and technology in weapon systems to the extent that it does not compromise critical system performance capabilities has a high AR savings potential, especially in electronics.
- Requirements reform, regulatory reform, CAIV, and especially contractor configuration control are all necessary to motivate greater use of commercial parts and technology by contractors.
- Commercial-style programs with greater contractor cost sharing would be encouraged by reducing constraints on foreign sales and technology transfer.
- Commercial-like "must-cost" pricing goals combined with competition appear to incentivize contractors to control costs.
- Commercial-style R&D and production programs with contractor configuration control may require contractor logistics support once systems are fielded. The Air Force may face serious problems applying these types of AR reforms to large, complex platform development programs.
- True dual-use (commercial and military) utilization of production facilities on a system or major-subsystem level is still rare. Government regulations and technology differences remain significant barriers.
- The level of AR actually implemented on some government pilot programs has been less than some contractors had expected.

Given the lack of data and the many uncertainties and complexities that surround commercial-like AR programs, how should cost estimators deal with such programs? It is our view that if an acquisition program entails extensive civil-military integration (CMI) and insertion of COTS parts and technology, specific cost reductions need to be assessed as appropriate, probably at the purchased-materials and purchased-parts levels of a cost estimate. For programs such as JDAM and various avionics efforts that claim large savings from AR, vendor-supplied parts, components, boards, and the like account for as much as 80 to 90 percent of recurring costs. Yet there can be wide variations from one system or program to another. Thus, no easy rule of thumb can be applied in this area.

If separate and significant AR initiatives can be identified in specific programs, they should be evaluated individually and the results used to adjust the baseline cost estimate, assuming that the baseline is derived from historical, pre-AR costs. One of the most important AR initiatives is the extensive use of CAIV. However, once the final design configuration is determined and frozen following the CAIV process, the AR savings from CAIV would already be clearly reflected in the life cycle cost (LCC) baseline of the system. However, if a program entails significant contractor configuration control throughout EMD and production, a careful assessment of ongoing cost-saving opportunities and contractor incentives is warranted. Possible positive and negative operations and support (O&S) implications of contractor configuration and Total System Performance Responsibility (TSPR) need to be examined.

Table S.6

Summary of Multiyear Procurement Savings Estimates[a]

Program[b]	Production Savings (%)	Estimate Quality
F-16 (FY82–85)	10	Forecast
F-16 (FY86–89)	10	Forecast
F-16 (FY90–93)	5.5	Forecast
F-16 (FY99–02)	5.4	Forecast
CDE for C-17	8.2	Forecast
C-17 (airframe)	5.5	Forecast
Javelin ATGM	14.3	Analysis
MTVR	7.4	Analysis
CH-60 (U.S. Navy and U.S. Army)	5.5	Forecast
DDG-51 (FY98–01)	9	Forecast
F-22 (1996 CAIG/JET)	3.9–4.7	Analysis
F/A-18E/F (target)	7.4	Analysis

[a]Savings percentages include government investments for cost reduction initiatives for C-17 airframe and F/A-18E/F.

[b]CDE = Commercial Derivative Engine; ATGM = anti-tank guided missile; MTVR = Medium Tactial Vehicle Replacement; CAIG = Cost Analysis Improvement Group; JET = Joint Estimate Team.

SUMMARY OF MULTIYEAR PROCUREMENT SAVINGS ESTIMATES

Data and analytical forecasts based on past experience suggest that multiyear contracts can save roughly 5 percent, and possibly as much as 10 percent on production contracts. Table S.6 summarizes the data and forecasts that support this claim.

Again, it is important to mention a key caveat regarding the comparisons on which these and many other savings claims are made: Such claims are based on comparing preprogram estimates of the program costs on a year-to-year contract to a multiyear basis. Once a decision is made to follow one path or the other, the two can no longer be compared on an equivalent basis, as fact-of-life changes occur throughout a production program. The savings are thus based on the best estimates available at the time of the decision, not on any actual historical data for the path not chosen.

Based on the evidence collected here, and keeping in mind the caveats stated above, we conclude that multiyear contracts that are effectively implemented by the prime contractor and government customer can be expected to produce approximately 5 percent or greater savings compared to traditional programs. Multiyear contracts permit long-range planning by contractors. In addition, they permit larger buys of materials and parts, and allow for strategic relationships between primes and subcontractors. Therefore, multiyear contracting should inherently result in some cost savings. However, strategic sourcing relationships between primes, subcontractors, and suppliers fostered under lean manufacturing will have to be evaluated by cost estimators in conjunction with the multiyear savings to ensure that double counting is avoided.[9]

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[9]See Cook and Graser, *Military Airframe Acquisition Costs: The Effects of Lean Manufacturing,* for a discussion of strategic supplier relationships.