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BY THE COMPTROLLER GENERAL

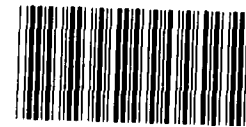
Report To The Congress

OF THE UNITED STATES

Impediments To Reducing The Costs Of Weapon Systems

Major weapons' cost growth since World War II far exceeds the rate of inflation, and no relief is in sight. Various Department of Defense efforts to restrain costs are worthwhile, but unlikely to achieve really substantial cost reductions. The rising costs have reduced the quantities of weapons produced and widened the U.S. forces' numerical disadvantage with the Soviet arsenal.

Many complex factors contribute to high costs; however, the military's desire for maximum performance, high-technology weapon systems together with congressional funding instability and constraints are the major cost drivers. Military and political considerations may prevent fundamental changes, but GAO makes recommendations that could relieve the cost problem.



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COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

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To the President of the Senate and the
Speaker of the House of Representatives

This report presents our views and conclusions formed through frequent evaluations of the major weapons acquisition process over many years. The report addresses the difficult problems connected with the process and their relationship to weapon systems costs, discusses the Department of Defense's attempts to deal with some of them, and recommends actions by the Congress and the Secretary of Defense to relieve them.

We are sending copies of this report to interested congressional committees and Members of Congress; the Director, Office of Management and Budget; and the Secretaries of Defense, the Army, Navy, and Air Force.

James B. Atchefs

Comptroller General
of the United States

*DLG
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CASB*

*Cost analysis
Agency mission
Acq. perf.
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Def. proc.
" contracts
Weapon systems
Def. systems*

C o n t e n t s

		<u>Page</u>
DIGEST		i
CHAPTER		
1	INTRODUCTION	1
2	THE ENVIRONMENT OF DEFENSE PRODUCTION	5
	Commercial practices	6
	Emphasis on performance rather than cost	7
	Concurrent development and production	9
	Determining mission needs and their solutions	10
	Limited rates of production	11
	Funding instability	13
	Absence of price competition	16
	Basing profits on anticipated contract costs	17
	Socioeconomic programs, Government controls, and red tape	18
	Impact on business	20
	Impact on defense industry	21
	Cost accounting standards	22
	Conclusions	23
	Recommendations to the Congress	24
	Recommendations to the Secretary of Defense	24
3	PRODUCTIVITY AND FACTORS THAT INFLUENCE ITS GROWTH	25
	National productivity growth rate	26
	Tangible capital investment	26
	Technological innovation	27
	Research and development	27
	Profit policy	28
	Conclusions	31
4	DOD EFFORTS TO REDUCE COSTS	32
	Investment protection against contract termination	32
	Design-to-cost	32
	Value engineering	35
	Manufacturing technology	36
	Work measurement systems	38
	Should-cost reviews	40

CHAPTER

Page

Contractor independent research and
development
Conclusions

41

42

5 AGENCY COMMENTS AND OUR EVALUATION

43

APPENDIX

I Office of Management and Budget comments

44

ABBREVIATIONS

CASB Cost Accounting Standards Board

DOD Department of Defense

GAO General Accounting Office

GSA General Services Administration

IR&D independent research and development

OMB Office of Management and Budget

D I G E S T

Through the years, concern within the Congress and the Department of Defense (DOD) has been increasing over the ever-rising costs of weapon systems. The unit costs of ships, aircraft, tanks, and related items have increased dramatically since World War II--even after discounting the effect of inflation. With constrained peacetime budgets, this has resulted in the production of relatively small quantities of many weapon systems and has seriously affected overall military capabilities.

In this report, GAO attempts to identify the major factors leading to increased weapon systems costs, discusses steps that have been taken to control those costs, and recommends further actions which could be helpful in restraining future costs.

GAO believes the major effects on costs have resulted from

- attempts to deploy systems with new technology and high performance;
- low rates of production due to budget constraints and desires to maintain active production bases as long as possible;
- absence of price competition between contractors;
- lack of real motivation on the part of contractors to reduce costs;
- the impact of socioeconomic programs, Government controls, and red tape; and
- a nationwide problem of reduced research and development expenditures and lessening productivity.

Some steps that have been taken by DOD in attempts to limit costs include

- revising profit policies to provide incentives for contractors to increase capital investments,
- providing protection against contract terminations,
- conducting design-to-cost programs,
- providing value engineering incentives,
- conducting a manufacturing technology improvement program,
- increasing attention to contractors' work measurement systems,
- performing "should-cost" analyses of contractors' operations, and
- supporting contractor independent research and development.

GAO has concluded that these cost containment/reduction programs are generally worthwhile and deserve continuing emphasis. GAO also believes, however, that such programs will not have a major impact on overall costs because the principal factors that tend to drive the costs upward are (1) the desire for high-technology systems and (2) the budget constraints that lead to uneconomical procurement and production practices. While changes in acquisition policies and funding patterns are possible and could result in lower costs, military and political considerations may preclude any radical departure from current practices.

CONTRACTORS' COMMENTS

A number of major defense contractors commented on this report and were in general agreement with most of the conclusions and recommendations. Almost all, however, disagreed with GAO's views on the noncompetitive nature of weapons systems procurement and the impact of the Government's profit policy.

In general, the contractors believe that there is intense price and technical competition during the planning phases of weapons systems acquisitions. Although they agree that there is little or no subsequent competition, they believe it is erroneous to categorize these procurements as noncompetitive. They further state that the Government obtains very real cost and technological benefits from the competition that does occur early in weapons programs.

GAO agrees that on many programs there is early technological competition and that it may not be feasible to expect continuing price competition throughout the life of major programs. GAO does believe, however, that the absence of price competition has an adverse long-term impact on total costs.

With respect to profit policies, most contractors did not believe that an increase in profits, based on facilities employed, would provide the motivation necessary for contractors to make capital investments. It was their opinion that program stability--some guarantee that investments could be recovered--was much more important than a slight increase in profits. Several contractors also stated that their investment decisions were related to maintaining and enhancing their long-range competitive position for future business rather than being related to specific contracts or programs.

On the basis of many studies conducted during the past 10 years, Government profit policies have been restructured to give more weight to invested capital in setting profit objectives, and less weight to production costs. The assumption was that if profits were based on costs, contractors would be motivated to keep their costs at high levels.

Until now, the revised profit policies have not accomplished the objectives sought, and the relative weighting in favor of invested capital is being increased again. If the contractors' comments are valid, the changes alone will not lead to increased capital investment and lower costs.

OFFICE OF MANAGEMENT
AND BUDGET COMMENTS

The Office of Management and Budget stated that multiyear funding has been considered in the past as a possible acquisition strategy. It believes the advantages offered by increased program stability still have to be weighed against the disadvantages resulting from reduced flexibility to meet changing priorities and needs.

GAO finds it difficult to accept the Office of Management and Budget's rationale. Multiyear funding does not mean that procurement schedules and funding cannot be subsequently changed by the Congress and the administration of necessity because of other priorities.

GAO believes the strong possibility exists that the real savings resulting from program stability could provide funds for a much greater degree of flexibility than is now possible.

DOD COMMENTS

DOD comments were received too late to be included in this report.

RECOMMENDATIONS TO THE CONGRESS

The "high-low" mix concept of weapons deployment has been widely discussed. Generally, however, U.S. military services have opted for the high-technology side of the mix. GAO recommends that the Armed Services and Appropriations Committees carefully examine lower cost options before approving new weapon programs. In particular, the committees should explore with senior military officials the pros and cons of larger quantities of alternative weapons versus smaller numbers of highly sophisticated and expensive systems. The committees also should--after being satisfied that a weapon system is ready for production--consider multiyear funding in order to take advantage of more economical production practices.

In addition, GAO recommends that the Congress should take the initiative to respond to the recommendations of the Commission on Government Procurement to (1) reexamine the full range of socioeconomic programs applied to the procurement process and the administrative practices followed in their application and (2) raise the minimum dollar thresholds at which such programs are applied to the procurement process.

RECOMMENDATIONS TO THE
SECRETARY OF DEFENSE

The Secretary of Defense should make a comprehensive study to identify those aspects of contract administration that can be relaxed or modified in order to reduce costs and paperwork.

The Secretary of Defense also should take stronger initiatives to accelerate the implementation of management policies for major weapon system acquisitions, as set forth in the Office of Management and Budget Circular A-109.

