R-2184/1-AF
November 1977

# Peacetime Adequacy of the Lower Tiers of the Defense Industrial Base

Geneese G. Baumbusch and Alvin J. Harman

A Project AIR FORCE report
prepared for the
United States Air Force

Rand
SANTA MONICA, CA. 90406

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Published by The Rand Corporation

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# PREFACE

The research described in this report was undertaken at the request of the Air Force Deputy Chief of Staff for Research and Development, after the Office of the Assistant Secretary of Defense for Installations and Logistics expressed interest in whether the lower tiers--the subcontractors and suppliers--of the defense industrial base had become inadequate to meet the needs of the Department of Defense. This phase of the study examines the peacetime adequacy of the domestic industrial base.

Concern has been expressed, and some evidence has been presented to substantiate the proposition, that lower-tier firms are finding it increasingly less attractive to do business with the Department of Defense. The reasons offered include the following: defense business is less profitable than comparable civilian business; regulatory constraints are making it increasingly costly for some industrial firms and contractors to do business; and the paperwork and administrative burdens surrounding government procurement are unattractive to firms, which would rather deal in the commercial marketplace where such activities are not necessary.

The research reported here was undertaken during the first half of 1976 as the "Industrial Base Study" under Project AIR FORCE (then Project RAND). The work has focused on U.S. domestic industry and on the procurement of products for the military during peacetime. The question of possible needs during times of crisis also was identified as an important topic for consideration, but was left for a later

stage of the analysis, the results of which will be reported separately.

This report should be particularly useful to decisionmakers and their staffs with responsibility for conducting, planning, or regulating defense procurement activities. It should be particularly useful to the Directorate of Planning, Programming, and Analysis and the Directorate of Procurement Policy Hq USAF as background for the consideration of current and future policies relating to the defense industrial base. It should also be of interest to a larger segment of the analysis and policy community--in the Legislative as well as the Executive Branch--and to industrial firms, by providing a broad perspective on questions concerning the adequacy of, and competition within, the defense industrial base.

# SUMMARY

This study focuses on the peacetime adequacy of the lower tiers of the U.S. domestic defense industrial base. These lower tiers consist of firms that have no direct contractual relationship with the government buyer for either development or production of a weapon system.* Accordingly, very large firms are included only to the extent that they are subcontractors or suppliers for a particular program. The scope of our coverage was also narrowed to include primarily firms that develop and produce technologically sophisticated equipment or components of such equipment. If such firms should leave the defense industrial base, they would potentially be the most difficult to replace.

To establish a context for gathering and analyzing data, we reviewed relevant existing and proposed public policy relating to the industrial base. For the information-gathering phase of the project (conducted during the first half of 1976), we contacted thirteen system program offices at two Air Force product divisions: Aeronautical Systems Division (ASD) and the Space and Missile Systems Organization (SAMSO). Included were four communication satellite, two missile, and seven aircraft programs.** This research

*By this definition, we do not intend to exclude firms that may get direct orders from the government for spares to support a system once it is deployed.

**The detailed information gained from this survey is published separately as G. G. Baumbusch and A. J. Harman with D. Dreyfuss and A. Gandara, Appendixes to the Report on the Peacetime Adequacy of the Lower Tiers of the Defense Industrial Base: Case Studies of Major Systems, R-2184/2-AF, November 1977.

methodology was used for three reasons. First, we wanted to avoid focusing on one or two "horror story" cases, such as the contention that federal regulatory policies have caused hundreds of foundries producing castings to shut down. We did not directly investigate these cases because we reasoned that if such problems were occurring in sectors of industry, their effects would surface repeatedly in our program survey. Second, to get at least a crude measure of the extent of any lower tier problems, we needed a sampling approach that did not start out with selected problem areas. And, finally, we sought to determine the perceptions of the program offices concerning possible problems in the lower tiers. Initial contacts with program offices were followed by interviews with prime contractors, subcontractors, and suppliers for programs that seemed to us to be the best sources of information.

Our results have been organized according to three aspects of the issue of peacetime adequacy of the lower tiers of the defense industrial base. First, we report the evidence pertaining to the supply side of the market--the possibility of too few suppliers; and, based on more limited information, the consequences of such situations in terms of price increases, delays, etc. Second, we examine the demand side--how the conduct of DoD business may be influencing suppliers to leave or stay in government business, and how DoD buying practices affect the efficiency with which the process of weapon systems acquisition is conducted. Third, we review the role of the DoD and other federal agencies in the creation and implementation of public policy that affects the adequacy and efficiency of the lower tiers.

## TOO FEW SUPPLIERS

What constitutes too few high-quality suppliers of the components and subsystems for the products needed by the DoD? The question is difficult to answer quantitatively. In some cases, an industrial base consisting of one or two suppliers may be adequate, provided there are no significant barriers to the entry of other suppliers should demand accelerate and/or the existing supplier(s) attempt to extract monopoly profits. On the other hand, an obvious indication of too few suppliers would be no suppliers for a product, regardless of price. We were not made aware of any such cases in the course of our survey. However, since we were surveying programs in progress or recently completed, this study was not particularly well suited to uncover situations in which the prime contractor was unable to advance a system beyond the conceptual stage because suppliers were unwilling or unable to participate.

We discuss the problem of too few suppliers in terms of three indicators. The first is a situation in which a change in subcontractors or suppliers becomes necessary after a program is underway, and great difficulties are experienced in obtaining acceptable alternatives. The weapon system programs that we surveyed did experience a number of problems that required a change in suppliers or other remedial action during the course of a program. These problems occurred for a variety of reasons: bankruptcy of firms, firms' preference for commercial business, labor trouble, changing corporate structure with new management disinclined to continue in military business, etc. But probably the most common problems that we encountered involved the technological difficulties

inherent in developing a new weapon system. In this sense, many problems were inherent in the intrinsic uncertainties of developing and producing something new and technologically sophisticated.

When, as a consequence of any of the reasons mentioned above, a change in source of supply became necessary, capable alternatives were generally available. Information on the costs of changing sources of supply is incomplete, however. In a few cases, such a change resulted in cost savings. But even assuming that there usually were substantial cost increases, the problems due to change in source of supply in the programs surveyed were the exception rather than the rule, so that the adverse cost effects on the program, as a whole, were not severe.

The second indicator is a situation in which the lower tiers, even if they have adequate capacity to provide initial and alternative suppliers during the course of programs, may not be able to provide sufficient competition so that DoD buyers are reasonably confident that they are not paying excessively high prices for products. Our limited information suggests that prices of some products have increased sharply in recent years because shortages of material and fuel, etc., have increased the costs of production. There is, however, some evidence of price increases resulting from monopolistic pricing, which can occur when a buyer becomes "locked into" a particular source of supply.

An example from the RF-4 photoflash system is provided in Appendix A to this study.* Where competition is introduced, as in dual sourcing, prices have usually been significantly reduced and a

*See Appendixes, R-2184/2-AF.

hedge has been provided against technological difficulties in development or an abrupt loss of production capability. But our evidence on the subject of excessive prices resulting from insufficient competition is limited, largely because we, like others before us, were not able to obtain cost data to use in our analysis of prices.

Several examples of the price effects of introducing competition are provided in descriptions of the Maverick and SRAM programs given in Appendixes B and C. Evidence on how these single-source dependencies affect prices is as yet very limited. It is worth noting, however, that many of the single-source dependency situations that were documented in the survey arose as a consequence of the buyer's actions rather than because of a lack of a sufficient number of suppliers.

A third indicator of too few suppliers is a situation in which the lower tiers, although providing adequate capacity and competition at an anticipated rate of peacetime demand, cannot sustain the requirements of a rapid acceleration of demand. This situation occurs mainly under nonpeacetime circumstances, which were not covered by this phase of the research. However, two products within our survey experienced much higher-than-anticipated production rates. In both cases, the existing base was sufficient to meet the accelerated production requirements: in the Maverick program, Hughes nearly tripled production by adding shifts; and in the production of traveling wave tubes (TWTs) for a phased-array radar, Varian was able to increase its production rate more than threefold. These are just two isolated examples that arose in the course of the program survey;

a study still in progress will provide more concrete evidence on the adequacy of the lower tiers for surge production.

From our survey of programs, some longer-term industrial trends are also discernible. For instance, there has been a recent exiting of firms from a number of industries. Examples include producers of rocket motors, motor cases, and TWTs. This reduction, however, appears to be a normal response to declining demand rather than a consequence of the burdensome buying practices of the DoD. Whereas there are several instances of firms leaving the defense industrial base, there are also cases in which new firms have entered or attempted to enter. Thus, sectors of industry must be considered individually in evaluating the adequacy of the industrial base, and even a declining sector is not necessarily evidence of a problem.*

## GOVERNMENT BUYING PRACTICES

Two broadly defined types of government buying practices that relate to major weapon systems reveal the effects of the "demand side" on the lower tiers of the defense industrial base. The first of these is the requirement of DoD buyers for highly specialized products, usually in relatively small quantities. These products have technological characteristics that range from extreme specialization and sophistication to occasional use of obsolete technology (no longer demanded in the commercial marketplace). The second is the requirement for a set of specialized procedures that the DoD uses to contract with industry for goods. These procedures

*For example, the reduction in numbers of producers of TWTs is more adequately described as a consequence of the technology becoming scientifically and economically obsolete.

include specifications, quality control requirements, and documentation (including extensive financial reporting requirements) with which the DoD's prime contractors and its subcontractors and suppliers must comply.

The demand for highly specialized products may result in limited possibilities for product substitution, few suppliers willing or able to produce needed products, and relatively high prices. Chemical compounds for missile batteries are examples of such products (these are described in Appendix B). Since weapon systems are sophisticated products designed to operate in hostile environments, the possibilities for reducing the requirements for product specialization may not be great. However, some evidence from our survey suggests that certain electronics components and test equipment might be possible areas for attempts to relax product specifications in favor of "best commerical design."

As far as the defense contracting procedures are concerned, most firms are willing to meet requirements for specifications, documentation, etc., provided they are paid for doing so. And in general they are. Some practices do draw complaints from firms and are occasionally cited as the reason why a firm no longer wants to do military business. Often, when firms have refused to comply with required contracting procedures, and prime contractors have perceived continued participation by these firms to be desirable, the prime contractors have sought exceptions to rules or taken extraordinary actions to keep the reluctant firms involved in the programs. In one such case in the SRAM program, certification documentation for a

brake system (provided by the prime contractor after the supplier had refused) added at least 20 percent to the price.

As this example suggests, a clear result of compliance with the multitudinous documentation requirements, prime specifications, etc., is increased costs to the DoD. Our limited evidence suggests that products manufactured according to all the specialized procedures may cost 2 to 5 times as much as products manufactured without them. However, more information about the real costs of these procedures is required, so that the DoD and its prime contractors can become better able to employ them only in situations where their benefits are clearly worth the extra costs.

## THE POLICY FRAMEWORK

The DoD has a uniform set of procurement policies and procedures embodied in the Armed Services Procurement Regulation (ASPR). It is possible for the DoD to use existing provisions of the ASPR where they are relevant to industrial-base problems. For example, ASPR 3-216 permits negotiation to be used as an alternative to formal advertising in the interest of preserving the industrial mobilization base. In one instance, the use of this provision had the undesirable consequence of creating an entry barrier in the wheel and brake industry--a situation that should not be repeated in any future applications.

The ASPR as it is currently constituted provides very little specific guidance on subcontracting policy. Recently, the Air Force took the initiative to sponsor a revision of the ASPR, which has now been approved. This revision is intended to expand the government's

authority over subcontract management: for major weapon system programs, it will give the government buyer more authority over the selection of critical subcontractors, the content of critical subcontracts, and greater surveillance of a prime contractor's management of its subcontractors. There may be some advantages to this ASPR revision, but there is also an intrinsic problem in the government buyer granting itself more authority over subcontracts without the commensurate responsibility of privity of contract (i.e., being party to a contract).

For example, in some recent disputes between prime contractors and their subcontractors, the subcontractors have argued that prime contractors, in taking various actions that relate to their subcontractors, are really acting as agents of the government buyer. Therefore, the government buyer should be directly responsible for the effects of the prime's actions. Should the courts accept such contentions, the result would be to undermine the concept that there exists no privity of contract between the government buyer and subcontractors. One consequence would be that the government buyer would become vulnerable to suits by subcontractors. Even if pending litigation does not produce this result, the recent revision to the ASPR mentioned above may make such outcomes more likely in the future.

The incentive structure created by the current procurement policies encourages DoD buyers and defense contractors to minimize estimates of costs and risks at the outset of programs, and then, because profits are largely a function of costs rather than efficiency, discourages firms from controlling costs once a program

is underway. These perverse incentives filter down to the lower tiers and are not likely to be changed by court decisions, ASPR revisions, or any other action that involves the government more directly in subcontract management.

Subcontractor and supplier problems are best dealt with by those participants in the acquisition process with the most direct responsibility for a program's outcome--the prime contractor and the System Program Office (SPO). Some potentially effective tools for selective application include the more frequent use of dual sourcing by the prime contractor; the use of competitive component "breakout" (separate procurement) by the SPO; and multiyear buying by the DoD. The alternative of using contractual incentive schemes has often proven to be administratively complex and generally ineffective.

Congress has a vital interest in questions that relate to DoD procurement of weapon systems, particularly since it is anxious to promote competition within industry and to distribute defense spending throughout the economy. It has created an extensive legislative framework within which the DoD must operate as a buyer. Most legislation designed to see that the taxpayer dollars buy products at a fair price (such as Cost Accounting Standards) has a patently reasonable objective; problems occur when such legislation is applied more comprehensively than necessary. Although most economic and social welfare legislation (e.g., special consideration for minority businesses) does not seem to constitute an impossible burden for defense contractors, it often does increase costs. And it is usually difficult to measure how effectively the objectives of these regulations are being realized.

* * *

Based on the results of our program survey, we have concluded that fears about peacetime erosion of the industrial base are largely unfounded. Subcontractors and suppliers have left the base, but their leaving seemingly has not interfered with the Air Force's ability to develop and produce the systems it currently needs. Our information about the purportedly higher prices being paid by the Air Force because of reduced competition is sketchy, and more research would be useful in this area. Further, when individual subcontractor and supplier problems have occurred in a given program, their primary causes have been technological rather than poor defense contracting techniques.

Since we did not uncover a pervasive problem, we have deliberately not recommended sweeping policy changes. What we have done is describe how the DoD, the Congress, and the courts interact in policymaking decisions that affect the defense industrial base. We have also made some tentative suggestions for policy actions (dual sourcing to maintain competition, multiyear buying, more selective use of specialized contracting practices, etc.) that have probably always been reasonable from the standpoint of increased efficiency in military acquisition but which seem to be particularly important in an era of declining procurement budgets (in real terms) for sophisticated military equipment.

# ACKNOWLEDGMENTS

The authors are grateful to a large number of individuals and organizations for their assistance in various stages of the industrial base study and in the preparation of this report. We would like to acknowledge here the guidance and assistance of some of these, within space limitations.

Air Force representatives from the C-5, A-7, A-10, F-16, F-15, F-4, F-111, Maverick, SRAM, Space Communications Systems, Defense Meterological Satellite Systems, and Space Navigation Systems programs provided valuable information about their programs and important additional contacts for our survey. Mr. Ralph C. Johnston, Assistant for Acquisition Management, Aeronautical Systems Division, was helpful in arranging initial contacts with System Program Office representatives from the aircraft and missile programs. ARF Products Inc., Boeing Aerospace Corporation, Eagle-Picher Industries, General Electric Corporation (Rocket Case Operation), Hughes Aircraft Corporation (Missile Division), Hughes Electron Dynamics, Litton Microwave Electronics, Teledyne MEC, Thiokol Chemical Corporation (Wasatch Division), and TRW provided information used in the case studies of individual programs and firms.

Mr. Jacques S. Gansler, formerly Deputy Assistant Secretary of Defense for Installations and Logistics (Material Acquisition) provided guidance on the conduct of the research, and members of his staff, particularly James J. Leonard, provided helpful data and backgound material. Captain Patrick Sullivan of the Office of the

Deputy Director for Contracts and Systems Acquisition (OUSD/R&E) made valuable suggestions for the formulation of the survey.

We would also like to acknowledge the contributions of several Rand colleagues. David Dreyfuss and Arturo Gandara conducted the research on the spacecraft programs that is reported as Appendix D in R-2184/2-AF. Richard Fallon assembled and interpreted relevant economics literature on barriers to market entry and exit. His work provided a useful framework for evaluating information gathered in our program survey. Patricia Dey participated in the survey of aircraft programs. Michael Rich reviewed the legal and procedural framework applicable to multiyear buying of defense products and provided other assistance in the research effort and the writing of this report. Robert Perry, Director of Rand's Systems Acquisition Management research program, provided valuable guidance throughout our research effort. Finally, we are grateful to George C. Eads, Adele P. Massell, and Giles K. Smith for their helpful comments and suggestions on an earlier draft of this report, and to Dorothy Stewart for her editorial assistance.

Of course, the authors alone are responsible for any errors of fact or interpretation that remain in this report.

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# I. INTRODUCTION

Concern has been expressed in some quarters, including high-ranking officials of the Office of the Secretary of Defense, that there is some erosion of the lower tiers of the defense industrial base.* And this concern is not new.**

In this report, we will present the findings of research conducted to evaluate certain aspects of this concern. We will elaborate on what we mean by the lower tiers of the industrial base and identify criteria for determining whether an "erosion" problem actually does exist in industry. Based on the initial evidence derived from our survey, we will focus on the extent to which the problem exists in peacetime. We will also outline the framework of public policy and regulation within which interaction between the DoD and the lower tiers of the defense industrial base occurs, and suggest some policy options that might be available to the DoD to remedy any real problems. Recommendations for policy changes have been deliberately held to a minimum, however, since the initial data-gathering phase of our research has not yielded results conclusive enough to warrant our making recommendations for extensive policy changes.

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*See, for example, Jacques S. Gansler, "Let's Change the Way the Pentagon Does Business," Harvard Business Review, May-June 1977, pp. 109-118; and Civil Preparedness Review, Part I, Emergency Preparedness and Industrial Mobilization, 95th Cong., 1st Sess., February 1977.

**See, for example, J. G. Miller, Strategies for Survival in the Aerospace Industry, Arthur D. Little, Inc., Cambridge, Mass., 1964.

## THE LOWER TIERS

From the outset it is important to state what we mean when we refer to the lower tiers of the defense industrial base. In its broadest terms, the defense industrial base includes any firm producing products or services that eventually support the production of equipment (or services) purchased by the DoD. Within this definition, there are three dimensions of firms and products that are particularly worthy of disaggregation. These dimensions have to do with whether a firm is a prime contractor or a subcontractor or supplier; the size of the firm; and the extent of technological sophistication involved in the product.

Our definition of the lower tiers includes those firms having no direct contractual relationship with the DoD for the development or production of equipment.* It is clear, then, that we are interested in firms participating in the defense industrial base as subcontractors and suppliers rather than as prime contractors.**

The differences between large and small firms are also significant from the standpoint of this study. Large firms may be subcontractors on some programs and prime contractors on others; also, different divisions of the same company can be "primes" and "subs" simultaneously. For purposes of this study, we are interested in the activities of large firms (ranging from major aerospace corporations such as Lockheed to major commercially oriented firms

*We are not, however, excluding firms that get direct orders from the government for spares procurement of equipment already in the inventory.

**Of course, contractors can be "subs" in one program and "primes" in others. They would still be considered to be, at some time, part of the lower tiers.

such as U.S. Steel) only to the extent that they are subcontractors or suppliers and not prime contractors. Small firms, although they are more likely to be involved in defense business as subcontractors, may be involved as prime contractors as well. Where possible, we have tried to evaluate the business prospects of small firms as both prime and subcontractors (if they have had such experience).

Finally, for the initial phase of this study, we were particularly interested in those firms that deal in high-technology products--both in development and in manufacturing. These are the firms that are potentially hardest to replace if they exit from the defense procurement marketplace.

It should be clear from the preceding discussion that as a class of firms, the lower tiers of the defense industry are not as easily identifiable as, for example, are airframe prime contractors or producers of automobiles. However, for purposes of the discussion that follows, the two important criteria for classifying a firm as lower tier are (1) that it has no direct contractual relationship with the government for development or production, and (2) that it is a supplier of high-technology products or their components. For the most part we have tried to avoid making fine distinctions based on the size of a firm, since our ability to do so is limited by difficulties of trying to categorize such entities as large corporations that are composed of many individual profit centers.

## THE DESIGN AND SCOPE OF THE RESEARCH

We undertook this research in 1976 at the request of the Air Force Deputy Chief of Staff for Research and Development. We limited

our study of defense suppliers to a review of equipment purchased from industry for use by the Air Force. Moreover, by confining ourselves to aerospace products rather than investigating a broader range of equipment and material (including uniforms and other high-volume merchandise), we have been able to focus on the high-technology aspects and components of such products. In that way, we have attempted to limit our attention to those elements of the defense industrial base that will be most difficult to replace if the sources of supply are insufficient at present or likely to be insufficient in the near future.

Also, we have deliberately designed our research strategy so that we can attempt to measure the extent to which problems of sources of supply are plaguing defense development and procurement. Thus, rather than concentrating on "horror stories" (such as the problem of large numbers of casting-producing foundries shutting down purportedly because of changes in federal regulatory policy), we have sampled Air Force products by investigating many of the major weapon system programs being undertaken by two Air Force Systems Command product divisions--the Space and Missile Systems Organization (SAMSO) and the Aeronautical Systems Division (ASD).

This overview includes a relatively diverse set of products involving about 32 billion dollars' worth of Air Force development and procurement. If the effects of the "horror stories" are pervasive, they should surface repeatedly in problems encountered by the various major weapon system programs that have been undertaken by the Air Force in the recent past.

Furthermore, by going to the program offices within the Air Force, as well as to industry, to obtain information, we hoped to refine available evidence on the ways in which the Air Force is involved in the lower tier aspects of weapon system development and production. This approach provided information about the extent to which the buyer is aware of problems in the industrial base, and about what the program offices may be able to do about them in terms of solutions that might be outside the province of the prime contractor.

Our program survey generated a considerable amount of information on the activities and problems of the lower tiers of the defense industrial base. This evidence is summarized, and some insights into trends in the composition of the various sectors of the lower tiers are provided, in Sections III and IV.*

We have also surveyed some of the relevant public laws and regulations pertaining to the industrial base (with concentration on

*In the Appendixes (published separately as R-2184/2-AF), we present the results of our survey of thirteen aircraft, spacecraft, and missile programs that was undertaken during the first half of 1976. At the outset, we were constrained, by time and resources available, to limit the number of in-depth investigations of programs included in our survey. Thus, the information yielded by our survey is fairly detailed only in the case of those programs for which information was relatively readily available or where certain characteristics of the programs seemed to make them good candidates for detailed case studies. In any case, since the depth of analysis was often not very great, the conclusions should be taken as preliminary.

In the Appendixes, the discussion of our program survey begins with an overview of seven aircraft programs, the F-4, A-7, A-10, C-5, F-111, F-15, and F-16. It continues with detailed case studies of two missile programs managed by the Aeronautical Systems Division (Maverick and SRAM). And it concludes with an examination of the spacecraft industry and the subindustry that manufactures one important satellite component, the traveling wave tube.

the lower tiers and small business parts of the industrial base) and have described the existing situation and possible changes that are likely to occur. This survey distinguished among the activities currently in progress within the DoD, possible congressional activity, and cases under litigation in the courts. Such a survey, combined with the preliminary evidence already gathered, naturally leads to some observations on the information and analysis needed to support firm recommendations for policy change. These are presented in Section V.

Before we take up any of this evidence, however, it is important to be explicit about the industrial setting in which the possibility of erosion of the lower tiers is to be investigated, and the criteria we expect to use to determine if real problems exist.

# II. CONCEPTUAL PERSPECTIVE ON THE DEFENSE INDUSTRIAL BASE

## MARKET SETTING: SOME FUNDAMENTAL INFLUENCES

Since the review of evidence of lower tier problems is to be based on a survey of procurement experiences of major weapon systems, there is a wealth of information already available that should be taken into account when evaluating our survey results.* We will therefore briefly summarize some of the points relevant to an understanding of how the defense industrial base functions.

The acquisition process for major weapon systems involves both development and procurement phases. Questions regarding the adequacy of the industrial base would seem to involve primarily procurement, since that is where most of the dollars are spent. Moreover, it is the ability of the industrial base to respond to the demand for reprocurement of existing systems (and their spare parts) that will be at issue if an international crisis occurs. However, the two phases cannot be so easily separated. Real price and, more often, technological competition usually exist only at the initiation of

*This section is based largely on the following sources: B. H. Klein, W. H. Meckling, and E. G. Mesthene, Military Research and Development Policies, The Rand Corporation, R-333-PR, December 1958; Robert Perry, Giles K. Smith, Alvin J. Harman, Susan Henrichsen, System Acquisition Strategies, The Rand Corporation, R-733-PR/ARPA, June 1971; H. O. Stekler, The Structure and Performance of the Aerospace Industry, University of California Press, Berkeley, 1965; Robert Perry, Comparison of Soviet and U.S. Technology, The Rand Corporation, R-827-PR, June 1973; J. R. Nelson, P. Konoske-Dey, M. R. Fiorello, J. R. Gebman, G. K. Smith, A. Sweetland, A Weapon-System Life-Cycle Overview: The A-7D Experience, The Rand Corporation, R-1452-PR, October 1974; and others.

development. Also, partly because of the technological sophistication of weapon systems and partly because of the institutional incentives to keep cost estimates and expenditures as low as possible early in the acquisition process, procurement expenditures must almost invariably be extended to cover some development activities that early use of a weapon system reveals to be necessary. Even after the original production configuration is refined, there are usually process difficulties to be ironed out before a high-technology system becomes fully producible. And even after such a system has been deployed, there is often additional development activity to improve system performance or lower operational costs.

What are the implications of government-buyer behavior for the industrial environment? Fundamentally, the business is fraught with risks and uncertainties. Analysts have taken this fact into consideration in their analyses of bargaining and contracts in defense procurement.* Contractual incentives have been devised to keep costs down, but they seem to have been ineffective.** In part, this ineffectiveness appears to be due to the inherent uncertainty about what the cost of a new system will be before it is designed--which is usually when any price competition takes place. It is also partly due to the opportunities that exist for changing the contractual terms as the design evolves. One result has been a

*See, for example, J. Michael Cummins, Cost Overruns in Defense Procurement: A Problem of Entreprenurial Choice Under Uncertainty, unpublished Ph.D. Thesis, Northwestern University, 1973.

**See, for example, I. N. Fisher, A Reappraisal of Incentive Contracting Experience, The Rand Corporation, RM-5700-PR, July 1968.

seemingly perpetual problem of program cost growth (actual costs exceeding earlier estimates); in fact, the available evidence suggests that there has been little improvement in controlling cost growth over the last three decades--in times of real contraction as well as in times of real expansion of national resources going to defense procurement.*

The DoD and the Congress are not sanguine about such a situation. An extensive set of public laws, regulations, and buying procedures has been devised in an attempt to change the status quo. Thus, one of the objectives in analyzing the defense industrial base must be to try to determine how the military buyer's environment affects the behavior of sellers--their willingness to participate in defense business, the cost of the buyer's practices themselves, and the seller's price for assuming some of the risk of a major system acquisition.

From the military buyer's point of view, there is a partial alternative to the current set of procedures. For some equipment, close substitutes for the tailored military designs might be found in the commercial marketplace. This type of procurement has recently been attempted for Army trucks.** It might also have applications for

*See, for example, Merton J. Peck and Frederic M. Scherer, The Weapons Acquisition Process: An Economic Analysis, Harvard University Press, Boston, 1962; Frederic M. Scherer, The Weapons Acquisition Process: Economic Incentives, Harvard University Press, Boston, 1962; and A. J. Harman with S. Henrichsen, A Methodology for Cost Factor Comparison and Prediction, The Rand Corporation, RM-6269-PR, August 1970.

**See "Army Launches $400 Million Buy for 6,000 Commercial Truck Fleet," Armed Forces Journal International, April 1977, p. 10.

some components and subsystems of major weapon systems (e.g., ground support equipment, electronic components). If technologies underlying standard (or standardized) military designs and parts are not keeping pace with, or are diverging from, technologies applicable to commercial products, and if the military buyer is becoming a smaller part of the customer base for some sectors of industry, it will become increasingly expensive (in terms of both resources and delays) for the military to buy according to its own standards.