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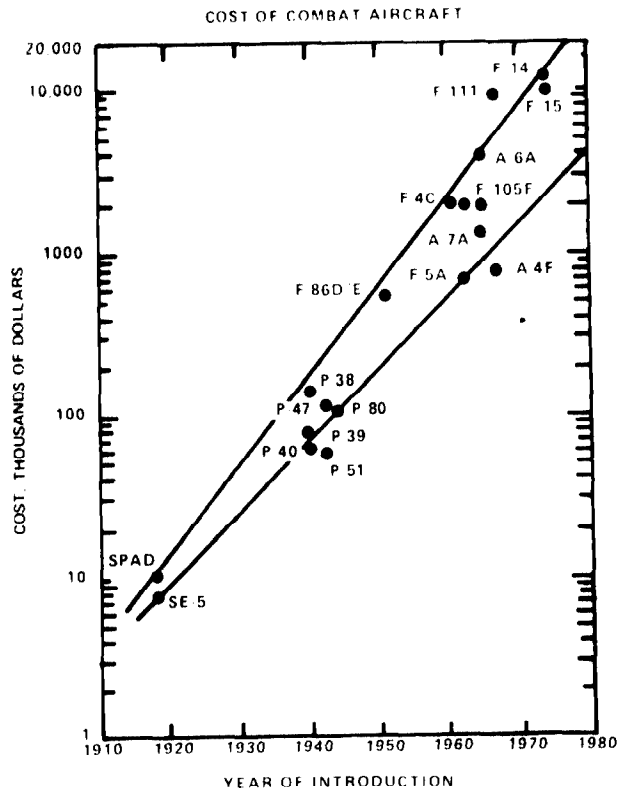
CHAPTER 1

INTRODUCTION

For many years, concern within the Congress and the Department of Defense (DOD) has been growing over the constantly rising costs of our weapon systems. Especially in recent years, inflation has certainly been an important factor, but sharp increases in the cost of major weapons since World War II have well-exceeded the rate of inflation. To illustrate, DOD testimony during 1976 appropriations hearings brought out that:

- The then-estimated unit cost of the XM-1 tank was seven times that of the World War II-Sherman tank.
- The aircraft carrier Enterprise, in the early 1960s, cost nearly 10 times more than the World War II-Essex and about twice as much as the mid-1950s' Forrestal.
- The unit costs of both the F-14 and F-15 fighter aircraft, in the 1970s, were more than 10 times the cost of the early 1950s' F-84F.

The following chart illustrates how the costs of military aircraft have risen since World War I.



Recent production unit price tags for weapons have reached \$1.8 billion for new nuclear carriers (excluding aircraft); \$1.3 billion for missile-firing nuclear submarines (excluding missiles); nearly \$80 million for a modern manned bomber; and \$1.5 million for a tank.

Even after recognizing that today's weapons systems are far more capable than those produced in the past, the high cost of weapon systems is having a serious and increasingly adverse effect on U.S. combat capabilities. One effect of rising costs has been reduced quantities of given systems, which are procured in numbers below what military experts have determined the requirements to be. Several examples drawn from the September 30, 1978, Selected Acquisition Reports illustrate this point.

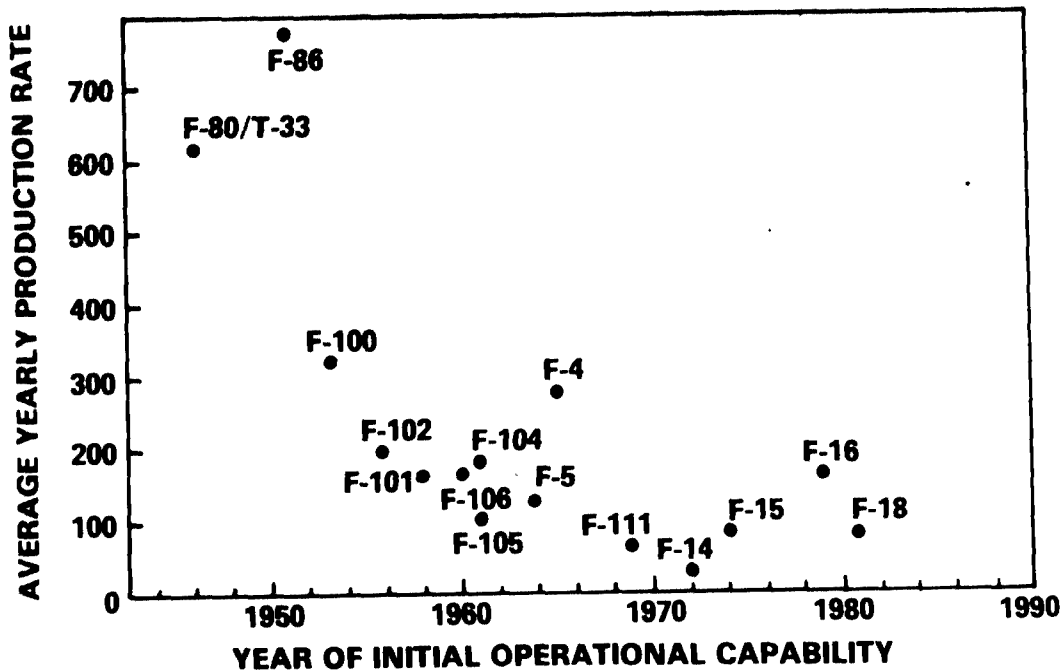
<u>System</u>	<u>Estimated unit cost</u>		<u>Quantities</u>	
	<u>Original</u>	<u>Current</u>	<u>Original requirement</u>	<u>Current program</u>
	(millions)			
Harpoon	\$.353	\$.734	2,922	2,159
LHA (note a)	153.4	314.0	9	5
M198				
Howitzer	.184	.421	664	478
Patriot	21.84	45.17	240	138
AWACS				
(note b)	63.4	122.2	42	34
CH-53E	7.8	14.6	74	53
MK-48 Torpedo	.418	.605	4,194	2,831
Laser Maverick	.045	.071	8,100	4,750
Copperhead	.009	.011	133,058	110,666

a/Amphibious Assault Ship.

b/Airborne Warning and Control System.

The following chart shows how the annual production rates of military aircraft have decreased over time.

TREND OF DECREASING YEARLY PRODUCTION RATE OF FIGHTER AIRCRAFT



Another effect of the cost of weapon systems on U.S. capabilities has been the diversion of available funding from support costs. Because, in peacetime, the defense budget is relatively stable, high procurement costs result in fewer available dollars for spare parts, munitions, and other support costs. U.S. forces around the world are currently facing a deteriorating combat readiness situation, partly due to shortages of spare parts, reduced inventories of munitions, and deferred overhaul and maintenance.

The cost problem facing the U.S. military is growing worse, and no relief is in sight. The so-called "bow wave" of future procurement costs is growing beyond the point of reasonableness. Current procurement programs are estimated to total about \$725 billion. If these costs are spread over the next 10 years (a conservative projection), the annual average of \$72.5 billion will be more than twice the current funding levels. Clearly, most of the programs will have to be cut back or eliminated.

Achieving substantial reductions in the unit cost of weapons, without reducing their combat effectiveness, would provide the most favorable resolution. However, many complex and interrelated factors mitigate against this. Some

of these, such as inflation and the decline in U.S. productivity growth, affect all segments of our economy, while others are either unique or more common to the defense weapon system environment. In this report, we discuss what we believe to be the major factors affecting the cost of weapon systems and make several recommendations for improvement in the future.

CHAPTER 2

THE ENVIRONMENT OF DEFENSE PRODUCTION

The development and production of weapon systems for U.S. military forces bear little or no relationship to commercial practices, and it is unreasonable to expect the same management principles and market forces to apply. The factors that differentiate between defense and commercial activities include:

- Technology and performance considerations. The drive for high performance of defense systems often supersedes costs concerns. Threat assessments and operational requirements can and do change during the acquisition cycle, thus, further compounding cost control efforts.
- Deployment dates. Specified dates for initial operational capability are often arbitrary and inflexible leading to uneconomical acquisition practices, such as excessive concurrent development and production.
- Limited quantities. Most major items are procured in relatively small quantities spread over long periods of time. Achieving production efficiencies comparable to commercial items is difficult if not impossible.
- Funding constraints. Limited funding and uncertainties of future funding levels affect investment decisions, rates of production, retention of capable personnel, and so forth.
- Lack of competition. Little or no competition exists subsequent to the conceptual/developmental phase of weapon procurement. Awarding a developmental contract most often guarantees the award of full-scale development and production contracts.
- Contracting practices. The inherent uncertainties in performance, schedule, and cost dictate contracting practices that provide few incentives for long-term efficiency. In general, contractor profits are negotiated as a percentage of anticipated costs.
- Government-generated paperwork and red tape. Doing business with the Government is inherently

more complicated and expensive than commercial practices. Government surveillance and contract administration, designed to protect the interests of the public, can be cumbersome and expensive. The attempts to achieve socioeconomic objectives through procurement programs also affect contractors' efficiency and economy.

COMMERCIAL PRACTICES

In the commercial market of consumer goods and private business trade, competition among suppliers has historically been a dominant factor. That market, when unencumbered by either internally or externally imposed artificial restraints or stimulants, is freely responsive to the natural forces of supply and demand. The resultant competitive environment requires that a company constantly seek ways to improve productivity and reduce costs in order to retain or increase its share of the market. The cost reductions resulting from productivity improvement create a financial resource pool which can be used in several very important ways to strengthen an enterprise.