From the seller's standpoint, there are several possibilities for dealing with the risks of defense procurement. First, a firm can refuse to engage in defense business. This refusal is presumably related to the firm's ability to make an "adequate" profit (with due regard for risk) from a defense contract. But if a firm does elect to engage in defense business, there are opportunities for hedging the risks. A firm under direct contract with the government can maneuver itself into a cost-reimbursable position. It can then subcontract work on fixed-price terms, sometimes to more than one subcontractor. Or it can choose to keep work in-house that would usually be subcontracted, thus providing itself with the opportunity of making higher profits on each of the intervening steps in the production process, and possibly making it more difficult for other firms to enter defense business.*

In short, to evaluate the adequacy of the lower tier portions of the defense industrial base for the procurement of major weapon

*See, for example, Frederic M. Scherer, Industrial Market Structure and Economic Performance, Rand McNally & Company, Chicago, 1970, especially Chapters 8 and 9; and W. S. Comanor, "Vertical Mergers, Market Power and the Antitrust Laws," American Economic Review, Papers and Proceedings, May 1967, pp. 254-265.

systems, one should be cognizant of the practices of the buyer and of the incentives operating on the sellers (the prime contractor and his suppliers) to cope with the intrinsic risks and uncertainties of the defense marketplace.

## DIMENSIONS OF INDUSTRIAL ADEQUACY

It is important to have a clear idea of how we would know that a problem exists in the lower tiers of the defense industrial base. In effect, we are concerned with problems in the "market" for defense goods--those relating to the price or production effects of having too few suppliers. One very clear indicator of the problem of erosion in the sources of supply available to the DoD would be if there were no qualified bidders for a particular item essential to the defense posture. If, for one reason or another, existing firms in that product line concluded that it was no longer attractive to be suppliers of that product and there were no adequate substitutes for the product, then a problem of inadequate sources of supply would exist. If there were suppliers abroad able to provide this product, then the problem might be alleviated, at least in peacetime. But questions of stockage and replenishment spares, as well as surge and mobilization capability, might arise with respect to a reliable "industrial base" (of a non-U.S. origin) available in times of crisis.*

A second type of problem would arise if, in the course of the development and procurement of a major weapon system, an original

*However, as indicated in Section I, these nonpeacetime conditions have, by and large, not been considered in the research effort reported here.

subcontractor or supplier left the business and no acceptable alternative sources of supply were available. This is another instance of the "no qualified bidders" problem, but it may pose larger problems, at least in the short term, in the sense that the procurement of an entire weapon system may be jeopardized by the unavailability of some critical component or material. At the outset of a program, if no qualified bidders are available for a particular component, it may be possible to design around that component. Once the program is in progress, however, it may be much more difficult to make design modifications without seriously affecting the cost and schedule of the entire program or jeopardizing the system's performance.

Next, and perhaps even more difficult to determine with precision, is the problem of paying too high a price for a particular component or subsystem--i.e., monopoly pricing. If there are too few sources of supply for a particular item, then the leverage of the supplier to extract an unusually high price may become important. However, simply counting the number of suppliers available in any particular product line is not an adequate way to determine whether monopoly pricing is possible, since for a sufficiently high price, firms not in that business may be attracted to it.

Finally, even if there are sufficient suppliers to provide adequate industrial capacity and an acceptable level of competition during the anticipated normal course of a program, a problem would arise if the quantity of products needed increased suddenly and there was not sufficient industrial capacity to sustain the higher-than-anticipated production rate. Of course, the more sufficient the

capacity is for coping with sudden increases, the more costly it is to maintain when it is not required. Although the issue of whether there is "sufficient" capacity for very-high-rate defense production is obviously most relevant to nonpeacetime conditions, which we are examining in related research, this study of the peacetime adequacy of the lower tier defense industrial base has surfaced some relevant evidence.

There are several factors underlying all of these possible problems with the lower tiers of the defense industrial base. First and foremost is product quality, and related to it are the buying practices of both the military services and the DoD. For a number of major weapon systems, the technological complexity of the system is one of the key features of its usefulness. However, it may be possible that the government buyer is asking for a higher-quality product than it really needs. The quality of a product is often a matter of judgment, and one that our study has not directly tried to evaluate. But it is important to keep in mind that what constitutes a "qualified bidder" is often a judgment of the very buyer who may find "too few" sources of supply. Thus, the buying practices of defense agencies are an intrinsic part of any study dealing with the lower tier suppliers of the DoD.

## CONSTRAINTS ON INDUSTRY TAKEN AS GIVEN

Throughout this research, four features of the environment within which the DoD buys weapon systems have been accepted as "constraints" not subject to review for purposes of recommending remedial policy action.

First, we recognize that there are cyclical patterns in the economy over which the DoD, like most other buyers, has very little control. The impact of recent trends in the economy--inflation, recession, shortages (i.e., increased prices and lead times)--has not been limited to the DoD buyer. In some cases, the DoD already has special means at its disposal to insulate itself from these effects.*

Second, the restrictions currently being implemented by the Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA) have also been accepted as constraints external to the influence of the DoD. Despite the fact that EPA and OSHA regulations are often cited as a problem for some segments of the industrial base that supports defense procurement--e.g., castings and forgings for tanks, and certain chemical compounds used in missile power systems--we believe that, for a variety of reasons, these standards should be considered as external constraints. For example, as was true in the preceding case of cyclical economic activity, the effects of EPA and OSHA restrictions are not limited to the DoD buyer. Furthermore, the goals that these standards were set to achieve--cleaner air and water and safer and more healthful working conditions--appear to have broadly based support, at least as they are perceived in the abstract. The extent to which this support remains firm when environmental and safety regulations result in higher prices, loss of jobs, etc., is less certain. But for purposes of this study, we will assume EPA and OSHA are promoting goals

*For example, under Title 1 of the Defense Production Act of 1950, DoD buyers can have priority access to certain controlled materials, such as copper, aluminum, and steel.

desired by most Americans, and that the DoD, like everyone else, must live with the consequences of the restrictions set to promote these goals. It is, of course, possible that this regulatory environment impacts differently on defense suppliers than on others. Because we had to limit the scope of our research efforts to a manageable set of topics, we have not studied this possibility.

Third, the congressional responsibility to protect the public interest, which manifests itself in various forms of congressional oversight of the dispersal of the taxpayers' dollars by the DoD, acts as a constraint on defense procurement. The oversight may take the form of legislation such as the Truth in Negotiation Act (PL-87-653) or the Cost Accounting Standards Act (PL-91-379). The requirements set forth in this and other legislation are imposed on the DoD from outside as part of Congress' perceived need to protect the public from inefficiency or corruption in dealings between the DoD and the private sector. We accept, for purposes of this study, that a consequence of this need to protect the public interest is a constraining regulatory framework that would not be a factor in strictly private-sector dealings.

Fourth, the environment within which the DoD does business is constrained by the existence of rigorous specifications for the materials, components, and production processes used in the production of weapon systems. Such specifications exist either to protect the lives of persons who operate the equipment, to ensure the safety of others who might be accidentally injured if the equipment malfunctioned, and to ensure the reliability of equipment that

operates in environments such as outer space, where repair is impractical.

To repeat, the acceptance of the last three constraints--EPA and OSHA restrictions, congressional actions to protect the public interest, and rigorous specifications--in no way indicates a lack of recognition of the necessity for a balanced approach to the development and implementation of public policy that affects the DoD's purchase of equipment. We are fully cognizant of the potential for imposing environmental and safety standards, accounting and other reporting requirements, or technical specifications whose costs far outweigh their benefits. However, it is beyond the scope of this study to make fine distinctions about costs versus benefits in the absence of corroborating evidence furnished to us by qualified sources. For example, in the case of specifications, unless the personnel in a system program office and/or an industrial firm suggested that the imposition of a particular specification had costs that could not be justified on the grounds of either protecting life or ensuring necessary reliability, we would not independently reach such a conclusion.

# III. BRIEF REVIEW OF THE EVIDENCE

## RESEARCH METHODOLOGY

As was stated in Section I, this research was conducted to determine whether the lower tiers of the defense industrial base (and, in particular, those segments of the industrial base that support Air Force prime contractors in the production of major weapon systems) are becoming inadequate to support peacetime requirements, and, if so, what the causes of this erosion might be. To assess the nature and extent of any problems, we decided to gather data on a program basis. This decision was made because we did not have the resources available to make a comprehensive survey of all industrial capability, and because we wanted to avoid the possibility of biasing our conclusion, which might have happened if we had focused on one or two industries that had previously been mentioned as problem areas.

Once we had determined to gather data by means of a survey of ongoing Air Force major weapon system programs, we devised a set of indicators to be used to measure the capability of industry to support these programs in their various stages of development, production, and operation. These indicators, outlined in Section II, seem to be a reasonable framework for analyzing evidence yielded from the thirteen programs surveyed.

In the next few pages we will briefly review the evidence that bears on the question of whether the lower tiers of the industrial base are becoming inadequate to support military programs even in a

peacetime environment.* We will present this evidence by turning first to the supply side of the defense marketplace to see if problems of the type suggested by our set of indicators are occurring in Air Force major system acquisitions. Then, having briefly highlighted recent experience regarding the extent of competition, and the ability and willingness of industry to be responsive to defense needs, we will turn to a review of evidence concerning the demand side of the market--the ways in which buyer behavior influences the seller's participation in defense business and the extent to which elements of this behavior are responsible for the current condition of the lower tiers of the defense industrial base.

## THE SUPPLY SIDE OF THE DEFENSE INDUSTRIAL BASE--ARE THERE TOO FEW SUPPLIERS?

As stated previously, the first obvious indicator of too few suppliers is a situation in which the military buyer wants to design and build a product and can find no acceptable suppliers for some of the parts and components needed. As we have said, our research was designed to survey on-going programs, so it was not structured to uncover examples of programs being thwarted in the conceptual stages because suppliers were either nonexistent or unwilling to become involved in government work. However, as we gathered data from both defense buyers and representatives of industry, we tried to elicit information about instances in which the type of situation described by this indicator might have occurred. No examples were provided to us.

*The detailed data from the program survey and the individual case studies that were undertaken are discussed in the Appendixes (R-2184/2-AF).

Our survey yielded the most evidence on the second indicator: whether or not capable alternative suppliers were unavailable or very hard to find during the course of a program. In each of the programs we surveyed (and particularly in those programs with recent or current production experience), there were several cases of the need to replace a current supplier. Both the causes of these situations and the actions taken by the prime contractor and/or government buyer varied from case to case.

A first example comes from the Maverick electro-optically guided missile program. The originally selected supplier of the torque assembly and the gyroscope motor, Guidance Technology, Inc., had technical problems during the development phase. The firm also had financial troubles and went into bankruptcy proceedings. The prime contractor, Hughes, then needed alternative sources for both components. Hughes first utilized in-house capability for both components before proceeding to find alternative suppliers. In the case of the torque assembly, Globe, a division of TRW, was selected as the supplier. Globe had been a competitor during the initial source selections, and even after it was not chosen as a supplier, its representatives periodically apprised Hughes of its interest in becoming a supplier if an appropriate opportunity occurred. For the gyroscope motor, Hughes had its own technical problems while doing the work in-house, and finally resorted to another supplier, Clifton Precision Products.

Two other examples of the need to find alternative suppliers (both from the SRAM program) illustrate both the varied causes of supplier problems that lead to change and the range of cost impacts

that changing suppliers can have. The original supplier of a filter connector ceased production and scrapped tooling because the planned purchases had been completed and no further orders were contemplated. Shortly after the original supplier had taken this action, the Air Force imposed a requirement for 25 additional filter connectors as spares. At first, the prime contractor, Boeing, received no bids for this item. Boeing ultimately did find a supplier, but because of the investment required for new tooling, the small quantity involved, etc., the price of each of the additional 25 filter connectors was double that of the last buy from the original source.

Another example from the SRAM program illustrates how a need to change suppliers can have very different cost consequences. The original supplier of an extension ring forging had technical problems with a milling process, and then its operations were disrupted by a labor dispute. Boeing took the work in-house, but only until an alternative supplier could be found. Because the new supplier used a different milling process than either the original supplier or Boeing, it required only a very small investment in tooling relative to the original supplier, and it both lowered the price of the extension ring forging and shortened the production time.

A final example of the causes and effects of a need to change suppliers during the course of a program comes from the F-15 fighter aircraft program. The original supplier of metal flaps and some other metal fabrication was acquired by a company that decided to get out of military work. The prime contractor, McDonnell Douglas, moved quickly to purchase all drawings, tooling, work in process, etc., from its former supplier, and established a production capability for

this metal work at its facility in Long Beach, California. According to the F-15 System Program Office (SPO), it was more costly for McDonnell Douglas to do the work in-house than it would have been to subcontract it. However, the primary concern was to adhere to the program's schedule, and doing the work in-house seemed to be the most likely way of avoiding delay.

Our survey did not yield any examples in which alternative sources of supply were unavailable when change became necessary during the course of a program. The ease with which change could be made varied from case to case. But evidence derived from our survey suggests that, at least in the recent past, sufficient industrial capacity has been available to supply the products needed in the development and production of major weapon systems. Of course, this conclusion does not take into account the efficiency that may have been sacrificed because of program delays, price increases, etc., resulting from changing sources of supply. As the case studies in the Appendixes (R-2184/2-AF) indicate, however, these changes were the exception rather than the rule, so, overall, their impact was not great.

Another common theme from our program survey that is reflected in these examples has to do with the way business is distributed among those firms traditionally considered prime contractors for defense weapon systems and those that are appropriately classified as members of the lower tiers. The prime contractor segment of the defense industrial base has been increasingly characterized as moving toward the in-house production of system components that have usually been produced by outside suppliers. This trend toward vertical

integration is believed to be occurring both as a result of prime contractors' acting to utilize their own existing excess capacity and as a result of corporate takeovers. The information gathered in our program survey does not tend to support this belief. Although in the illustrative cases cited above there was some in-house activity as a consequence of the loss of suppliers, in all but the F-15 metal-working case, the business was redirected to a subcontractor as soon as proper arrangements could be made. The metal work for the F-15 progam was kept in-house by McDonnell Douglas because they decided that avoiding the risk of possible delay to a very-high-priority Air Force program was (at least in the short run) worth the extra cost of keeping this particular manufacturing operation in-house. Similarly, but with the opposite result, Hughes' assessment of the risks of developing and producing the torque assembly and gyroscope motor in-house--two very complex operations--seems to have contributed to their decision to find new suppliers for these components.

We have less evidence regarding a changing market composition as a result of corporate acquisition or merger. However, there are some examples from our survey of communication satellite programs that suggest that acquisition sometimes occurs as a prime contractor's "last resort" to preserve access to a preferred supplier. In one instance, Hughes acquired its only supplier of space-qualified solar cells when it appeared that the firm was about to be bought by an oil company that planned to terminate the space-oriented part of the business.