- Price reductions to customers will improve the company's market position through more sales, which in addition to increasing income, may also contribute to further productivity growth through fuller utilization of labor and equipment resources.
- Wage and salary increases to workers, reflective of their increased productivity, provide an incentive to strive for further improvement. Since the increases are keyed to actual gains in the workers' productive output, they are not inflationary and do represent real increases in earnings.
- Some of that portion of savings, retained as profit, is available for investing in further improvements in facilities, equipment, processes, and methods to feed additional productive growth.
- The balance of profit rewards the investors, in a publicly held company, with increased dividends strengthening the value of the company's stock and encouraging more investments in the company.

Commercial capital investments can be made with reasonable assurance of an acceptable return on the investments

because these companies maintain current and realistic assessments of market conditions and sales potential through the continuity of their steady presence in the market. The companies are also able to moderate the risk associated with such investments because they can control several key elements which affect the level of risk. Capital is controlled within the company, and total production quantities and monthly production rates for the company's products can be set by the company to most efficiently utilize its labor and capital resources. If market fluctuations alter demand, the company can adjust its total production volume and monthly production rates in a way that best serves the overall efficiency of its production operations.

Furthermore, most successful commercial companies generally proceed very carefully with product research and development and will not bring new or extensively modified products into production until the companies are confident that the design of an item and the processes, equipment, materials, tooling, and technology required to produce it are proven to be reliable. The companies are usually not inclined to develop state-of-the-art designs and technology on the production line where they would be highly vulnerable to the disruptive and costly effects resulting from the failure of unproven concepts during a production run. Such failures can cause long production shutdowns with severe productivity and financial losses as a consequence of costly and time-consuming corrective changes.

This hazard is minimized when product development is thorough and proven production techniques are employed. Therefore, the commercial company commonly finds it necessary to make only minor changes during production to correct defects and to improve product marketability.

The business of DOD procurement is conducted in an environment which is substantially different in many important ways from that of the commercial market. The balance of this chapter discusses the previously itemized factors that limit cost reduction in the production of defense hardware.

EMPHASIS ON PERFORMANCE RATHER THAN COST

The military places its principal emphasis on the production of technically superior weapons to assure that they will outperform the enemy's weapons in combat. DOD believes that superior performance is essential to counter the numerical advantage of the Soviet arsenal. Matching this concern is the desire to bring improved weapons to operational status

as quickly as possible to meet known or calculated enemy weapon growth and advances. Weapon operational performance and delivery performance are paramount in the minds of DOD program managers and directors, and their careers ride on these priorities. These factors generally overshadow cost concerns and, since DOD priorities are usually made quite clear to a contractor, the contractor has reason to rank productivity improvement and cost reduction as subordinate objectives.

There are many programs where extraordinary performance requirements have been the driving force behind high costs. Some examples are:

--The B-1 Bomber. The Air Force's desire to have a supersonic dash capability led to a variable-swept-wing design. This was one of the performance requirements that contributed to a combined production and research and development unit cost in excess of \$100 million and cancellation of the program.

--The Phoenix Missile. The Navy's desire to equip its F-14 aircraft with an air-to-air weapon and fire control system that could track and fire against multiple targets at very long distances resulted in a missile with a combined unit cost in excess of \$500,000.

--The Patriot Missile System. The Army's desire to deploy a ground-to-air defensive missile system that could defeat high-speed targets, at high altitudes in a sophisticated electronic counter-measures environment, led to development of a system that will cost in excess of \$45 million per fire control unit.

Debate continues about the wisdom of the U.S. weapons acquisition policies--should we stress high cost, high capabilities, and low quantities or lower cost, lesser capabilities, and larger quantities? Hopefully, the answer will never be learned, because the only real test will be war.

What is certain, however, is that the high-technology policy is a major contributing factor to cost. The drive for greater capability usually means complex electronics, avionics, fire control systems, and so forth, that keep adding to the cost in three ways. First, the research, development, and test costs are driven up by the need to design, test, and integrate these complex subsystems to make them all work together to do the job that is desired. Secondly, the

cost of procuring these items for production is extremely high, pushing the production costs way up. Third, and probably the greatest cost, is the high-maintenance and support costs of the deployed system's complex equipment. These costs, which can be many times those of acquisition, are often overlooked during the acquisition cycle.

The use of the earlier illustrative examples is not intended to question the military need for such weapons, but rather, to stress the fact that high performance does not come cheaply and could even be the single most important cost driver.

CONCURRENT DEVELOPMENT AND PRODUCTION

In the absence of an overriding immediate military requirement that is not often evident in peacetime, experience has shown that total costs are minimized and system performance optimized by a well-coordinated, step-by-step approach. This approach identifies and attempts to resolve high-risk technical problems, relative both to the design of the weapon and its manufacture, prior to production. Often referred to as the "fly-before-buy" concept, it attempts to reduce unwarranted concurrent development and production of weapons. More simply, it means--be confident that the design of an item and the methods for its manufacture will work before starting the production run and pouring huge sums into the process. The advantage of this approach is clear; but forces work against it, particularly when fear exists that Soviet weapon technology and capabilities may pose an immediate short-range threat.

It may take 10 years or more from DOD's visualizing a new major weapon concept to deploying that concept as an operational weapon system. The fear that the Soviets may "beat us to the punch" with a new or improved weapon capability that we cannot match or exceed often moves DOD to start production before weapons are fully developed and proven. Significant production problems usually result and, if the overlap of the development and production cycles is excessive, the problems reach critical proportions. During this production period, while development is still underway, the weapon design and the manufacturing process are extremely vulnerable and typically subjected to many changes. It is a highly uncertain period, precluding the balance and stability in production operations essential to efficiency and productivity in manufacturing.

The drive to make technological breakthroughs, rather than orderly advances with proven technology, involves a high degree of technical risk. Excessive technical risk is probably the single most significant factor leading to weapon failures, cost growth and overrun, production interruption or shutdown, production inefficiency, and schedule slippages. Some concurrency in development programs is both necessary and desirable in order to keep development and production cycles from becoming too long and to keep costs down. The key issues facing both the Government and the contractors are how much risk is acceptable and how to identify those elements of a program which could cause unacceptable cost growth and schedule delays if the developmental problems are not resolved at the appropriate time.

DETERMINING MISSION NEEDS AND THEIR SOLUTIONS

Weapon system cost and technical risk are heavily influenced by early key decisions involving the respective roles and missions of the military services, determining the capability needs for fulfilling the missions, and determining the best solution for those needs. These early decisions shape many of the basic weapon characteristics bearing directly on the level of technical complexity and risk and ultimate weapon system cost.

Each service, however, has been entrusted with defining its own missions and, with competition among the services for missions, the mission needs statements prepared by the services often represent limited viewpoints. Furthermore, the mission needs statements may be so narrowly drawn that they predetermine the selection of a specific solution and preclude considering other possibly less complex and expensive alternatives.

The April 1976 Office of Management and Budget (OMB) Circular A-109 stems mainly from recommendations made by the Commission on Government Procurement in 1972 for improvements in the management of DOD and civil agency major system acquisitions. While OMB Circular A-109 covers a wide range of acquisition activities, it heavily emphasizes, as did the Procurement Commission, improvements in the process of formative determinations discussed above. Two major objectives are:

- Strengthening the role of the agency head in determinations of agency components' missions, mission needs, alternative need solutions, and final solution decisions.

--Expressing mission needs to competing contractors in broad terms, outlining the capabilities wanted and operating and environmental constraints, in order to encourage the development of more innovative and varied alternatives for consideration in arriving at the best solution.

Although DOD has responded more diligently than most other agencies to OMB Circular A-109, its progress toward implementation has been slow. ^{1/} We believe that increased attention by the Secretary of Defense is needed to ensure full implementation and compliance with OMB Circular A-109. ✓

LIMITED RATES OF PRODUCTION

Commercial production volume is set at optimum rates by company management based on production efficiency and market analyses. However, the production rates of military weapons are dictated, though indirectly, by constraints set by the Congress, OMB, or the Office of the Secretary of Defense. Major weapon systems are subject to annual review by the Congress and can be revised numerous times. Also, either the Congress or DOD may dictate that production of an item be stretched out at a low rate to assure that a warm industrial base, that is, an in-place production capability, is available to quickly increase production in the event or threat of war.

The production of new DOD hardware may also be established at an uneconomical rate, because the item is undergoing concurrent development and production, which dictates that a limited production rate must be maintained until the item has been fully tested and proven effective. The weapon also may be produced at a limited rate because sufficient funds are not available in the DOD budget to produce a greater number in a given year. Whatever the reason for limiting production of an item to less than the optimum rate, the effect of this action is a loss of productivity and an increase in the cost of major weapons.