Overall, our evidence regarding trends toward vertical integration is not conclusive. In general, our survey did not show that there is a dramatic trend toward shrinkage in the number of individual firms comprising the defense industrial base as a result of vertical integration of the larger, prime contractor participants in the business. And, in the programs we surveyed, individual make-or-buy decisions seemed to be based as much on the potential risks and benefits of each situation as on broader considerations, such as the enhancement of a firm's competitive position in the longer term. Finally, there is no hard evidence to suggest that typical average percentages of business subcontracted in major weapon system programs have recently been declining. But our survey focus on existing programs does not provide a clear picture of the make-or-buy decisions of prime contractors on different programs over an extended period of time. However, some members of Congress, interested in the way defense procurement money is distributed throughout the economy, have recently expressed concern that so much of the defense business is subcontracted that the DoD does not keep track of where (with what firms in what location) at least 50 percent of its procurement budget is spent.*

On the preceding pages, we have given some examples, based on evidence provided by our survey data, of the capacity of the defense industrial base to supply products needed for major weapon systems. By examining this evidence in terms of the two obvious indicators of

*The concerned members of Congress want the DoD to provide records of how the subcontracted money is being distributed. See "Pentagon Accused of Losing Track of $20 Billion in Procurement Funds," The New York Times, May 23, 1977.

too few suppliers--no acceptable suppliers at the outset of a program and unavailability or scarcity of alternative sources during the course of a program--we have concluded that the lower tiers of the industrial base have adequate capacity to produce products for the Air Force in peacetime.

We turn now to the question of whether this industrial base also provides sufficient competition to ensure that the Air Force and its prime contractors are not paying excessively high prices for the parts and components going into major weapon systems. Our evidence with regard to excessive pricing is meager, largely because we did not have access to the kind of data that would allow us to compare prices with costs of production. In one instance, however, our survey did uncover information about a fairly clear case in which a supplier capitalized on his monopoly position by extracting a very high price from a government buyer. The original supplier of a photoflash ejector system for the RF-4 aircraft sold its data rights for production of the system to a second firm, which then resold them to a third firm. The third firm reopened production, raising the price of the whole system by a factor of 2 to 3 and the price of certain spare parts by as much as a factor of 10. The Air Force is purchasing the data rights so that, belatedly, competition can be reintroduced. Reintroducing competition at this point however, is obviously not as effective as the initial use of some contractual arrangement that would prevent this situation.*

*See, for example, G. A. Carter, Directed Licensing: An Evaluation of a Proposed Technique for Reducing the Procurement Cost of Aircraft, The Rand Corporation, R-1604-PR, December 1974.

It was, in fact, during our investigations of the problems of maintaining competition between two or more firms during weapon system programs that we indirectly uncovered most of our evidence on excessive pricing and the adequacy of competition in the lower tiers of the industrial base. In several instances we found that competition was maintained or reintroduced (often through the technique of dual sourcing) in order to lower prices and to provide backup capability in case one firm had serious technical problems. In some cases, the circumstances suggested that, in the absence of the competition, an excessive price would have been charged by the single supplier. For example, Lockheed Propulsion Company was the original supplier of the rocket motor for the SRAM-A program. During the early part of the program, both Boeing (the prime contractor) and the Air Force decided that Lockheed's price was too high, so they tried to qualify Thiokol as a second source. Although Thiokol did not complete the qualification process within the required time, the threat of competition encouraged Lockheed to make bids for the final years of procurement that were considerably less than the prices predicted by a learning curve derived from the first 2 years' prices when there was no competition. Overall, we have estimated that the savings to the program were between $30 and $40 million, net of second-source costs.*

Our evidence concerning excessive prices as a measure of sufficient competition in the lower tiers of the industrial base is the least conclusive of any derived from our survey. However, we can

*See Appendix C of R-2184/2-AF for the details of this case.

make a few useful observations about it. First of all it is obvious that if a firm secures some special advantage at the outset of a program (such as the total control of data rights), it is likely to be in a very powerful negotiating position farther into the life of the program when the cost of seeking other suppliers is perceived to be high in terms of dollars and delay. What seems to be less readily recognized is that there are powerful pressures to keep early program costs down; these pressures lead to relatively infrequent use of dual sources (as compared with commercial practice) and little effort to preserve the option. This is a characteristic of buyer behavior that we will discuss in more detail below.

Second, our survey showed that when prime contractor or government buyers did attempt to maintain competition, second-source firms were almost always available, thus providing the government with a price saving as well as a backup capability in the event of unforeseen problems. In fact, it appears that the major issue with regard to adequate competition in the defense industrial base is not the willingness or availability of suppliers to provide it, but rather the extent to which the buyer is (perhaps inadvertently) acting to limit competition in his own marketplace, because of the highly specialized products he requires and the environment within which these products are acquired.

Before turning to our discussion of buyer practices, however, there is one final indicator of lower tier adequacy about which we have some evidence. As we stated at the outset of this report, the research reported here was directed only to the question of peacetime adequacy of the industrial base. However, in the course of our

investigation of the capabilities of the industrial base to provide adequate capacity and a sufficient level of competition to meet the DoD's needs for products in peacetime, we also gathered some evidence that bears on the question of whether there is sufficient capacity available to meet higher rates of demand--i.e., surge demand--such as might occur during an international crisis.

We encountered two cases in our survey in which contractors were required to produce their products at a significantly higher rate than had been anticipated. In the case of the first contract for Maverick missiles, the Air Force exercised options for almost twice as many missiles as Hughes had assumed would be purchased during a particular period of time. Production was accomplished on schedule and within contractual price limits. Hughes relied largely on extra quantities of parts and components purchased from its existing base of subcontractors and suppliers and on extra work shifts for missile assembly. In the second case, Varian, a manufacturer of TWTs, entered into a large contract with the Navy that caused it to triple its weekly production rate. The requirement for increased production was met by hiring additional labor.

The examples, although they certainly suggest the existence of extra capacity in the relevant industries, obviously provide only limited insight into the adequacy of the industrial base to meet surge demand.* Research on surge demand is in progress and will explore this subject in greater detail.

*See Section IV for a further discussion of available capacity in certain defense-related industries.

## DEFENSE BUYER PRACTICES AND THEIR EFFECT ON THE INDUSTRIAL BASE

Having reviewed the status of the supplier side of the defense marketplace, we will briefly review how certain characteristics of the defense buyer influence supplier behavior and affect both the price and quality of products produced by defense suppliers. Since the results of our survey indicate that suppliers can usually be found for the parts and components needed for major weapon systems, we infer that neither the complex buying procedures associated with defense contracting nor the nature of the products required by the DoD are perceived by firms to be so specialized or onerous that they are totally unwilling to participate in defense business. Therefore, we have focused on those features of government demand that may lower efficiency and raise prices either by placing special administrative burdens on industry or by reducing the number of potential competitors for the business.

To begin with, as we stated earlier, the process of developing and producing major weapon systems is an undertaking fraught with risks and uncertainties--both because of the highly sophisticated technologies and rigorous requirements associated with advanced weapon systems, and because of pressures operating on the government buyer to minimize and/or shift these risks in order to ensure that a particular program will not be scrapped.* One consequence of the technological and cost uncertainties inherent in the process that firms must face is occasional financial loss on a contract, or in more extreme cases, bankruptcy. For example, the original suppliers

*See Section V for a more detailed discussion of the incentives operating on participants in the acquisition process.

of both the hydraulic actuator system and the missile motor for the Maverick are estimated to have lost money on their firm-fixed price contracts for the first buy of Mavericks. However, since the Maverick is a successful program, and a long production run is anticipated, both firms have the opportunity to capitalize on their positions as sole suppliers and substantially raise prices for follow-on buys, assuming of course that the prime contractor or the government does not decide to reintroduce competition.

In the production of components and subsystems, the question of whether or not to maintain or reintroduce competition is also affected by the risks (particularly by the buyer's perception of them) in the acquisition process. We have already said that by maintaining two suppliers the buyer can provide himself with a backup capability if one supplier has serious technical problems. Perhaps this tactic would also help to preserve a healthy industrial base by keeping more firms active in defense business. However, it often happens that a buyer's* perception of the need to minimize early estimates of total program cost leads to a decision to forego the potential future benefits of competition in order to reduce up-front expenditures.** For example, at the outset of the Maverick program, Hughes decided to pursue dual sourcing for only one subsystem because any additional investment for other subsystems would simply be too

*Here we mean either the government itself or a prime contractor acting as an agent.

**For more detailed evidence on this point, see J. P. Large, Bias in Initial Cost Estimates: How Low Estimates Can Increase the Cost of Acquiring Weapon Systems, The Rand Corporation, R-1467-PAE, July 1974.

costly. Later on, when production had to be increased to a very high rate, attempts were made to bring in additional sources to expand the supplier base. But, because of the compressed timing, these attempts were uniformly unsuccessful for technological reasons.

To minimize the risk that products purchased by the DoD will not be of the high quality and reliability desired, DoD buyers have devised complex buying procedures that provide for documentation to verify what a product can do and to record, often in minute detail, how a product was built in order to perform the required function.

These buying procedures constitute part of the "paperwork burden" so often cited as a troublesome feature of defense contracting. The balance of it (which we discuss further below) consists of documentation to demonstrate compliance with economic and social legislation and to account for how government funds are being spent. Imposition of this share of the paperwork burden is largely external to the control of the DoD. Of course, all of these procedures differ from most standard commercial practice, but, as we discussed in Section II, they may be a necessary feature of defense contracting, given the specialized nature of the products and the functions they must perform. One thing is certain: production that conforms to all the special procedures is very expensive. In the SRAM-A program, for example, the supplier of an item of test equipment, a command destruct receiver (CDR), had previously built these devices under contract to the Army. As a subcontractor to Boeing in the SRAM program, the firm (ARF Products, Inc.) was required to do piece-part traceability--a procedure in which the history of all parts and components is recorded so that all individual components of a

particular type or batch may be traced if one fails. In its work with the Army, ARF Products had not been required to perform piece-part traceability. Whereas the two different methods of operation used by the firm produced CDRs of virtually equal reliability, those produced with piece-part traceability cost approximately twice as much as those produced without it.

Another example from the SRAM program involved the brake system for the missile's rotary launchers. The supplier firm refused to build to anything other than its usual commercial specifications or to provide any documentation. Boeing decided to provide the documentation to show that the brake units met all the specification and configuration requirements. To accomplish this, Boeing ordered extra units, dismantled a sample, and inspected them to verify that all the requirements had been met. No units were rejected by Boeing as a consequence of these inspections, and Boeing officials completed the necessary paperwork. In terms of extra hardware alone, 20 percent was added to the total cost of the brake systems.

The preceding two examples illustrate how the military buyer's demand for products manufactured according to a highly specialized set of procedures can place a special burden on its suppliers that is quite costly to the DoD and ultimately to the nation.

Other features of DoD-buyer behavior may also help to raise prices by reducing the amount of competition available. For example, military buyers' preferences or requirements for specialized products not widely demanded in the civilian market (or even in some other area of the DoD market) may present a demand-related barrier that could be a significant obstacle to increased competition in

defense-related industries. The extent to which technologies and products for defense have diverged from those of other customers may be causing the defense market to become an entirely separate market, or, at least, may be substantially reducing substitution possibilities. Some defense products, by being overly specialized and hence unsubstitutable with similar civilian products, may represent such a small market that very few firms can effectively participate in it. Because of its requirements for specialized products--which in some cases are undoubtedly essential--the DoD may be creating a barrier to competition that will lead to higher prices due to deterioration of the competitive structure of their "marketplace." Thus, the DoD may not only pay higher prices for more expensive production techniques, but also because of deterioration in competition.

For example, when ARF Products produced the CDRs for the Army, they used certain plastic-encased transistors in the unit. As a subcontractor to Boeing building CDRs for the Air Force, ARF was required to use only (little used) metal-encased transistors. The specification of the type of case not only limited the number of suppliers available to ARF but necessitated some redesign of the CDR unit. In another case, a generator in the A-7 aircraft utilized an uncommon square wire. After a time, even the sole supplier that had produced the square wire dropped the product line. A redesign to accommodate more common round wire was made, and suppliers once again became available.

The range of competition may also be limited by product differentiation advantages due to buyer preferences for established

firms over new firms. The DoD, for example, may prefer to buy from certain established suppliers rather than from possibly risky new suppliers, a preference that may be very difficult and costly for potential new firms to overcome. This problem is well illustrated by the case of a small firm that tried to enter the business of designing and producing wheel and brake systems for military aircraft by selling spare parts. When one of the three established developer/producers of wheels and brakes threatened to leave the business unless competition in the sale of certain spare parts could be restricted, the Air Force acquiesced. Since selling spare parts was the means being used by the firm to gain a foothold in the military market, it was forced to abandon its efforts to become a full-scale developer/producer.*

We have described how the government buyer requires highly specialized products and imposes requirements for documentation (sometimes voluminous) in order to be sure that these products can perform their functions. In addition, DoD buyers carry out extensive oversight operations to make certain that contractors are using the right procedures to meet the standards, and that they are using the taxpayers' money efficiently. Much of the requirement for the latter type of oversight (accounting, etc.) is outside of the DoD's control. Furthermore, it is largely accomplished by the review of financial records and does not require DoD involvement in day-to-day manufacturing operations. In contrast, the oversight that attempts

*See Section IV for further details of this case.

to determine whether products and processes conform to the standards set by government buyers is undertaken at the DoD's discretion and is often characterized by the active involvement of DoD personnel in contractor affairs.

In some of the programs that we surveyed, the "standards" oversight involved multiple performance of the same function. In the SRAM-A program, for example, the surveillance process at ARF Products consisted of the activities of two virtually full-time quality control personnel from the firm, a resident inspector from Boeing, and periodic visits from the local Defense Contract Administration Services (DCAS) representative. Fortunately (at least as perceived by ARF), the DCAS representative was confident enough in the extensive quality control operation that was underway that he gave ARF Products a virtual "blank check" of approval in advance.