Our findings, in connection with an earlier review of F-14A aircraft procurement, show the magnitude of the effect of production rates on cost and efficiency and the complexity of related matters which must also be considered in setting the rates. We learned that a reduction of 66 in the number

1/PSAD-79-9, Feb. 20, 1979.

of F-14A aircraft to be procured and an increase in the time over which they would be produced had increased estimated program cost by \$2.3 billion--about 38 percent. In January 1969, the Navy planned to procure 469 F-14 aircraft (6 development and 463 production) at an estimated total program cost of \$6.2 billion or \$13.2 million per aircraft. The production aircraft were initially to be produced over a 6-year period from 1971 through 1976. The revised plan stretched the reduced total of 403 aircraft (12 development and 391 production) through fiscal year 1981 at an estimated total program cost of \$8.5 billion, or \$21.1 million per aircraft. We estimated that the Navy could have saved about \$640 million if the production rate for the aircraft remaining to be produced at the time of our review was increased to the contractor's optimum rate of eight a month. Furthermore, the contractor for the F-14A's weapon control system stated that it could produce in 1 year all of the remaining control systems then planned to be produced over a 4-year period and estimated the savings at about 38 percent--\$109 million.

The following chart was provided by a contractor from data derived from its own cost and production records of an actual program.

IMPACT OF QUANTITY/RATE ON UNIT COST

	<u>QTY</u>	<u>UNIT FLYAWAY COST</u>	<u>MFG PORTION OF UFC</u>	<u>NON-MFG PORTION OF UFC</u>
PLANNED	200	\$10M	\$ 8M	\$2M
REDUCED TO	50	18M	10M	8M
\$ INCREASE		\$ 8M	\$ 2M	\$6M
% INCREASE		80%	25%	300%

The cost penalties resulting from stretched production and the restraint of production rates below the optimum levels of production efficiency are clear and substantial in these examples. However, on the other hand, the following considerations related to the F-14A are fairly representative of the types of very real counterforce factors complicating the choices and decisions regarding the term and rate of production.

- The industrial base for the system could become inactive and adversely affect a restart of production if needed.
- Going from full production to no production within a short time frame could have an adverse effect on both the stability of the contractor's organization and the local economy.
- Increased costs could result from having to incorporate possible later design changes on a larger number of completed units.
- Storage and caretaking costs would be incurred in instances in which the component manufacturers have the capability to produce their items in excess of the end item production schedule. Some weapon control system components, for example, would require regular servicing at 6-month intervals to maintain their shelf-life during a wait for installation in airframes.

FUNDING INSTABILITY

Funding levels in the commercial world are controlled by company management and are generally stable and predictable over a number of years. Annual review of the DOD budget by the Congress and changing priorities, whether political or military, cause funding levels to change frequently on a weapon program. Cutbacks in funds by the Congress or delays in approving production funds for an item disrupt the production process and increase the ultimate cost of the weapon. The uncertainty of funding for a system makes effective long-term production planning extremely difficult and decreases the probability that contractors will employ adequate investment capital to reduce the cost of production and increase productivity. Defense contractors may choose to stay labor intensive in many areas of production, since adjusting the balance of labor resources is easier than adjusting heavy capital investments to cope with fluctuating business volume, and production costs remain high because the investments in labor-saving equipment are not made.

The contracting authority of DOD and civil agencies is closely tied to congressional appropriations. The appropriations are usually stated in maximum dollar amounts and are for a definite period of time. There are three main types of appropriations: no-year, multiple-year, and annual.

No-year appropriations remain available for obligation until expended, while multiple-year appropriations are made available for a specific time period, such as 3 or 5 years. Annual appropriations are available for obligation only for the current fiscal year unless otherwise specified by law.

Annual appropriations are the most prevalent form of congressional funding for the operating expenses of Federal agencies. Most agencies may obligate funds during the appropriation year for the needs of that specific year only and are precluded from entering into contracts which obligate the Government in excess of those needs. This principle is contained in 31 U.S.C. § 712a, which provides that:

"Except as otherwise provided by law, all balances of appropriations contained in the annual appropriation bills and made specifically for the service of any fiscal year shall only be applied to the payment of expenses properly incurred during that year, or to the fulfillment of contracts properly made within that year."

A multiple-year appropriation entitles the Government to contract services or supplies from the contractor for more than 1 year. The parties are released from their mutual obligations only upon termination of the contract. A multiyear contract differs from a single-year contract with options for continuation beyond 1 year, in that the latter gives the Government the choice of continuing the contract beyond 1 year, but does not guarantee to the contractor that the Government will do so. Unless the Government takes positive action to exercise the option, the contract will expire. Not knowing whether the contract will be renewed, the contractor has no inducement for price concessions.

Multiyear contracting authority is sometimes granted for special projects, such as research and development and major acquisitions, through funding for more than 1 year or statutory provisions. It is now used by agencies which have either no-year or multiple-year appropriations or special statutory authority.

According to the Commission on Government Procurement, DOD had estimated annual savings in excess of \$52 million in

the period 1968-73, resulting from the use of multiyear contracting on procurements funded by no-year or multiple-year appropriations.

The savings gained through use of multiyear contracting generally stem from

- reducing recurring costs connected with the award and administration of a series of contracts over a span of time to nonrecurring administrative costs for only one contract over the same period,
- reducing contract material costs through discount price breaks realized by purchase of materials in more economic order quantities,
- avoiding impact of price escalation on out-year material purchases, and
- increased efficiency resulting from continuity of work and stability of the work force.

Like the Commission on Government Procurement, we too found that savings are realized by Federal agencies through multiyear contracting in a review which we completed in 1977. In that review, we identified annual savings of \$3 million--about 21 percent--on a total of 26 Defense Logistics Agency and Air Force contracts valued at \$14 million. The 21-percent savings were exclusive of administrative cost savings. Furthermore, estimated administrative savings of \$2 million were identified by the General Services Administration (GSA) for 70 multiyear public utility contracts awarded by GSA or by other agencies with GSA's assistance.

In addition to the benefits previously discussed, Federal officials and representatives of one contractor association we questioned generally agreed that multiyear procurement could encourage more competition by providing a longer time period for investment amortization.

We recommended, in our January 1978 report to the Congress on the results of our review of multiyear contracting, that the Congress enact legislation giving the Federal agencies general multiyear contracting authority for supplies and services and providing for the Office of Federal Procurement Policy to:

- Develop appropriate criteria for use of the procurement method.

--Require responsible agency officials to determine when the criteria are met.

--Provide for the payment of cancellation costs.

✓ Legislation giving agencies general multiyear contracting authority has been included in the Federal Acquisition and Reform Act, Senate bill 5, introduced on January 15, 1979.

ABSENCE OF PRICE COMPETITION

In contrast with the commercial market, DOD business is largely conducted without the benefit of price competition among its suppliers. DOD procurement data for 1977 shows that less than 27 percent of the nearly \$50 billion in contract awards that year was based on price competition. Contracts valued at \$36 billion--nearly three-fourths of the year's total--were awarded to sole-source contractors facing no form of competition for \$31 billion and to others competing for \$5 billion only on a basis of the quality of their design and technical proposals.

The bulk of DOD's procurement is for major weapon systems and associated equipment--accounting for \$29 billion in 1977 contract awards--with most of the sole-source awards coming in this area. Several factors tend to minimize price competition for major weapons contracts. The systems have become highly sophisticated and increasingly complex, with respect to the range of diverse technologies embodied in their production. The industrial base of qualified prime contractors for major systems has narrowed and there are few to choose from, particularly in such weapon categories as tanks, bomber aircraft, nuclear submarines, and high-thrust jet engines. A relatively small number of contractors have the capabilities, experience, and resources to handle a major prime contract. DOD feels compelled to spread work across the present industrial base in order to prevent its further decay.

Obtaining price competition is further complicated by the fact that DOD often has insufficiently complete, explicit, and realistic specifications and definitions for what it is buying to assure that contractors competing for the initial procurement of an item would be submitting prices for the same thing. Furthermore, the contractor selected to initially produce a new weapon system usually receives the later follow-on production contracts on a sole-source basis, because of the difficulty in transferring the tooling and processing methods of one contractor to another and the

loss of the first contractor's experience and learning if such a change is made.

Competition for DOD prime contracts is essentially limited to design and technical competition in the development phase of a major weapon system. DOD tries to negotiate reasonable prices based on cost analysis of a sole-source contractor's price proposal, but the pressure of true price competition as a motivating force to improve productivity and reduce contractors' costs is generally not present in the acquisition of major weapon systems.

According to representatives of a number of major defense contractors, design and technical competition for initial contract awards for development of many new systems is intense. They believe that this competition has a very beneficial effect on both cost and performance factors.

We would agree that whatever competition exists in early program phases is beneficial, but the history of cost growth and performance degradation in weapon acquisitions indicates that competitive forces do not carry over into the full-scale development and production phases.

The consistent pattern of gross underestimation of early program costs and overestimation of capabilities may indicate that many contractors buy into programs knowing that they are in the "driver's seat" with respect to the follow-on development and production contracts. Given the environment of DOD weapons procurements and the fact that effective competition is extremely difficult to achieve in the latter stages, they are probably prudent management decisions.

BASING PROFITS ON ANTICIPATED CONTRACT COSTS

The major portion of DOD procurement funds is expended on contracts negotiated without benefit of price competition. The practice has been to base contract profits primarily on the estimated cost of contract performance. Once the contracting parties agree upon the costs, profit is negotiated largely as a percentage of these costs.

It has long been an accepted "fact-of-life" within Government procurement circles that this method of contracting does not provide any incentive for contractors to reduce costs. In fact, it encourages higher costs. Studies by DOD, the Logistics Management Institute, and our Office have all concluded that changes in the bases upon which profits are determined are necessary to motivate contractors to make the

capital investments necessary to reduce costs. Recently, guidance to DOD negotiators has directed that more weight be given to invested capital and less to cost in reaching profit objectives. This has been a relatively modest shift and, at the current time, has shown few or no results. It is not yet clear whether this lack of results is due to the limited potential benefits to the contractors or to some other factor. While various incentives for cost reduction have been devised, frequently the costs actually incurred on the prior contract form the baseline for negotiating the costs of a follow-on contract. Thus, we still believe a cost-based profit structure discourages the acquisition of plant and equipment items that could lower the overall acquisition costs to the Government. Many defense contractors have taken issue with us on this point and maintain that they are just as cost conscious on defense work as on their private commercial work because they cannot have competing cost philosophies in the same company.

Further discussion of our views on this issue and DOD efforts to reduce the weight of cost in negotiated profit rates is included in chapter 3 of this report under "Profit Policy."

SOCIOECONOMIC PROGRAMS, GOVERNMENT CONTROLS, AND RED TAPE

One of the most consistent complaints from contractors has been that doing business with the Government is difficult, time-consuming, and costly, particularly when compared to commercial practices.

There is no doubt that Government procurement practices are complex and costly. Two reasons are the perceived needs to protect the interests of the Government and to provide safeguards over the expenditure of public funds. This leads to large contract administration organizations, project management teams, and extensive financial controls.

Another aspect of the problem stems from the desire of the Government to use the procurement process to help accomplish its socioeconomic objectives. Attempts to attack the following and other diverse problems are all built into the procurement process:

- Employee health and safety.
- Environment.
- Small business.
- Minority business and employment.

- Minimum wages.
- Aiding the economy and protecting domestic business.
- Encouraging North Atlantic Treaty Organization standardization.
- Rehabilitating prisoners.
- Employment for the handicapped.

The work of the Commission on Federal Paperwork just a few years ago gives an overview of the pervasive impact of Federal paperwork and red tape. The Commission was charged by the Congress and the President with the task of making recommendations to eliminate needless paperwork while assuring that the Federal Government has the information necessary to meet the mandates of law and operate effectively.

The Commission found that that the total cost of Federal paperwork was huge and estimated that it may exceed \$100 billion a year. The following table shows the estimated annual cost to various major segments of society.

	<u>Estimated cost</u>
Federal Government	\$ 43.0 billion
Private industry	\$ 25.0 billion to \$32 billion
State and local government	\$ 5.0 billion to \$9 billion
Individuals	\$ 8.7 billion
Farmers	\$350.0 million
Labor organizations	\$ 75.0 million

The Commission concluded that much of it was excessive and unnecessary. A few examples of the excesses are described below.

- One company had to comply with Federal requests for 8,800 reports from 18 different agencies in 1 year.
- A school disregarded a \$4,500 Federal grant because it would have required \$6,000 in paperwork to obtain and administer it.
- Fifteen employees lost their pension plan because the small company they worked for could not handle the paperwork connected with the plan.

- Six Federal energy agencies used nearly 220 forms yielding 3.5 million responses, which took the responders an estimated 11 million staff-hours to complete.
- Seventeen different agencies wrote Equal Employment Opportunity regulations.
- The Trucker's Daily Log, required by the Department of Transportation to assure that drivers did not drive more than 10 hours a day, resulted in 1.2 billion sheets of paper annually. Ironically, the log which a driver was supposed to fill out every 15 minutes of each working day, whether driving or not, neither identified possible violators nor helped in their prosecution.
- The Department of Health, Education, and Welfare at one time had a Student Loan Application, a supplement to the application, and an addendum to the supplement to the application.

The Commission made recommendations designed to reduce red tape and paperwork by \$10 billion in the first year of implementation. Upon completion of its work in October 1977, the Commission reported that about 50 percent of its 770 recommendations had been adopted, with an estimated first-year savings of \$3.5 billion.

Impact on business

The Government needs information from the business community to plan and manage Federal programs. However, business rightly complains that more information than necessary is collected. As a result, many businesses feel that they are engulfed in a sea of paperwork and red tape. Some smaller firms avoid doing business with the Government because the paperwork is too frustrating and costly.

The Government has not properly considered the costs its requirements impose on the private sector. The Commission on Federal Paperwork, with the help of the business community, profiled these Government-imposed costs:

- As indicated earlier, all of American business spends \$25 billion to \$32 billion each year on Federal paperwork and red tape.
- The 10,000 largest firms spend \$10 billion to \$12 billion, or an average of over \$1,000,000 each on Federal paperwork and red tape.

--Five million small businesses spend \$15 billion to \$20 billion, or an average of over \$3,000 each, and small firms often lack the expertise to comply with Federal information requirements.

The procurement of goods and services by the Federal Government from the business community is large in dollar volume, complex in its procedures, and varied in user requirements. Total Federal procurement outlays of \$65 billion to \$70 billion in 1976 comprised approximately one-fifth of the total expenditures in that year. Some 80,000 employees in more than 100 Government agencies were engaged in procurement and related activities. These activities are conducted through a massive aggregation of laws, regulations, directives, instructions, circulars, bulletins, reports, manuals, forms, contractual instruments, specifications and standards, data management and processing systems, and general publications. The resultant paperwork burden on both Government and contractor organizations is enormous.

As mentioned previously, the Government makes use of the procurement process not only to obtain supplies and services, but also to implement the various socioeconomic programs which have been enacted into law. The Commission on Government Procurement identified 39 statutes whose socioeconomic objectives have been made part of the terms and conditions contained in Government contracts.

Impact on defense industry

All of the things we have just discussed in connection with the private business sector affect the defense industry. In fact, as illustrated by the \$50 billion level of DOD procurement in 1977, defense contractors as a group are the Government's principal contracting partner and, consequently, carry a very substantial share of the total paperwork and red tape burden imposed on the entire business community. But in addition to that, defense contractors are subjected to what they believe to be extremely excessive Government presence and interference in the day-to-day operation of their businesses. This takes the form of large numbers of Government personnel either in residence at contractors' plants or there on frequent visits. Their mission is basically to assure successful performance of the contract, to enforce compliance with the provisions and terms of the contract, to maintain accountability for the proper expenditure of public funds, and to prevent abuses in the DOD procurement process. The function is called contract administration and begins with evaluation of the contractor's capabilities and overall qualifications prior to the contract award and continues until the completion and final settlement of the contract.

Many of the 80,000 Federal employees engaged in procurement-related work are involved in defense contract administration. This body of contract administration people is made up of auditors; inspectors; procurement and contract specialists; cost, price, and financial analysts; industrial specialists and engineers; quality and production control specialists and engineers; management analysts; legal experts; and more. They essentially want to know what a contractor is doing and why and how it is done. They check, audit, examine, inspect, measure, and test to see if it is done right. In addition to their permanent or frequent presence in the plant, they administer and monitor the many extensive management, cost, and schedule control and reporting systems imposed in the DOD procurement process. Moreover, national security requirements to safeguard classified material add again to the administrative burden of defense contractors.

While there is also Government presence and interference in the commercial market and still more in the general area of Federal procurement, the degree and scope of its impact in DOD procurement is unmatched. The National Aeronautics and Space Administration and the Department of Energy (in its nuclear weapons acquisitions) employ the same or very similar procurement practices, but the scale of their procurements is much smaller.

Whether there is agreement or not on the need for the degree of Government control, regulation, paperwork, and red tape in the defense industry, the fact remains that these are important elements in driving the cost and reducing the productivity of defense production.

Cost accounting standards

During the past several years, many defense contractors have claimed that the institution of cost accounting standards, in accordance with regulations promulgated by the Cost Accounting Standards Board (CASB), has been disruptive to their operations and costly to implement. Contractors have been urging the CASB and congressional committees to measure the costs against the benefits of the standards that have been adopted, but no one has found a practical means of doing this.

Studies conducted in the late 1960s indicated that individual companies' accounting practices were not always consistent between accounting periods and did not always treat Government and commercial customers equally. In response to these studies, CASB was created as an agent of the Congress in 1970 by an amendment to the Defense Production Act of 1950.

The CASB's objective is to achieve consistency, uniformity, and equal treatment of Government and commercial accounts in estimating, accumulating, and reporting costs in connection with pricing, administering, and settling large negotiated national defense prime contracts and subcontracts. With limited exceptions, the standards apply to negotiated defense contracts in excess of \$500,000 awarded by DOD, the Department of Energy, and the National Aeronautics and Space Administration. GSA has, through the Federal Procurement Regulation, extended the standards to some nondefense contracts. But here again, because DOD is the largest Federal buyer and most of its procurement dollars are expended through negotiated contracts, defense contractors are much more involved with the standards than any other contractor group.