Such was not the case at the General Electric Rocket Case Operation, the supplier of the rocket motor case for SRAM-A. Because GE is a big firm, doing a considerable amount of military prime contract business, it has a resident team of government administrators. However, the surveillance functions performed by the resident contract administrators affected GE's subcontract business in the SRAM program as well. These surveillance activities were carried out in addition to GE's own quality control and the efforts of a resident inspector from the prime contractor. Further inspections by the prime contractor were, of course, undertaken on receipt of the product. The multiplicity of inspection and surveillance efforts occasionally disrupted GE's production schedule

by requiring that machinery be shut down for a day until some kind of inspection could be performed.*

We have now reviewed some of the evidence yielded by our program survey on the characteristics of the demand side of the defense marketplace. At the beginning of this discussion we observed that since our program survey had not provided examples of buyer practices that were driving large numbers of firms out of defense business, we concentrated our analysis instead on those practices that seemed to raise prices either by requiring that contractors do business according to burdensome procedures or by reducing potential competition. The examples presented in this section, and the additional material in the companion volume (R-2184/2-AF), demonstrate quite clearly that the requirements for highly specialized products and volumes of documentation to accompany them is expensive. What is not clear, however, is whether these expensive characteristics of DoD demand are always necessary in the development and production of major weapon systems.

In Section II, we indicated that when we conducted our research, one of the four constraints we had accepted as given was that military products require rigorous specifications because of the types of missions they perform. We indicated that we would not make independent judgments that these expensive requirements were overdone, if evidence to that effect was not supplied to us. However, based on the evidence that we gathered in our study, it

*More detailed discussion of the role of contract administrators in the programs we surveyed can be found in Appendixes B and C of R-2184/2-AF.

seems reasonable to question, for example, whether ground-based test equipment needs to meet the same rigorous standards as the actual weapon. Given the different environment in which such equipment operates, and the use to which it is put, some additional review of the costs versus the benefits of specialized buying practices would be useful.

In theory, there are certainly benefits to be had from lowering costs both by reducing the requirements for specialized processes that must be verified by voluminous documentation and by potentially broadening the base of competitors by reducing the divergence between DoD products and similar products sold in other markets. However, with the exception of the test-equipment example discussed above, no evidence from our survey conclusively suggests that this could be done.* Nevertheless, given the very high unit cost of modern weapon systems, and the fact that military expenditure for these weapon systems has declined in real terms in recent years, making it increasingly difficult for the DoD buyer to support a healthy, competitive industrial base of its own, further investigation should be undertaken to determine whether specialization is clearly worth its cost. Such an investigation would have to involve the detailed study of a weapon system and its mission and operating environment to determine exactly what parts and components make up the system, to what extent any of those parts are even remotely similar in function

*On this point, we must reiterate that we have not been reviewing all DoD procurements--such as mess kits, uniforms, raincoats, or trucks--but only the more technologically sophisticated major weapon systems.

to existing commercial products, and whether it is possible (given the constraints imposed by the function of the complete system and its operating environment) for commercial products or manufacturing procedures to be used.

Finally, although we have concluded that an accurate assessment of the costs and benefits of DoD specialized buying practices involving rigorous specifications and documentation of product characteristics and production processes requires further investigation, we can say that the buyer practices relating to oversight and surveillance to see that these standards are met seem to be unnecessarily duplicative and costly. We will have more to say on this subject in Section V.

# IV. STATUS OF THE LOWER TIERS

In the preceding section, we summarized some of the data on individual subcontractor and supplier problems that are presented in detail in the companion volume of appendixes. Having highlighted some examples from our weapon system program survey, we can now make several general observations about the nature and extent of any subcontractor problems in these programs. We can also draw some conclusions about evolving trends in certain industries and their likely impact on the DoD's (and particularly the Air Force's) ability to develop and produce weapon systems in the future.

## CURRENT CONDITION--RESULTS OF THE PROGRAM SURVEY

We have tried to determine whether or not the lower tiers of the industrial base are eroding (and, if so, why) by evaluating thirteen programs from two Air Force Systems Command product divisions in terms of three problem indicators: (1) the total lack of initial suppliers; (2) extreme difficulty encountered in finding alternative suppliers during the course of a program; (3) the existence of very high prices, indicating too few suppliers. Any of these circumstances would suggest that there are supplier problems in the lower tiers of the industrial base.

The information we gathered from the thirteen programs indicates, first of all, that there were no cases in which a total lack of initial suppliers posed a problem in the sense of thwarting the Air

Force's intentions to develop and produce a new system. Nor did we expect to find much evidence of this type of problem, since our approach--a survey of ongoing programs--was not tailored to shed light on this issue.

Our program survey yielded the most evidence on the second indicator--the relative difficulty of obtaining alternative sources of supply during the course of a program. Most of the individual cases of subcontractor and supplier problems reported in the survey data had to do with remedial action taken by a prime contractor when a participating firm dropped out of a program.

There are several common themes running through this material. First of all, our survey found no cases in which a prime contractor needed to replace a supplier and could not find an adequate alternative. Second, the difficulties experienced by subcontractors and suppliers that necessitated remedial action by the primes (often bringing in a new source) had various causes: bankruptcy; changes in corporate structure that produced new management disinclined to continue in military business; natural disaster; dissatisfaction with some feature of the administrative burden involved in government contracting; and many others. Indeed, some of the causes that we encountered were the very ones that had been originally postulated as the underlying causes of a trend toward erosion of the lower tiers of the industrial base. Low profitability of defense business and too much "red tape" are two good examples. However, by far the most pervasive cause of the subcontracting problems discovered in our survey was the technological difficulty and uncertainty that is inherent in the process of developing and producing sophisticated new

weapon systems. In addition to the cases in which the supplier problems were directly attributable to the uncertainties of working with new technology (the F-16 cockpit canopy, for example; see Appendix A of R-2184/2-AF), many of the other cases mentioned as examples in Section III experienced technological difficulties as a root cause of whatever problems surfaced.* Bankruptcy of the original producer of the gyroscope motor and the financial loss sustained by the rocket-motor producer for Maverick are just two examples.

The extent of the problems measured by the third indicator--very high prices suggesting monopoly pricing growing out of insufficient competition--is much more difficult to determine with precision. The information we gathered did suggest that in a few cases (the RF-4 photoflash ejector and the SRAM-A rocket motor, for example) firms were able to charge very high prices because of their sole-source advantages. When the Air Force and/or the prime contractor was able to reduce or eliminate these advantages--i.e., by acquiring the data rights in the case of the photoflash ejector and by bringing in a second potential supplier of the SRAM-A rocket motor--prices were substantially reduced. However, our evidence is much too sketchy to allow us to draw any firm conclusions about the dimensions of the excessive-price problem. To have expanded our analysis in any systematic way, we would have needed data on costs and prices by product line.

*These cases are discussed in detail in the Appendixes (R-2184/2-AF).

What we can say with some certainty as a result of information generated by our survey is that increasing competition does lead to lower prices. It also provides a hedge against abrupt loss of production capability, such as might occur if a single source experienced severe technological problems during the course of a program. The technique for increasing competition most often used in the programs we surveyed was dual sourcing. The data we gathered provides hard evidence (the SRAM-A rocket motor and remotely activated silver zinc battery, for example; see Appendix C of R-2184/2-AF) about the potential for savings and for maintaining or enhancing competition through dual sourcing.*

As we conclude our discussion of what the program survey tells us about the current condition of the lower tiers, we should keep in mind that the subcontractor and supplier problems described in the appendixes were experienced by only a small number of the subcontractors participating in a program (for example, 2 out of 72 SRAM-A subcontractors were no longer available for the proposed SRAM-B program, and alternatives for those two were readily available). Even assuming that the survey, planned as it was for breadth of coverage instead of depth, has not uncovered every single problem case, the percentage of firms experiencing difficulties (whatever their cause) was quite small in relation to the number participating in the total program.

*For our observations about the feasibility and utility of programs, see Section V.

## FUTURE PROJECTIONS--SOME TRENDS IN SELECTED INDUSTRIES

In addition to their consequences for an individual program and its prime contractor, some of the problems that were revealed by our survey may have longer-term implications for the lower tiers of the industrial base, and for the Air Force's ability to develop and produce systems in the future.

The data on the lower tiers presented in Section III (and in the appendixes) have a number of potential implications for the future. For example, our survey showed that there are situations in which subcontractors experience various difficulties during a given program and resolve the problems with no apparent effect on the firm's ability or willingness to participate in future programs. However, there are also cases in which firms decide to get out of defense business altogether as, for example, the original supplier of the SRAM rocket motor, the Lockheed Propulsion Company. When firms do choose to exit from defense business, they seem to be primarily motivated by a decline in the demand for their products rather than by any disenchantment with the military business.

In real terms, the Pentagon's procurement budget has been reduced by about 50 percent over the last decade. And, in addition to the absolutely declining volume of total demand, prospects for defense suppliers are further clouded by the erratic nature of that demand, which is a function of both the vagaries of the annual appropriations process and what appears to be less than completely systematic planning by the military for spares procurement. The Air Force's requirement for additional filter connectors for the SRAM missile, described in Section III, is an example of the latter problem. In

this case (and in many similar instances) the main consequence of erratic demand seems to have been a sacrifice of efficiency (a large price increase from the new supplier of the filter connector) rather than the creation of a situation in which a firm deliberately left the defense industrial base.

The situation of the GE Rocket Case Operation illustrates the uncertainty faced by a defense supplier as a result of the political decisionmaking process that surrounds weapon system acquisition. After the SRAM-A program ended, GE considered discontinuing its manufacture of rocket motor cases because it had no work to sustain the facility until SRAM-B production was scheduled to begin. Then the production of some additional Minuteman missiles was approved, providing GE with enough work on cases for that missile to tide it over. During all this time the need for SRAM-B cases hinged on the decision to go ahead with the B-1 bomber, on which the SRAM-B was to be carried. After a long, tortured decisionmaking process, involving both the Congress and the President, it was decided not to produce the B-1. Meanwhile, funding for the production of additional Minuteman missiles has continued to be in doubt.

General Electric's situation in the SRAM Rocket Case Operation may be extreme because of the highly complicated nature of the B-1 decision. Nevertheless, it is true that in virtually every program we surveyed neither the actual total volume of demand for a system nor the rate of that demand (production rate) matched what had been projected at the outset of the program. At the very least, the inability of industry to plan very well either for total volume or rate of demand results in a sacrifice of efficiency. Given the

highly political nature of the system acquisition process, such a result may be almost inevitable. In Section V, however, we will offer some very modest suggestions for smoothing the flow of demand.

Information obtained in the program survey of firms in the lower tiers suggests that some industrial trends are discernible in certain sectors of industry that support the programs that we surveyed.* While there are numerous examples of firms exiting the defense market in recent years, there are also examples of firms entering it or trying to enter it. We will deal with the exit data first.

## Exit from Lower Tiers

Rocket Motors. The industry that produces solid-fuel rocket motors lost a participant when the Lockheed Propulsion Company dropped out of the defense business. This occurred after the SRAM-A program ended, the only one in which the company participated. Much of the equipment owned and used by the company for building rocket motors was sold to the South Koreans. Thiokol was chosen to be the supplier of a long-life rocket motor for SRAM-B, and there are several other suppliers (including Aerojet, Rocketdyne, Atlantic Research Corporation, UTC, and Hercules) available in an industry that Thiokol estimates to be operating at about 30 to 40 percent of capacity. Thus, although Lockheed's decision to exit the industry could not be easily reversed because the company has disposed of the rocket motor division's equipment, it appears that the remaining

*This evidence is particularly relevant to the question of the degree of competition in various sectors of industry. It is also important in the context of "nonpeacetime" levels of demand for products needed by the DoD.

capacity in the industry is sufficient to sustain foreseeable future needs.

Rocket Motor Cases. The steel rocket motor case industry currently consists of six firms. At least five other firms have left the industry in the last few years, and GE's continued participation may be uncertain, as described above. The expansion of this industry occurred in the late 1950s and early 1960s when it appeared that there would be a considerable demand for large rocket motor cases for long-range nuclear missiles. However, the demand did not materialize as projected, because not as many ICBMs and IRBMs as anticipated were produced and because other materials were introduced into the manufacture of rocket motor cases. When the volume of business turned out to be insufficient to support nearly a dozen firms, several firms simply dropped this product line, and at least one other, GE, has considered doing so. Should GE decide to discontinue the manufacture of rocket motor cases, however, most of the equipment and facilities would probably be retained, since they could be used in the firm's aircraft engine operation. Thus, if the demand increased radically, it might not be too difficult to restart the operation.

Traveling Wave Tubes. TWTs were developed about 25 years ago. They have, for the most part, replaced klystron or magnetron tubes as amplifiers. In turn, as technology matures, TWTs are gradually being replaced by solid-state devices (so far only at low power levels). These changes are reflected in the composition of the industry that manufactures TWTs. In recent years, Sylvania, RCA, Sperry Rand, Westinghouse, and General Electric have all dropped the product line,

although they all remain active participants in other parts of the defense industrial base. To a certain extent their capacity has been absorbed by the firms that have remained in the business (Varian, Litton, Hughes, Teledyne, and Watkins-Johnson) through the acquisition of plant and equipment and the hiring of some skilled personnel. Overall, industry officials estimate that they are currently operating at about 50-percent capacity. When demand does increase, as when Varian recently contracted with the Navy to produce 6000 TWTs (requiring almost a tripling of Varian's usual annual production), the needs are met by hiring additional personnel.

Forgings and Castings. Estimates of the numbers of foundries that have gone out of business entirely in the last few years range from hundreds up to two or three thousand.* There is speculation as to whether this large-scale "exodus" is the result of the imposition of impossible EPA and OSHA requirements or whether it is a result of a predictable consolidation of the industry that was bound to occur anyway. Whatever the reason, the impact on the defense industry has been profound. Just at the time that the Army decided to increase the production of tanks after the 1973 Mideast War, two of the three facilities that had made castings for tank hulls and turrets closed their doors because the foundry operators did not believe that long-term business projections warranted making the capital investments necessary to comply with EPA and OSHA requirements.**

*For varying estimates of the scope of the problem, see "Where Overregulation Can Lead," Nation's Business, June 1975, p. 29; and H. Dana Moran and James L. McCall, "If Studies Were Steel, and Talk Titanium," Astronautics and Aeronautics, May 1976, p. 48.

**Debbie C. Tennison, "The Foundry Industry--Achilles' Heel of Defense?" National Defense, March-April 1976, pp. 366-369.

Several of the programs we surveyed (e.g., the A-10 and the Maverick) had problems of some sort in obtaining castings because of EPA and OSHA restrictions, the suppliers' preference for commercial business, or some other reason. Also, virtually all the aircraft programs we surveyed depend on Wyman-Gordon for large forgings because it has the only heavy press in the United States.

Our survey suggests that although this industry has lost participants in recent years (and that the consequences of loss may be especially severe for the DoD), in no case did the Air Force programs involved suffer severe disruptions as a result. What may happen in the future is less predictable; it is conceivable that some type of public-sector intervention--such as subsidies or the setting up of government-owned (or captive) production lines--could become necessary to ensure adequate supplies of vital products.*

Entry into Lower Tiers

Although several industrial sectors that support the programs we surveyed have been characterized by an exiting of firms in recent years (mostly because of declining demand), there are also instances in which firms have entered or attempted to enter some of the lower tier industries.