Compliance with CASB regulations requires most contractors to initially file a voluminous disclosure statement and to thereafter ensure that their accounting practices are uniform, consistent, and in accordance with the published standards. There is no doubt that there is a cost associated with these requirements. However, few, if any, contractors have been able to isolate the cost, and many understandably claim there is little or no benefit.

The need for consistent and equitable accounting treatment of costs charged to Government contracts is undeniable. The benefits realized from application of cost accounting standards probably cannot be quantified--neither can the costs be accurately measured. We believe, therefore, that it is unreasonable for contractors to urge that the standards be repealed because there is no evidence that the benefits outweigh the costs. If, on the other hand, there is any evidence that the standards are too cumbersome and impose a significantly unnecessary burden on contractors, it is incumbent on the Government to take corrective action.

CONCLUSIONS

There are a number of complex and interrelated factors that tend to drive up the costs of defense procurements, particularly major weapons. In our opinion, the desire of U.S. military leaders to push the state-of-the-art with new concepts and designs has the biggest effect on costs. Another major factor, the inherent uncertainty in funding and production schedules, limits adequate production planning and provides little or no incentive for capital investments on the part of contractors. Other factors, such as the absence of competition, contracting formats, and paperwork, all tend to compound the problems.

Many of the acquisition practices discussed in this chapter are dictated by military judgment as well as political and economic considerations. In this context, relatively high costs for weapon systems must be accepted. We believe, however, that there are some initiatives that can and should be taken by the Congress and DOD to minimize costs to the greatest degree possible.

RECOMMENDATIONS TO THE CONGRESS

The Armed Services and Appropriations Committees should carefully examine lower cost alternative programs before approving new weapon systems. In particular, the committees should explore with senior military officials the pros and cons of larger quantities of alternative weapons versus smaller numbers of highly sophisticated and expensive systems.

The Congress also should, after being satisfied that a weapon system is ready for production, consider multiyear funding in order to take advantage of more economical production practices.

The Congress should also take the initiative to respond to the recommendations of the Commission on Government Procurement to (1) reexamine the full range of socioeconomic programs applied to the procurement process and the administrative practices followed in their application and (2) raise the minimum dollar thresholds at which such programs are applied to the procurement process.

RECOMMENDATIONS TO THE SECRETARY OF DEFENSE

We recommend that the Secretary of Defense make a comprehensive study to identify those aspects of contract administration that can be relaxed or modified in order to reduce costs and paperwork.

We also recommend that the Secretary of Defense take stronger initiatives to accelerate the implementation of management policies for major weapon system acquisitions as set forth in OMB Circular A-109.

CHAPTER 3

PRODUCTIVITY AND FACTORS THAT INFLUENCE

ITS GROWTH

One of the major problems facing the United States today is the apparent decline in the productivity growth rate. Retarded productivity growth feeds inflation and contributes to higher costs for DOD hardware, as well as consumer goods. Failure to maintain a reasonable rate of productivity growth tends to offset efforts for cost reduction. While it is not clear, given the relatively low production rates, how much this problem has affected DOD procurement costs, there is no doubt that increased productivity growth could reduce weapons costs.

The definition of productivity is not universally agreed upon, but the one most often given describes it as a measure of efficiency derived from the ratio of production output to resource input. This ratio is commonly used to express the efficiency of the labor workforce in terms of the quantity of goods produced from each hour of work. In this context, productivity will rise whenever the quantity of goods produced increases more than the hours required to produce them, and it will fall in the reverse circumstance.

The extent to which workers fully apply themselves to the performance of their tasks is clearly a key element in productivity and, thus, in the cost of things produced. But, labor is only one of the resources that influence productivity and cost. Many resources which bear heavily on both labor productivity and the total productivity of an enterprise are beyond the control of the worker. Management prescribes the methods, processes, and procedures to be used by the workers and provides the training, equipment, facilities, machinery, and tools for doing the work. If management fails to provide labor-efficient work methods and equipment with capabilities which are adequate to produce the quantity and quality of work required, it has blocked the achievement of labor's productive potential. Management also selects and provides the product design and the materials which labor must convert to a final product; and, if the design and materials are flawed or if they have not been properly evaluated from the standpoint of optimum producibility prior to their selection, labor productivity will be further retarded.

Moreover, total productivity and cost are affected by a multitude of management functions, systems, and decisions involving the input expenditure of very substantial resources

in such areas as overhead staffing, general and administrative support, procurement, engineering, inventory and production control, and make/buy decisions. Poor planning and decisions here can result in the needless expenditure of millions.

A true expression of total productivity must include recognition of all of the resource elements which go into a productive endeavor. We believe that the most realistic measurement of productivity and its trends is one which compares the constant dollar market worth of an end product to the constant dollar value of all of its resource inputs.

NATIONAL PRODUCTIVITY GROWTH RATE

According to the 1978 Annual Report of the Council of Economic Advisors, the current slowdown in United States productivity growth is "one of the most significant problems of recent years." The average annual rate of productivity growth in the past 10 years has been only one-half that of the preceding 20 years, and the present rate of productivity improvement is considerably less than that of other industrial nations. Great Britain has been viewed as the world's worst case of industrial decline; however, United States' manufacturing productivity growth during the period 1967-77 has sunk below Great Britain's. The United States has achieved the alarming distinction of maintaining the lowest average annual manufacturing productivity growth rate among six major industrialized countries. The range is from Japan's high of 6.8 percent to the United States' low of 2.3 percent, and both West Germany and France have more than doubled our rate.

According to the 1977 annual report of the National Center for Productivity and Quality of Working Life, if United States' productivity over the past 10 years had increased at the same 3.2 percent annual rate of growth of the previous two decades, the output per hour would have been 11 percent higher in 1977. This difference would have meant an additional \$100 billion in terms of real gross national product at the 1977 employment level.

Tangible capital investment

Productivity gains in the private sector have historically followed increases in the amount of tangible capital invested across the work force. While this may result from only increasing the number of existing machines to reduce the manual or hand operations of a greater number of workers, it has often come about with more impressive results through

the introduction of new automated labor-saving equipment incorporating current advancements in manufacturing technology. For example, one major contractor recently reported that its sustained investments in plant and equipment modernization have enabled it to maintain a long-term annual productivity growth rate 30 percent higher than the average for its segment of industry.

Advanced machine and manufacturing technology has been a strong force in productivity improvement, but often requires very large capital investments. To illustrate, extensive plant modifications or even completely new plants may be required to adopt a basic manufacturing technology breakthrough, such as solid-state electronics or integrated circuits. Furthermore, the uninstalled price of a large, multi-spindle, five-axis, numerically controlled milling machine for an aircraft manufacturing plant has doubled over the past 8 years to nearly \$2 million. Such investments, however, can yield very substantial returns through sharp reductions in operating costs. A 1976 study by the Logistics Management Institute for DOD reported that an investment of \$25 million in a particular automated manufacturing facility could reduce operating costs by \$6 million a year--about 40 percent.

Technological innovation

Tangible capital is, however, only one of the principal sources of productivity improvement. Economic research indicates that nearly one-half of the United States' productivity growth is attributable to technological innovation leading to new applications and more effective utilization of existing equipment and technology. Striking recent examples are the utilization of laser technology in both metal cutting and eye surgery and the adaptation of fiber optics technology to telephone communication systems.

Research and development

Many believe that the United States must accelerate investment in research and development to maintain its technological position and competitiveness in world markets. Unfortunately, research and development expenditures as a percent of gross national product have been declining in the United States since 1964. Meanwhile, Japan and the Soviet Union have been steadily increasing theirs, and we now rank second behind the Soviets in this important area.

A number of those commenting on this report believed that national productivity--or its decline--in the United States was the single most important problem that the U.S. Government

must face. They pointed out that the United States has no strategy or policy that recognizes the relationship between productivity, investment, and tax policy.

PROFIT POLICY

Until about 3 years ago, profit objectives were established by DOD contract negotiators upon the basis of estimated costs to be incurred in contract performance. Thus, as mentioned earlier, the higher the projected costs, the higher the negotiated profit. The adverse effects of this policy were pointed out by our Office in a 1971 report on defense industry profits. In that report, we recommended that emphasis be redirected to computing the profit objectives primarily on the basis of providing a reasonable return on contractor capital required for contract performance, rather than on costs to be incurred.

Little progress was made until DOD completed a similar profit study in 1976 and came to the same conclusion. Effective October 1, 1976, DOD made two changes in its profit policy to motivate defense contractors to make investments which would increase productivity and reduce contract costs. The first change provided that the imputed cost of capital for facility investment would be considered allowable on most negotiated contracts. The second provided that the level of facility investment would be recognized in reaching a pre-negotiation profit objective. DOD expected that the policy changes would encourage contractors to make substantial investments in cost-reducing facilities and equipment, while at the same time, keeping average negotiated profits at previous levels. Our recent review and report to the Congress in March of this year shows, however, that the intended results have not been achieved. 1/

The new policy has resulted in higher profits being negotiated with some contractors without any demonstrable reduction in costs to the Government. We found little indication that contractors responded positively to DOD's attempts to encourage greater investments in new or upgraded plant and equipment which would lower production costs. Although some added investments were identified, the reasons for making them were unrelated to DOD profit policy. We attributed this lack of success primarily to the limited emphasis given to facilities investments in establishing the Government's prenegotiation profit objectives. The new policy provided that about 10 percent of the Government's profit objectives

1/PSAD-79-38, Mar. 8, 1979.

would be based on the level of the contractors' investments in plant and equipment. DOD recognized that this was a modest beginning and that the weight might have to be increased. We believe that the emphasis given to capital investment must be substantially increased if desired results are to be achieved.