Wheels and Brakes. The airframe prime contractors in the programs we surveyed have, for several years, been supported by a base of suppliers of wheel and brake systems that consists of Goodrich, Goodyear, and Bendix. Although these three firms were the

*See Section V for a more detailed discussion of the policy implications of establishing government production lines.

only ones with a capability for developing and producing entire wheel and brake systems, several small firms were producing replacement parts, such as brake pads. One of these small firms, Nasco Engineering, indicated that it had made a corporate decision to become a full-fledged developer/producer of whole systems.

The spares sold by the small firms, including Nasco, were typically lower priced than those of the three major developer/producers that had traditionally priced their spares in such a way as to recover R&D costs not charged directly against their development contracts. Being underbid by the small firms, and thereby deprived of its usual method of recovering all R&D costs, led Goodrich to threaten to get out of the military aircraft wheel and brake business altogether unless the Air Force took exceptional measures, available under the Armed Services Procurement Regulations (ASPR), to negotiate for the purchase of certain spares with the original equipment manufacturers. The Air Force invoked the restrictions permitted by ASPR-3-216 to use negotiation instead of formal advertising (competitive sealed bids) in the interest of preserving vital industrial mobilization capabilities. The restriction (called a D&F 16) was in force in FY 1975. Although it has not been reimposed, the initial use, together with the possibility that it might be reimposed, has caused Nasco to abandon its plans to become a developer/producer of whole systems.

The wheel and brake case has been a controversial one. At the request of the Congressman from Nasco's district, the General Accounting Office (GAO) investigated the Air Force's use of the D&F 16. The major finding was that the Air Force did not violate its own

procedures in this particular application of the ASPR provision. However, the whole matter was subsequently turned over to the Federal Trade Commission (FTC) for investigation into possible anticompetitive practices by the "big three." The parties are currently embroiled in disputes over FTC subpoenas of corporate records.

What seems to have happened in this case is that the Air Force, believing the Goodrich threat was credible, and that the risk of losing an established supplier was too great to take a chance on the possibility of getting a new one, created a barrier to entry (by the imposition of the D&F 16) into the industrial base.

Cockpit Canopies. In the recent past, most cockpit enclosures for Air Force fixed-wing aircraft have been built by Goodyear Aerospace Corporation, PPG Industries Aircraft & Specialty Products, and Sierracin Corporation. Texstar, the supplier of the canopy for the F-16, has mainly been a producer of windshields for Army helicopters. However, by promising General Dynamics a technological breakthrough in the form of an improved coating for the polycarbonate canopy, Texstar has been able to diversify into a different segment of the transparent-canopy market.* No doubt one of the firm's major incentives for trying to expand into technologically sophisticated cockpit enclosures for fixed-wing aircraft is the volume of business anticipated in the F-16 program. And, if Texstar is successful, the Air Force will have an expanded base of suppliers on which to rely.

*See Appendix A of R-2184/2-AF for a more detailed discussion of Texstar's participation in the F-16 program.

Thermal Batteries. The industrial base that manufactures this particular power system for missiles consists of Eagle-Picher, Eureka, Catalyst Research, and KDI. KDI is a relatively new entrant into an industry that had had only three participants until employees of one of the other firms split off and joined KDI several years ago.

Communications Satellites. Two U.S. communications satellite producers, General Electric and Philco-Ford, recently defeated the dominant American manufacturers, Hughes and TRW, in competition to provide various communications satellites for Japan. Insofar as GE and Philco-Ford use different subcontractors than the major producers, their opportunity to participate in this foreign business may suggest that some changes in the market positions of various subcontractors and suppliers will occur as a result.

# V. THE POLICY FRAMEWORK

The main purpose of the research reported here has been to test the hypothesis that the lower tiers of the industrial base are becoming inadequate to meet DoD's peacetime needs because the latter's business characteristics are driving firms, either voluntarily or involuntarily, from the base. We have therefore deliberately limited our examination of defense procurement policy issues to a description of the roles that the DoD, the Congress, and the courts play in policymaking decisions that affect the industrial base. Further, since the results of our research suggest that the real problems are due to a technological uncertainty about new weapon system development, and to some industry contraction as a normal response to declining demand, we have obviously not tried to develop elaborate policy recommendations designed to correct problems that we have found to be largely nonexistent. Thus, whatever tentative suggestions we do make in the context of our elaboration of the policy framework are aimed primarily at increasing the efficiency of the weapon system acquisition process in general. With that in mind, let us turn to an examination of the role of the DoD and its military departments as policymakers and as implementers of the policies established by other government agencies.

## THE DEPARTMENT OF DEFENSE

The DoD's responsibility for and authority over the industrial base is derived largely from the Armed Services Procurement Act of

1947, the legislation that sanctions the DoD's role as a purchaser of goods and services, and from the Defense Production Act of 1950, which charges the Secretary of Defense with ensuring that an adequate industrial base exists to meet the needs of the DoD. Also, the Defense Industrial Reserve Act of 1973 indicates that the industrial base should be composed, to the maximum extent possible, of private-sector firms. However, it also provides for the maintenance of some government-owned facilities that are necessary to support our defense needs in an emergency.

Much of what the DoD does in its interaction with firms supplying defense-related products is merely implementation of other legislation passed by the Congress. Obtaining certified cost and pricing data as required by the Truth in Negotiation Act and requiring compliance with Cost Accounting Standards are two examples. Certain other DoD actions that affect the industrial base are also mandated by actions taken elsewhere in the executive branch, e.g., requirements that firms have affirmative action programs in accordance with an executive order by the President.

Use of Procurement Regulations

Although the DoD is constrained in some respects by the provisions of legislation or other executive actions, it does have considerable flexibility in dealing with the industrial base. This flexibility derives largely from its authority to develop regulations implementing the provisions of the Armed Services Procurement Act. These regulations, the Armed Services Procurement Regulations (or ASPRs), provide the framework for policies governing development and

procurement of products for the DoD.* In addition to a few thousand pages of ASPRs, there are also individual service regulations, directives, manuals, military specifications and standards, etc. In total, the volume of documents governing procedures for the DoD's relationships with the industrial base is astounding. As an example, the Commission on Government Procurement noted that one contracting officer at the United States Army Electronics Command, Philadelphia Procurement Division, has a 5-foot shelf of procurement and procurement-related regulations for which he is supposed to be responsible.**

Because of the sheer volume of the regulations, it has not been possible to study them all in great detail. And, since the DoD often interacts with the lower tiers indirectly, many of the rules and procedures found in this maze of regulations are not applicable.

However, there are several features of this regulatory framework that are relevant to the lower tiers and which DoD either has the authority to change or to use with discretion. The first of these is ASPR-3-216. This ASPR provision contains the sixteenth of seventeen exceptions to the basic requirement that government procurement be

*Most of the discussion that follows ignores the role of the Office of Federal Procurement Policy, an agency created 3 years ago within the Office of Management and Budget. OFPP's charter is to streamline the overall federal procurement process by establishing one agency in charge of setting government-wide policies, consolidating multiple sets of rules and regulations, etc. Since most of the important policy tools appear to fall within the control of DoD itself at this time, we have not broadened the discussion to include OFPP.

**Report of the Commission on Government Procurement, Vol. 1, 1972, p. 33.

conducted by formal advertising or sealed bid competition.* The alternative to formal advertising is negotiation, in which there is usually some form of competition (price, technology, etc.) but no requirement for the government to choose the low bidder. Although negotiation is officially the exception rather than the rule, most defense development and procurement dollars are spent as outcomes of a process of negotiation rather than formal advertising. And, under the terms of one or another of the seventeen exceptions, virtually all R&D and procurement of major weapon systems is negotiated.

The intent of ASPR-3-216 is to permit negotiation as an alternative to formal advertising in the interest of maintaining vital industrial capabilities to support our needs in a national emergency. In other words, if purchasing a particular product by taking sealed bids and accepting the lowest bid can be shown to have effects harmful to the goal of preserving the industrial capabilities necessary for a national emergency, negotiated procurement may be used as an alternative.

As mentioned in Section IV, this danger to vital industrial capability was deemed to have been posed when Goodrich threatened to drop its role as a developer/producer of wheel and brake systems for military aircraft. This threat was made after Goodrich had consistently lost sealed bid competitions for spare parts to some smaller firms, one of which (Nasco) had indicated that, having established itself as a supplier of spares, it now intended to enter

*This requirement is established by the Armed Services Procurement Act, 10 U.S.C. 2304.

the market as a developer/producer of entire wheel and brake systems. Although the exercise of the ASPR 3-216 (by use of the D&F 16) ensured that Goodrich would continue to be a subcontractor developing and producing wheel and brake systems for military aircraft, it also appears to have effectively kept a potential entrant out of that market.

The Goodrich example calls into question the wisdom of a contracting policy that, in effect, permits firms to refrain from billing the government for direct costs as they occur, on the assumption that these costs can be recovered later, once the firm is in a sole source position in the production phase of a contract (in the wheels and brakes case, during the purchase of spares for logistics support). One ramification of such a policy is that firms lacking the financial strength to price below costs during development (small firms presumably) will be at a severe disadvantage in a competition.* In the case of the three manufacturers of wheel and brake systems mentioned in Section IV, the FTC has begun an investigation to study possible restraint-of-trade issues.

The wisdom of the use of the D&F 16 in the wheels and brakes case is obviously a debatable issue. However, since recent DoD policy

*The U.S. district judge who heard arguments in the Garrett case (for a more detailed discussion, see below) observed that this practice of large subcontractors getting into a program by pricing below cost may have antitrust implications because it effectively excludes the "little guys" from the market ("Subcontract Disputes: The Case of the Missing Remedy?" Federal Contracts Report, No. 550, October 7, 1974, p. K-3). Meaningful implementation of recently developed cost accounting standards that prohibit this practice could alleviate the problem. For further discussion of cost accounting standards, see the section on "The Congress," below.

guidance (DoD Directive 4005.16 "Diminishing Manufacturing Sources and Material Shortages," December 3, 1976) contemplates further use of the D&F 16 as one of the ways in which the DoD can "take rapid remedial action when faced with a material shortage or manufacturer phaseout," the subject merits further discussion. Although the required high-level approval probably means that the provision will not be used too frequently in the future, it seems important that serious consideration be given to the extent to which any future "wheels and brakes"-type applications really contribute to the goal of maintaining an adequate supply base for times of crisis. The "bird in the hand" argument is simply not a sufficient reason for sanctioning "buy in/get well" behavior while at the same time excluding a potential new entrant. Whatever might have happened with regard to Goodrich's bidding or not bidding on the next major aircraft program, other competitors would have remained. And even Goodrich itself would certainly not have disappeared from the U.S. industrial scene.

This incident suggests that future applications of the D&F 16 ought to be limited in number and restricted only to those instances in which they would not result in complete exclusion of the low bidder. Using the D&F 16 to pave the way for negotiation so that business could perhaps be shared between two firms would contribute more to the maintenance of an adequate and competitive industrial base than would an application that restricts entry, possibly prevents exit (although that is even questionable), and results in the Air Force paying higher prices for spares than when formal advertising was used.

This ASPR provision for negotiation as an alternative to purchase by formal advertising was discussed first because it has, until recently, been one of the few provisions of real substance (excluding requirements for "flow-down" of congressionally mandated financial reporting and social legislation, etc.) that relates to the lower tiers of the industrial base. And, since it is only used when the government is buying directly from a firm (most generally, for spares procurement from firms in the lower tiers), it is relevant only to negotiations occurring rather late in the life-cycle of systems.

Procurement regulations containing substantive rules or guidance have been rather limited with respect to the lower tiers, because the DoD's current approach to the development and procurement of major weapon systems is (a) to select a prime contractor and/or system integrator and, (b) to delegate to that firm the responsibility for making business judgments concerning the choice of appropriate subcontractors (which then have contractual commitments to this prime contractor instead of to the government buyer).* Consequently, ASPR regulations concerning subcontractors have been basically limited to (a) provisions requiring review of some prime contractor procurement systems, (b) some limited requirements for government consent to the award of subcontracts over a certain dollar threshold, and (c) to an

*It is important to distinguish the prime contractor from the system integrator, since most large weapon system programs have several primes (firms with direct contractual commitments to the government). In an aircraft program, for example, these might include suppliers of engines, avionics equipment, and armament. The integrator, in addition to being a prime contractor, has overall responsibility for making these various systems work together.

evaluation of some of the prime contractor's proposed "make-or-buy" decisions.

Beginning about a half dozen years ago, events occurred that began to persuade concerned Pentagon officials that the DoD ought to exercise more control over subcontracting, particularly in major weapon system acquisition programs. In part, this increased DoD attention may have been prompted by urgings from members of the Congress, whose concern was largely over corruption in the form of illegal kickback payments by subcontractors to primes.* More fundamentally, however, the DoD was already in the process of implementing a new policy for developing and procuring major weapon systems. The Total Package Procurement concept (see Appendixes B and C of R-2184/2-AF) had been discredited and a new policy had been promulgated. Briefly, this new policy (as embodied in DoD Directive 5000.1 "Acquisition of Major Weapon Systems," July 13, 1971) encouraged the use of prototypes, declared that system costs were to be considered equally with schedule and performance in making program tradeoffs, and mandated the use of contract types consistent with the level of risk present in a particular stage of a program.** According to Directive 5000.1, this last requirement meant that cost-type contracts (for both prime and subcontracts) would usually be appropriate for development.

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*See, for example, The Acquisition of Weapon Systems, U.S. Congress Joint Economic Committee, Subcommittee on Priorities and Economy in Government, 93d Cong., 1st Sess., Part 7, November 1973.

**A major system as defined in Directive 5000.1 is one with dollar value in excess of $50 million for RDT&E and/or dollar value in excess of $200 million for production.

Within a couple of years after the introduction of Directive 5000.1, some officials in the DoD (and the Air Force in particular) became concerned that the policy was not flowing down to the subcontract structure. Given that, overall, about half of the dollar volume spent on major weapon systems goes to the subcontractors, this lack of flow-down was considered to be a potentially serious problem.

This concern was certainly heightened by a dispute between McDonnell Douglas and Garrett Corporation, a major subcontractor for the F-15. During the development phase, Garrett found that unplanned changes and unanticipated R&D costs made it impossible for it to fulfill its commitments to McDonnell Douglas within the limits of its firm-fixed price contract.* At one point during the dispute Garrett stopped performing the contract, but later resumed work under a court order that also required McDonnell Douglas to negotiate Garrett's monetary claims.

The claims and counterclaims by the two parties in this dispute are too numerous and complex to be dealt with in detail here.** However, particularly relevant to a discussion of the Garrett case as an impetus for changing ASPR regulations to increase DoD authority over subcontracting was Garrett's claim that the Air Force, in effect, allowed McDonnell Douglas to violate DoD acquisition policy

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*For another interpretation of Garrett's financial problems with the F-15, see the footnote on page 55, above.

**For elaboration of the issues in this case, see, "Subcontract Disputes: The Case of the Missing Remedy?" op. cit., and "Subcontracts: Garrett Appeals District Court Ruling on Exercise of Option and Findings of Irreparable Injury," Federal Contracts Report, No. 566, February 3, 1975, pp. A-17 through A-21 and pp. K-1 through K-9.

(as embodied in Directive 5000.1) by not requiring them to give Garrett a cost-plus incentive fee contract for development--the same kind of contract that McDonnell Douglas had with the Air Force.*

Despite the language of Directive 5000.1, nothing had been added to the ASPR provisions to specifically require that the policy be applied to subcontracts. The Air Force drafted revised ASPR provisions (known as ASPR Cases 75-36 and 73-36), which have recently been approved for inclusion in the ASPR. The basic thrust of these ASPR changes is to increase the government buyer's authority over prime contractors' decisions regarding selection of "critical" subcontractors and over the content of contract terms; they also allow the government buyer to single out "critical" subcontractors for special surveillance once a program is underway.

First, additional authority over subcontractor selection derives from expanded requirements for government consent to the prime's "make-or-buy" decisions through broader applicability of Contractor Procurement System Review (CPSR) requirements (now extended to subcontractors with contracts worth $5 million/year or more), and from expanded requirements for government consent to the placing of individual subcontracts. Second, increased government authority over the content of "critical" subcontracts is based on the explicit requirement that the government determine whether the contract type conforms to current acquisition policy (Directive 5000.1) and whether it contains an accurate statement of the technical requirements found in the prime contract. The government must make these determinations

*"Subcontract Disputes: The Case of the Missing Remedy?" op. cit., pp. K-1 through K-2.

as part of the process of issuing consent to individual subcontracts. Third, the government has the authority to single out "high risk or critical subsystems or components thereof as requiring the application of special management attention in addition to assignment of support administration."*

To make sure that all of these requirements can be carried out, the guidance of ASPR 23-108, "Surveillance of the Contractor's Approved Procurement System," has been approximately tripled in length to provide for what appears to be nearly nonstop evaluation of a contractor's system for procuring products once that system has passed the initial CPSR. However, according to the ASPR, it is understood that none of these regulations dilute the prime contractor's responsibility for managing his subcontracts.

Except for the use of a clause modeled along the lines of these new requirements in the F-16 prime contract, the regulations are too new to have been implemented. One certain result of their implementation will be to increase the prime contractor's volume of paperwork (and that of the subcontractors to which the CPSR requirement becomes applicable). It is the anticipation of more paperwork that has caused industrial groups such as the Council of Defense and Space Industry Associations (CODSIA) and the Machinery and Allied Products Institute to object to these changes in the ASPR provisions. Another result will be an increased intrusion of contract administration staffs into the business affairs of the prime and subcontractors.

*ASPR-20-704 (b).

This increased administrative burden is bound to raise costs of weapon systems, since the government pays the firms for compliance with the new rules. Further, if the new regulations are fully implemented, they are likely to undermine the prime-contractor concept and to create a series of de facto associate contractorships. Such a result would probably force the government to assume (in addition to its new authority) much more direct responsibility for subcontractor performance than it may want.*

Since most problems with subcontractors during programs appear to be caused by technological uncertainty or by more fundamental difficulties in the system acquisition process (some of which are raised in the preceding discussion of the Garrett case), the new ASPR provisions are not apt to provide a very effective remedy. Further, since their implementation is likely to have some costly and troublesome side effects, they should probably be rescinded.

## Incentives Operating on Acquisition Programs

Although our analysis (and indeed research on other procurement topics) suggests that just changing the ASPR to provide for more government oversight is not likely to yield major or lasting improvements, certain actions, if taken by DoD buyers, could increase peacetime efficiency in developing and procuring weapon systems as well as help to ensure that the DoD has access to necessary industrial capabilities in times of crisis.

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*For a more detail discussion, see the section on "The Courts," below.

To begin with, there are some real issues with regard to division of financial and technological risks between the prime contractor and his subcontractors. At the start of a new program, as well as during development and production, there is considerable pressure on all participants in the programs to minimize cost estimates and the appearance of technological uncertainty. The reason is simple: Congress is more likely to approve a new program that does not have a huge price tag and acknowledged high levels of technological risk. The DoD, its service components, and the offering prime contractors are thus faced with incentives to minimize their estimates of these risks in order to get initial approval of a program. To use the McDonnell-Garrett case as an example, Garrett claimed that McDonnell Douglas had submitted cost proposals to the Air Force 6 months before it even asked for bids on many of the subcontracted systems. These proposals were designed to maximize McDonnell's chances of winning the program contract, so they had to be based on a plan to shift considerable financial risks to the chosen subcontractors.* None of this risk seems to deter potential subcontractors, who presumably assume that they can recover any early losses over the life of the program.

The point here is that there are fundamentally perverse incentives in a process that encourages the military buyer and its prime contractor to underestimate program costs, grants the prime contractor a development contract that reimburses all of his actual

*"Subcontract Disputes: The Case of the Missing Remedy?" op. cit., p. K-3.

costs, and ultimately uses these costs as the base for determining profit. It is arguable whether the incentives in this situation are any better than those provided under Total Package Procurement, in which the prime contractor was also encouraged to underestimate real costs and risks, pressed when things went badly under the fixed-price arrangement, and was ultimately rescued, if necessary,* by the government through complete reformation of the contract (as in the SRAM program), federally guaranteed loans (as in the C-5A program), or other means. Until some steps are taken to change the incentive structure, a mandated extension of cost-plus arrangements (much of which would presumably affect other large firms such as Garrett) will simply encourage "bad behavior" by a larger number of participants in the process.

One recent policy initiative in the DoD constitutes a small step in the direction of changing this perverse incentive structure. As a result of its "Profit '76" study, the DoD has issued new guidelines for determining profit objectives in defense contracting.** However, despite some changes that are designed to encourage contractors to make investments to increase productivity and reduce costs, about 90 percent of the prenegotiation profit objective is still based on the estimated costs.*** Unless the balance can be shifted more, it seems

*Rescue wasn't necessary in all cases, as, for example, in the Maverick program discussed in Appendix B of R-2184/2-AF.

**Defense Procurement Circular Number 76-3, September 1, 1976. Other DoD policy guidance indicates that these new policies should filter down to the subcontract structure.

***"Profit: GAO Review of DoD 'Profit '76' Study Generally Favorable, Some Recommendations Offered," Federal Contracts Report, No. 670, February 28, 1977, p. A-2.

doubtful that the new policy will do much to change the status quo.* Consequently, cases of confusion over government policy affecting a contractor's acquisition of new facilities and equipment** are likely to be repeated as long as the volume of defense business is too small to merit purchase of new equipment and as long as profits are largely a function of negotiated costs.

Perhaps the most reasonable approach to subcontractor and supplier problems is to deal with them on a case-by-case basis rather than by mandating specific approaches that may only be applicable to a small percentage of the cases. Since most of the problems that occurred in the programs we surveyed were the result of technological difficulties and therefore not predictable in advance, it seems reasonable to rely on the discretion of the SPO and the prime contractor to deal with problems as they occur. For example, as the SRAM-A program progressed, both the SPO and the prime contractor believed that the price for the rocket motor was too high. So they reintroduced competition.

Our analysis suggests that the use of dual sources of supply during a program can result in significant price reductions and can

*For an interesting comparison of the incentive structures in commercial and defense contracting, see "Design-to-Cost, Commercial Practice vs. Department of Defense Practice," Report of the Defense Science Board Task Force on Reducing the Costs of Defense Systems Acquisitions, Office of the Director of Defense Research and Engineering, Washington, D.C., March 15, 1973. For a related discussion of the negative effect of cost-based profit policy on ASPR-mandated cost-reduction incentives, see Geneese G. Baumbusch, The Impact of Required Contractual Clauses on System Acquisition Policies: The Case of Value Engineering, The Rand Corporation, R-1722-PR, September 1975.

**We describe such cases in Appendixes A and C of R-2184/2-AF.

provide backup capability in case one of the suppliers has serious technological problems. The value of maintaining competition was demonstrated by examples from both the Maverick and SRAM missile programs, as well as by some of the aircraft programs. DoD program managers can use their influence (and available resources) to encourage the maintenance of competition where it seems likely to yield cost savings and/or a desirable backup capability. Program offices could also hedge against risks by "breaking out" critical items and managing them directly, a tactic that has been employed at several points by the Maverick SPO. Competition could be used if deemed appropriate, or perhaps the degree of technological uncertainty might suggest that a cost-plus contract be used. Further, within the limits of available funds, some multiyear buying could be initiated. The one-time buying of items to meet anticipated requirements (life-of-type buys) could be done in situations in which a supplier plans to drop a product line before all the DoD's projected needs are satisfied--as in the example of the SRAM filter connector.* Selected other multiyear buying actions could relieve some production planning problems for some suppliers.

Before we move on to discuss some other policy options that, in addition to possibly improving peacetime efficiency, would also enhance the DoD's access to a broader industrial base in both peacetime and crisis situations, some comments may be in order

*Such a suggestion is obviously based on an assumption that the DoD not only has the capability to anticipate requirements but uses it.

regarding who in the development and acquisition process should be making the kinds of decisions described above.

We have already suggested that a tailored approach to dealing with problems on a case-by-case basis seems more appropriate than blanket requirements for ASPR-mandated reporting systems. Our analysis indicates that the prime contractor and the SPO personnnel are in the best position to know about and deal with problems (regardless of origin) in weapon system programs.* Despite this fact, there seems to be some overlap between the activities of the contractor and/or the SPO and the contract administration contingents, particularly when the latter are resident in a particular plant.** This overlap seems to be most significant in the quality assurance and engineering areas. In quality assurance, a recent DoD study*** indicates that contract administrators often duplicate activities for which the contractor is responsible and for which he is being paid. Since the average age of contract administration services personnel is inclined to be rather high (37 percent are eligible for retirement, either immediately or if their jobs were abolished), they tend to lack modern training, particularly in the discipline of engineering. Program offices have expressed dissatisfaction with the quality of services received.

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*This is not a new finding! See, for example, B. H. Klein, W. H. Meckling, and E. G. Mesthene, Military Research and Development Policies, The Rand Corporation, R-333-PR, December 1958.

**For discussion of contract administrators (mostly belonging to the Air Force Plant Representatives Office) in the programs we surveyed, see Appendixes A, B, and C of R-2184/2-AF.

***"A Study To Improve Management of the Department of Defense Contract Administration Mission," Office of the Assistant Secretary of Defense for Installations and Logistics, March 1976.

If the scope of contract administration activities were reduced, duplication of effort could be avoided, costs reduced, and responsibility for an individual program's success or failure localized where it reasonably belongs--with the contractor and the military buyer.* Such reduced activity would include generalized responsibilities for monitoring plantwide, nonprogram specific activities (such as the status of government-owned equipment in the possession of contractors and the disbursement of progress payments).

Maintaining an "Adequate" Industrial Base

To conclude our discussion of the role played by the DoD in policymaking decisions that affect the industrial base, we would like to describe some of the policy tools that, in addition to contributing to increasing peacetime efficiency, might also help to ensure that the DoD has access to adequate supplies of products in a time of crisis. First of all, our research indicates that the specialized nature of the DoD demand (i.e., for products that either perform differently from similar products sold in other markets or that are manufactured by procedures different from those used for other purposes), combined with the absolutely reduced and erratic nature of that demand, has both limited the base of suppliers

*The "Forward Look" study mentioned above suggests that reducing the scope of contract administration activities could allow for an overall 22 percent personnel cut in DCAS and the Air Force, Army, and Navy contract administration groups. It is not yet clear what impact this would have on the size of the staff required to carry out the new ASPR provisions discussed above.

A further suggestion might be to fully implement the recommendation made in the early 1960s to merge all the groups into one DoD-wide service.

available to the DoD and raised prices. Although our information is sketchy, what we do have suggests that the defense buyers' use of specialized buying practices, both substantive and administrative, raises prices by a factor of 2 to 5 over comparable products made without these practices.

In Section II, we stated that in the absence of corroborating evidence from industry and government sources, we did not have the expertise to make judgments about the government's specialized buying practices. However, there does seem to be evidence to support the notion that many of the specialized contracting practices and production techniques are overused. This is particularly true as far as the administrative portion of the specialized buying practices--documentation, verification, surveillance, etc.--is concerned. However, there may also be possibilities for reducing some of the other specialized requirements as well. For example, a firm quoting a price for test stations for the SRAM-B programs indicated that to manufacture the stations in accordance with all the military specifications, etc., would raise their price 300 to 500 percent.* Investigation revealed that perhaps one reason for not manufacturing the stations according to standard commercial practice was the requirement that they operate in explosive environments. However, this requirement could have been met without a blanket application of military specification procedures. Both in order to reduce prices in peacetime and to broaden the base of suppliers available to the DoD in times of crisis, DoD buyers should give

*For a more detailed discussion of this example, see Appendix C of R-2184/2-AF.

serious consideration to a more selective application of specialized contracting practices and to purchasing very close substitutes in the commercial marketplace whenever possible as an alternative to insisting on a "militarized" version of a product for which there may be a very close substitute.

Still another way for the DoD to broaden its base of supply is to make greater use of foreign sources of supply. Even within the limits of the Buy America Act, selective use could be made of foreign suppliers. Having access to foreign suppliers, particularly those located in allied countries, might enhance our abilities to meet requirements for increased demand, as well as serve other foreign policy and trade objectives.*

Finally, in order to maintain an adequate supply of critical products, it may be necessary for the DoD to occasionally establish captive production lines. Although congressional policy calls for reliance on the private sector, it also provides for situations in which the private sector may not be adequate. We have outlined one case** in which the use of existing policy tools within the DoD has set off a chain of events that might result in the creation of a captive production line. Other instances may occur in the future when similar actions could be required. The point here is that an adequate existing policy framework is in place to permit such actions to be taken in the limited number of cases in which owning and/or

*For a related discussion, see Charles Wolf, Jr., et al., "Offsets" for NATO Procurement of the Airborne Warning and Control System: Opportunities and Implications, The Rand Corporation, R-1875-PR, February 1976.