Although the new profit policy has not encouraged contractors to increase their investments in cost-reducing facilities, contrary to intent it has resulted in the negotiation of higher profit rates on an overall basis.

The new profit policy lacks sufficient definitive criteria needed for determining appropriate profit allowances for productivity improvements. We examined several productivity awards made during contract negotiations and questioned the adequacy of the determinations and the reasonableness of the awards. This inadequate criteria weakness may have resulted in unjustifiable increases in negotiated profit.

DOD is aware of the problems associated with implementing its profit policy. It has taken some corrective actions and is considering others. We recommended in our previously mentioned March 1979 report to the Congress that, to increase the likelihood that the new profit policy will motivate contractors to invest in cost-reducing facilities and improve its implementation, the Secretary of Defense should:

- "1. Substantially increase emphasis on facilities capital investment and further reduce the portion of the prenegotiation profit objectives that is based on estimated contract costs. Even though a portion of the profit rate might still be based on costs, the overall rate of return on facilities investment should be computed to assist in identifying any potential excessive profit.
- "2. Perform additional analysis to determine more precisely the impact of the new profit policy on overall negotiated profit rates and the need to increase the offset factor to more closely approximate the amount of imputed interest on facilities capital.
- "3. Establish more definitive criteria and procedures to enable contracting officers to determine appropriate profit allowances for"

"contractors' facilities capital investments, cost risk, and productivity improvements subject to special profit rewards.

- "4. Develop safeguards to prevent negotiating profits significantly greater than Government objectives without a complete explanation and review of the rationale and consideration of possible alternatives, such as the development of another source of supply.
- "5. Monitor more extensively the implementation of the new profit policy, and revisions made thereto, to provide greater assurance that the desired results are achieved."

Representatives of most of the defense contractors that we questioned did not favor a shift in emphasis to contractor capital investment in establishing profit objectives. One frequently voiced criticism was that a return on capital basis does not give adequate recognition to the human resources required for such activities as overall management, design, test, and analysis. The fact is, however, all of these activities affect the rate of return on investment that a corporation realizes. Also, the costs of all of these activities are, of course, recouped as contract costs. Further, we recognize that the profitability of industries vary; and, rather than developing an overall basic rate of return on investment to be applied to all negotiated Government contracts, we have urged that rates be developed for each major industry involved in defense work. Such rates should reflect the differing factors affecting each industry. We have also recommended considering the rate of return the contractor involved in a particular procurement is realizing on comparable commercial work.

We recognize that, even if DOD adopted the policy to base the major portion of contract profit objectives on return on capital required for contract performance, this would not necessarily result in a major increase in contractor investments in facilities and equipment that would reduce contract costs. There are many other factors that could be controlling; that is, the instability of DOD programs, the small quantities frequently ordered, the status of the capital market, and so forth. We also recognize that contractors do make some facility investments to maintain their competitive position or to be able to perform a contract. None of these points, however, negates the need to eliminate the present disincentive to cost reduction that results from basing contract profits primarily on costs. The situation was well

summed up in a September 1967 study report issued by the Logistics Management Institute entitled, "Weighted Guideline Changes and Other Proposals for Incentives for Contractor Acquisition of Facilities, AD660-388." The report concludes on page 3-6:

"The acquisition of facilities that increase efficiency may affect the ability to obtain a contract. Under the present rules, however, if a contractor can get the business without additional facilities investment, he can expect more dollars, and a higher percentage of profit on invested capital by refraining from investment as much as possible and allowing or causing expected costs to be as high as will be acceptable. Many defense contractors are aware of this paradox and have told us that they consequently avoid facility investments whenever possible."

CONCLUSIONS

Even though most weapon systems are produced in limited quantities, productivity improvements could probably have a measurable effect on costs. United States industry is facing a severe decline in productivity growth. The situation is possibly more serious in the defense industry because of the lack of competition and the profit policies that do not provide incentives for capital investment. Continued experimentation and emphasis on this problem is required.

CHAPTER 4

DOD EFFORTS TO REDUCE COSTS

DOD has taken various actions over the years which were intended to increase the productivity of its contractors and restrain the cost of producing DOD hardware. These efforts, in our opinion, are highly worthwhile and appear to be cost effective. We do not believe, however, that they are of the type that can make substantial (multibillion-dollar) inroads into the cost of weapons. Some of the more important efforts are described below.

INVESTMENT PROTECTION AGAINST CONTRACT TERMINATION

A very major concern which defense contractors have in considering substantial long-term facilities improvement investments is the uncertain future of many DOD programs. In order to relieve that concern and encourage more capital investment, DOD has agreed in a few instances to purchase at depreciated value the contractor's fixed capital assets which were acquired for use on a specific program, if that program is later canceled or drastically curtailed.

In 1977, DOD introduced changes to the Defense Acquisition Regulation, providing policy guidelines and methods to protect both Government and contractor interests, which it felt were needed to enable wider use of the practice.

We believe that this approach does have the potential for stimulating increased contractor investment in more efficient equipment and that, if it is carefully employed with proper controls, it could be expected to lower the cost of DOD hardware.

DESIGN-TO-COST

DOD introduced the design-to-cost concept in 1971 when it concluded that, in view of budget limitations and the rising cost of weapons, it might be more realistic to design weapons with greater consideration to what it could reasonably afford to pay for them. This gave rise to the term "design-to-cost" (or design-to-price). The following paragraph states DOD's policy on this concept.

"Cost parameters shall be established which consider the cost of acquisition and ownership; discrete cost elements (e.g., unit production cost, operating and support cost) shall be"

"translated into 'design to' requirements. System development shall be continuously evaluated against these requirements with the same rigor as that applied to technical system capability, cost and schedule. Traceability of estimates and costing factors, including those for economic escalation, shall be maintained."

We reviewed DOD's use of the design-to-cost concept in connection with the following programs and reported our findings to the Secretary of Defense in March 1978.

- CH-47 MOD, Modernization of Chinook Medium Lift Helicopter Fleet (Army).
- FFG-7, Guided Missile Frigate (Navy).
- A-10, Close Air Support Aircraft (Air Force).
- Advanced Medium Short Takeoff and Landing Transport (AMST) (Air Force).
- Utility Tactical Transport Aircraft System (UTTAS) (Army).

The concept has been applied to these programs for several years. Each program had reasonably firm design-to-cost goals before contracting, large projected production runs, early consideration of life-cycle cost, medium technological risks in four programs, and some contractor competition in three programs. The conditions, in our opinion, made the programs good candidates for successful application of the design-to-cost concept.

Generally, we found that the design-to-cost concept was not closely followed. The departures included:

- Design-to-cost targets (affordability limits) were not established during concept formulation, when the greatest flexibility existed to maximize total performance for the dollars available.
- Overemphasis on controlling the more immediate and visible acquisition costs rather than the more substantial life-cycle costs.
- Failure to develop the cost data base needed to establish cost-performance estimating relationships relevant to design-to-cost objectives, goals, and decisions.

Of the five programs reviewed, only the Navy's FFG-7 program established design-to-cost goals before conceptual design. The goals were based on early feasibility studies that determined relationships between size, cost, and number of escort ships that would maximize force effectiveness within anticipated funding constraints. The FFG-7 Project Manager attributed significant cost avoidances on each follow-on ship to conceptual design decisions required to stay within the design-to-cost constraints. These were, however, greatly overshadowed by later cost increases.

In the other four programs, design-to-cost goals were not established until after the basic or minimum performance requirements had been defined; that is, after completion of the conceptual phase of the system's acquisition cycle.

Traditionally, pressures have been toward increased performance during development with little consideration of cost. Regardless of the differences between the concept and its implementation, design-to-cost goals have discouraged demands for additional performance that would have increased production costs. In fact, the design-to-cost goals and constraints, which by necessity were based on preliminary information of cost-performance relationships, may have become more important than technical requirements during design and development. In both the A-10 and FFG-7 programs, the goals and constraints were rigorously adhered to in design decisions that traded off performance features.

Four of the five programs we reviewed were initiated before DOD's current directives, guidelines, and instructions were developed. These documents provided information and guidance for implementing the concept, based on accumulated experience. Nevertheless, the discrepancies discussed above appear to also be present in many of the more recent programs.