**See the discussion of critical compounds used in missile batteries in Appendix B of R-2184/2-AF.

operating a production line may be the only way for the DoD to get adequate and timely supplies of a particular product.

## THE CONGRESS

Since much of what the DoD does in its interaction with the industrial base involves carrying out the will of Congress as embodied in legislation, much of our previous discussion relates to the Congress as well. As stated previously, it was the Congress, through the Armed Services Procurement Act of goods and services. Since that time, Congress has, in its role as a protector of the public interest, passed a variety of legislation designed to ensure that the taxpayer dollars are spent efficiently by the Defense Department. The Truth in Negotiation Act, Cost Accounting Standards Act, and the Renegotiation Act are examples of such legislation. As we stated in Section II, we have taken the regulatory framework that is an outgrowth of the role of Congress as a protector of the public interest to be a constraint within which defense business must operate. However, there are elements of the regulatory framework that could probably be modified without undermining Congress' responsibility to see that taxpayer dollars are properly spent.

### Cost Accounting Standards

For example, the purpose of the Cost Accounting Standards Act is to create a uniform set of accounting standards for government contracting. Before the passage of the Act, there was concern that industry was exploiting different accounting systems to overcharge the government. Admiral Rickover had estimated that the application

of uniform accounting standards could save the government $2 billion a year.* So the Act that was passed established criteria for applicability of the standards and created the Cost Accounting Standards Board (CASB), chaired by the Comptroller General, as the agency that would promulgate standards and have authority to grant exceptions.

Cost accounting standards (CAS) now apply to a firm's negotiated contracts of $100,000 or more if that firm has at least one negotiated contract valued at $500,000 or more. Given the reduced purchasing power of the dollar, the $100,000 and $500,000 thresholds are not very high. Furthermore, there is confusion over whether subcontractors are responsible for complying with all standards promulgated by the time the subcontract is awarded or if their responsibilities for compliance are based on those of the prime contractor.**

One obvious result of the relatively low dollar threshold used for determining applicability of cost accounting standards is that many small firms that are not sufficiently staffed to take the time to understand and adapt to the standards are forced to comply. The argument is that the financial burden of compliance is disproportionately heavy on those firms that do small dollar volumes of government business. Also, some very large firms (U.S. Steel is an example) that do only a small fraction of their business with the

*House Committee on Banking and Currency, To Renew the Defense Production Act of 1950, As Amended, House of Representatives, 90th Cong., 2d Sess., Hearings on H.R. 15683, April 10-11, 1968, p. 77ff.

**"Accounting: DoD Proposes Changes to ASPR Coverage on Cost Accounting Standards for the Subcontractor," Federal Contracts Report, No. 670, February 28, 1977, p. K-15.

government are also required to change their accounting systems to comply. Further, the applicability of standards to all negotiated contracts includes those that are fixed price and that may (although negotiated) have been awarded after meaningful price competition. The Office of Federal Procurement Policy has continued to question the utility of the blanket requirement for CAS for all negotiated contracts.*

Recently, the CASB itself has taken the initiative to suggest that all contracts under $500,000 be exempted from its requirements. It also has proposed that small businesses doing less than $10 million of government business per year should be exempt. Both of these suggestions seem to be reasonable steps toward reducing the administrative burden on smaller, nongovernment oriented firms. These modest reductions in coverage would also allow more government administrative effort to be expended on monitoring compliance where large amounts of business are involved.

Renegotiation

Another piece of legislation that is designed to protect the taxpayers' money from improper use and that affects the lower tiers is the Renegotiation Act. The Renegotiation Act provides that part of contractor (or subcontractor) profit may be recovered retroactively if, under the terms of the Renegotiation Act, such profit (not profit on an individual contract but on an average of the

*"Accounting: OFPP Suggestions for Limiting Application of Cost Accounting Standards Get Cool Reception from CASB," Federal Contracts Report, No. 668, February 14, 1977, p. A-1.

firms' contracts that fall under the terms of the Act) is determined to be excessive. This legislation (which originated after World War II because of concern over defense contractor profiteering), and the authority contained in it, was supposed to have been temporary. Despite controversy over whether renegotiation and the efforts carried on by the Renegotiation Board are ineffective, anachronistic, or a useful contribution to protecting taxpayers' dollars, the Act has been repeatedly renewed by Congress. Legislation that would change Renegotiation Board procedures and make the Act permanent (the Minish Bill, H.R. 4082) is currently under consideration in the Congress.

Our analysis has indicated that the real subject for concern is contractor costs and not contractor profits, and we therefore agree with those who argue that renegotiation is an ineffective anachronism that does little in peacetime to protect the public interest. Comments by Senator Charles McC. Mathias (R-Md.) when he introduced a bill to abolish the Board summarize the subject in a manner very consistent with our findings. Senator Mathias asserted, among other things, that the burden of renegotiation has traditionally fallen most heavily on small firms that do not have many product lines among which to offset profits and therefore "hide" evidence of high profits on a particular product line.* Use of renegotiation in peacetime is also identified as being inconsistent with the notion of a free enterprise system, and it diverts attention

*According to Congressman Stewart B. McKinney, a former member of the House Subcommittee on General Oversight and Renegotiation, during the most recent extension of the Board's life, 86 percent of its renegotiations involved small firms.

from the real problems in defense contracting.* And finally, renegotiation virtually ignores the risks inherent in the types of major weapon system programs we have been discussing.

## Economic and Social Welfare

In addition to trying to ensure that taxpayer dollars are spent efficiently and are not subject to fraud or corruption as they are dispersed in weapon system acquistion programs, Congress has also mandated that the contracting process be used to accomplish a number of economic and social welfare goals. Because of congressionally imposed requirements, special efforts are to be made to (a) involve small businesses in defense contracting, (b) involve minority businesses in defense contracting, (c) place government business in areas of the country where rates of unemployment are relatively high, etc. In addition, Congress has passed the National Environmental Protection Act and the Occupational Safety and Health Act (OSHA) in a further attempt to promote certain social goals.**

The economic and social welfare legislation has an impact on the lower tiers of the defense industrial base because these contractual responsibilities are usually imposed on them in much the same way

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*"Renegotiation: Abolish Board, Focus Excess Profit Prevention in Contract Process, Sen. Mathias Urges," Federal Contracts Report, No. 671, March 7, 1977, p. A-13.

**Since these Acts were not specifically designed to use the government contracting process to implement their goals, and since much of the controversy over them revolves around the method of enforcement used by the executive agencies they have created, we forego further discussion of them here. However, see the section on the courts below for a more detailed discussion of OSHA.

they are on the prime contractors, and also because at least some of this legislation was specifically designed to benefit segments of American industry that may need special assistance to enter into the defense industrial base. The Small Business Act is an example of legislation that was passed to help smaller firms to get government business. The Act created the Small Business Administration, which is supposed to assist firms in various ways and encourage government buyers to make use of the services of small business. As a result of this congressional action, there are officials designated within the military buyers' organizations to assist small businesses.

Insofar as legislation such as the Small Business Act is effective, it can contribute to broadening the industrial base. However, there are questions about how effective it really is. Several of the government and corporate officials interviewed in our survey did not feel that the legislation is implemented very effectively. As an example, one small firm had been awarded a regional certificate of excellence as a small business defense contractor. But this was no assurance of the firm's being considered qualified on related products. In fact, in a subsequent bid, this firm had to sustain the costs of two separate site visits after the first produced an unsatisfactory pre-award survey. There has also been recent criticism of the efficacy of legislation requiring the Pentagon to contract in high unemployment areas and to utilize minority business.*

*See, for example, "Pentagon Is Criticized for Not Aiding Jobless," The New York Times, April 4, 1977.

It is difficult to know whether these criticisms are legitimately directed at those who do defense contracting or at those who wrote the legislation that the DoD is supposed to be implementing. It is also difficult to know whether the criticisms are valid or whether the recordkeeping systems are merely not comprehensive enough to reflect the real level of implementation. It is important to keep in mind, however, that although the stated goals of the economic and social welfare legislation may indeed be desirable, they are not accomplished without costs to efficiency of the weapon system development and procurement process. Any consideration of either broadening their requirements or trying to gather more detailed information about how they are being implemented should also take into account the special burden their application places on the procurement process. Congressional deliberations should recognize that making defense procurement an instrument of social and economic engineering runs contrary to the requirement that defense procurement be conducted with a high degree of economic efficiency.

## Appropriations and Implications

Having discussed Congress' role in the creation of the regulatory framework which governs defense contracting, we turn now to describe Congress' most direct policy tool--its power to approve and finance major weapon system acquisition programs. We have already discussed how elements of the program approval and appropriations process may create perverse incentives for DoD buyers and contractors.* What

*See the discussion on "Incentives Operating on Acquisition Programs," above.

remains to be said is that almost any policy change of any significance contemplated by the DoD involving large amounts of money and/or the status of individual programs would have to be approved by Congress in the appropriations process. For example, the possibilities for increasing multiyear buying actions to smooth demand might be limited by available funds and congressional unwillingness to provide additional money. Also, Congress might be unwilling to (or, alternatively, inclined to) take certain actions because of constituent interests. For example, a recent DoD/OMB study concluded that there is significant extra capacity in the aircraft industry, and it proposed eight policy alternatives for reducing this capacity and thereby saving money.* Since some or all of the eight alternatives would ultimately result in the attrition of individual airframe prime contractors accompanied, presumably, by effects on supporting industries, employment, etc., in the affected areas, there will be some members of Congress whose constituents will be affected by whatever the DoD proposes. Whether or not these regional interests would be substantial enough to thwart any action at all remains to be seen.

The control exerted by Congress over the defense procurement process, both through regulation and, more importantly, through the appropriations process, is a complicated subject that we have only tried to outline here. While we agree that there are some features of the regulatory process (such as cost accounting standards) that

*"Defense Program: Findings on Aircraft Industry 'Overcapacity' Not Reflected in FY 1978 Budget," Federal Contracts Report, No. 676, April 11, 1977, pp. A-8 through A-12.

are reasonable congressional attempts to protect the public interest, we suggest that these features could probably be applied less comprehensively with substantial savings and little detriment to the goal of protecting the public interest and some improvement in conditions for firms that do defense business. We have also indicated that the DoD will probably have to continue to live with the burdens of economic and social welfare and environmental and safety legislation, but that, so far, those burdens, although sometimes costly, have not been impossible ones. Finally, we have suggested that Congress, through the appropriations process, exerts powerful control over the DoD's ability to adjust its policies. In this area, and in the others, the influence of the DoD on congressional action cannot be much more than a long-term educational process.

## THE COURTS

In addition to the legislative and the executive, the judicial branch of government also plays a role in policymaking decisions that affect the industrial base. The courts may nullify existing policy by voiding legislation, etc., and/or they may help to set policy precedent through other judicial decisions. As an example of the former action, the Supreme Court of the United States has recently agreed to hear a case that could result in a finding that the Occupational Safety and Health Act is unconstitutional because the procedures it establishes for determining compliance--spot checks--violate Fourth Amendment rules against unreasonable search and seizure. Should OSHA be struck down, it would presumably be

rewritten with different inspection procedures. What would happen to firms that have been subject to its regulation in the meantime is not known. Basically, this case (and a contractor debarment case described in Appendix A of R-2184/2-AF) illustrates the power of the judicial branch to interpret and, potentially, to reject the social and economic welfare legislation or regulation that is applied to firms.

Further, the courts may set policy precedent with regard to the relationships among government buyer, prime contractor, and the subcontractor. In some recent disputes between prime and subcontractors, the subcontractors have argued that the prime contractors, in taking various actions that relate to the subcontractors, are really acting as agents of the government buyer. To quote from a brief in a recent case,

> ". . .[the prime contractor] has a cost-plus contract with the Air Force. . ., every cent of its costs incurred are reimbursed to it by the Air Force plus profit and administrative expenses, [the prime contractor] employs numerous Government-owned facilities in the performance of the prime contract which are provided to [the prime contractor] on a rent-free basis. . ., [the prime contractor] has resident in its plant a substantial corps of Government officials to oversee and to supervise its performance of the prime contract and other contracts, and the overwhelming majority of the work done by [the prime contractor], both throughout its huge corporation and at the facility responsible for performing the prime contract at issue here, is Government business . . . . Thus, [the prime contractor] virtually stands in the shoes of the Government in terms of this procurement . . . ."

The point here is that increased government authority over subcontracting decisions, as recently incorporated in the ASPR provisions, is likely to strengthen the claim that the prime is

merely "standing in the government's shoes" and that the government should be responsible for the consequences of actions taken by its agents. Should the courts move toward accepting this argument, the result would be to undermine the concept that the government is not responsible for subcontractor affairs because it has no privity of contract; one consequence would be that the government buyer would become vulnerable to suits by subcontractors. Over the longer term, the prime contractor concept would be replaced by relationships between the government buyer and each of perhaps 10 to 50 associate contractors for a given program. Such a situation may or may not be desirable, but it appears that its implications should be weighed in the DoD, particularly in terms of the new ASPR rules on subcontracting.

## IMPLICATIONS AND FUTURE RESEARCH

Based on the results of our program survey, we have concluded that fears about peacetime erosion of the industrial base are largely unfounded. Subcontractors and suppliers have left the base, but their leaving seemingly has not interfered with the Air Force's ability to develop and produce the systems it currently needs. Our information about the purportedly higher prices being paid by the Air Force because of reduced competition is sketchy, and more research would be useful in this area. Further, when individual subcontractor and supplier problems have occurred in a given program, their primary causes have been technological rather than poor defense contracting techniques.

Since we did not uncover a pervasive problem, we have deliberately not recommended sweeping policy changes. What we have done is describe how the DoD, the Congress, and the courts interact in policymaking decisions that affect the defense industrial base. We have also made some tentative suggestions for policy actions (dual sourcing to maintain competition, multiyear buying, more selective use of specialized contracting practices, etc.) that have probably always been reasonable from the standpoint of increased efficiency in military acquisition but which seem to be particularly important in an era of declining procurement budgets (in real terms) for sophisticated military equipment.

Finally, as indicated at the outset of this report, our research to date has focused primarily on peacetime issues. Future research in this area will try to determine whether the lower tiers of the defense industrial base are capable of meeting the additional demands that might be levied in some forseeable future crisis, and, if not, what the costs would be of maintaining such a capability on a standby basis.

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