Departmental guidance points out the need to establish cost objectives or goals during the conceptual phase, because about 70 percent of a system's life-cycle cost is determined by decisions made at that time. At the time of our review, however, the Office of the Director of Defense, Research and Engineering, 1/ reported that 21 of 62 major acquisition programs were in system validation without established design-to-cost goals and five programs were in full-scale development without established goals. Except for the five programs

1/It is presently the Office of Under Secretary of Defense for Research and Engineering.

we have discussed, we do not know if any of the remaining 36 programs had design-to-cost objectives established before basic or minimum performance requirements were determined.

VALUE ENGINEERING

The concept of value engineering is largely a byproduct of material shortages during World War II. These shortages led to the creation of innovative material and design alternatives, and it was found, in many cases, that the alternate approaches functioned as well or better and cost less. From this beginning, an analytical discipline later evolved in private industry which was structured to challenge the proposed way of doing things and systematically search for less costly alternatives. Commonly known as value engineering, it is sometimes termed value analysis, value control, value improvement, or value management.

Value engineering involves a systematic analysis of each function to be performed by an item with the objective of achieving the function at the lowest overall cost consistent with performance, reliability, quality, and maintainability requirements. In essence, the prevailing viewpoint of value engineering analysis is that while anything providing less than the essential functional capability is unacceptable, anything providing more is unnecessary and wasteful and should be eliminated or modified. Those features or characteristics of an item which exceed actual needs and contribute nothing to essential functional capability are often called "gold plating."

DOD established its value engineering program in 1963, and it consists of two distinct elements. The first is an in-house effort wherein value engineering is performed by DOD personnel. The second is a program for contractors, created to stimulate them to develop and submit proposals for changes to those contract specifications, purchase descriptions, or statements of work that the contractors feel impose costly nonessential requirements. The incentive is provided by giving the contractor a share of the savings resulting from the change proposals it submits. The value engineering program for contractors is implemented through the inclusion of value engineering clauses in contracts. These clauses are unique in that they provide the only incentive specifically designed for cost reduction contract changes. All other incentives are designed to apply within the scope of work of the contract.

We believe value engineering is an effective management tool for identifying and eliminating unnecessary costs

in hardware procurement and construction work. In our opinion, it can also be effective in reducing not only the procurement cost for services and software, but also the costs of the internal operations of an organization and the service it renders.

Almost all of the value engineering applications we have examined show a good return on investment. Through fiscal year 1978, DOD has reported a total savings to the Government of about \$6.4 billion since the start of its value engineering program in the early 1960s. Over \$5.5 billion came from in-house value engineering changes originated by DOD personnel and nearly \$850 million from changes proposed by defense contractors. Savings in fiscal year 1978 amounted to \$427 million for the in-house program and \$65 million for the contractor program. The 1978 figures represent returns on investment of about 17 to 1 and 9 to 1 for the respective programs.

Several contractors advised us that there has recently been a noticeable decline in acceptance of value engineering proposals by program managers. It appears that program managers are more interested in making no changes in their programs than in achieving cost reductions. If so, there needs to be a renewed emphasis within DOD on the benefits of value engineering.

MANUFACTURING TECHNOLOGY

While there have been countless improvements in manufacturing technology since World War II, manufacturing technology growth is perhaps best epitomized by the highly advanced computer-aided design techniques and computer-aided and operated manufacturing equipment, which have evolved to their present state through steady refinement over the past 25 years. While the early research, technology development, and application in industry were centered in the United States, the impressive labor-saving and precision-manufacturing capabilities of this technology have led foreign countries, notably Japan and Germany, to adopt it in their search for competitive advantage through productivity improvement.

Computer-aided design enables visual analysis of complex design problems by means of a cathode-tube display of the actual image of the object under study. Data covering a range of variable product design characteristics and a range of variable stress or product-use conditions is stored in a computer and the effect of any combination of these variables can be seen on the cathode-tube screen. The technique has been used in such areas as structural and spacial analyses

in building and ship design and in drag-coefficient, weight, and strength trade-off studies in connection with the recent development of the new generation of smaller, more energy-efficient automobiles. The technique has been helpful in producing more efficient designs and in reducing the levels of design and drafting labor, testing, and downstream corrective design changes.

Computer-aided manufacturing equipment first appeared in significant numbers in the late 1950s to early 1960s. While such equipment has found a wide range of productive applications, the best known use is in metalworking, where one machine can often perform a full range of metal cutting and shaping operations that previously required the use of several different machines, such as drills, milling machines, lathes, boring machines, and punches, each capable of only one basic metalworking function. It is generally called numerically controlled equipment and, in early models, was automatically controlled through an electronic control unit operated by taped instructions.

Machine technology has advanced rapidly since then, and current maximum capability units are now directly controlled from a central computer and perform a greatly increased variety of operations. They are also massive in size, cost substantially more, and are commonly called machine centers. For example, a 90-foot long computer-controlled profile milling machine equipped with three individual five-axis spindle heads on each of two gantries is capable of automatically producing six large airframe members simultaneously and costs close to \$2,000,000.

Increases in productivity from using automatically controlled, multifunction machining equipment vary with the machines and the kind and quantity of the parts to be produced. On some parts, productivity improvement ratios of 10 to 1 over conventional machines are not uncommon. But the automated machines are expensive and complex, and they require special management. Their control systems contain high-density electronic circuits and components, which compound maintenance problems and require specialized maintenance skills. Also, special training is needed for programmers, operators, and other personnel.

We recently completed a review of DOD's manufacturing technology program. The program's objective is to develop or improve manufacturing processes, techniques, materials, and equipment to provide timely, reliable, and economical production of defense materiel. Program projects are intended to

bridge the gap between laboratory research and development innovations and full-scale production applications. The primary goals are to improve manufacturing productivity and reduce materiel acquisition costs. Over \$660 million has been spent on the program to date. Present funding is about \$120 million a year, and DOD plans to gradually increase that to \$200 million by fiscal year 1983.

We endorse the program's objective and goals and believe it has the potential to provide significant benefits to the Government. However, we found that DOD needs strengthened management controls to improve project selection, reporting of project results, program evaluation, and active promotion of the use of project results in defense production. Particularly, much needs to be done to determine what benefits are actually realized from the expenditure of program funds.

In our recent report to the Congress, we recommended specific steps that should be taken by the Secretary of Defense to correct the weaknesses in program management control. 1/ We also asked the Congress to consider withholding approval of the increases in manufacturing technology program funding proposed by DOD until the Secretary of Defense demonstrates that improvements have been made and are effective.

WORK MEASUREMENT SYSTEMS

Work measurement is the term generally used to describe the body of knowledge and techniques used to design job activities so they require a minimum amount of resources and, when appropriate, to establish labor standards. The standards are useful to management in forecasting staff requirements, formulating budget estimates, measuring and controlling efficiency and performance, and comparing actual with expected accomplishments.

Work measurement embraces two major, but independent, activities--job design and standards development. Normally, job design is completed before standards are developed. To do otherwise would build the gross inefficiencies of an existing job into the standards. However, judgment must be used in selecting the appropriate jobs. For example, it would not be economical to spend money to optimally design jobs which are infrequently done and consume a small portion of resources.

1/PSAD-79-99, Sept. 11, 1979.

Depending on the job and its frequency, a number of techniques are available for economically establishing a standard, such as time study, work sampling, predetermined time standards, and mathematical modeling. Qualified work measurement technicians or industrial engineers select the appropriate technique.

Almost universally, studies have found relatively low levels of manufacturing efficiency in major aerospace contractor plants. An Air Force review of private industry practices disclosed that the adoption of a disciplined work measurement system improved productivity substantially. Consequently, in June 1975, the Air Force issued a military standard to be incorporated in selected major weapon system contracts. This standard requires a contractor to install disciplined and integrated work measurement systems covering manufacturing direct labor operations.

The Air Force found that some of its contractors had labor standards, but many were poorly conceived and developed, not fully utilized to analyze production operations, and not used to develop budgets or price proposals. The Air Force estimated that implementation of its military standard could improve direct labor productivity by 20 percent and reduce costs by about \$1 billion. Although the potential savings are impressive, implementation of the standard has been very slow. The Air Force command responsible for obtaining contractor acceptance of this program has received little support from DOD or Air Force headquarters. Also, the Army and Navy are now only considering the adoption of the Air Force work measurement program.

One major contractor who implemented the Air Force work measurement system estimated that productivity improved by 13.4 percent, a savings of over \$6 million. Another contractor informed us that installation of a work measurement system is usually a good investment and can lead to labor-hour reductions of from 10 to 20 percent. Many contractors, however, have been reluctant to accept the Air Force work measurement standard. Most of those we have contacted tell us they use work measurement techniques in their plants and find them valuable in controlling costs. On the other hand, the contractors do not favor the Air Force standard because they feel it goes too far in telling them exactly how to do work measurement, requires use of work measurement in inappropriate applications, and imposes excessive requirements and administrative burdens which increase implementation costs unnecessarily.

SHOULD-COST REVIEWS

The first should-cost review was performed by the Navy in 1967, at the direction of the Secretary of Defense, when the contractor's predicted costs for producing the TF-30 jet engine appeared unreasonably high. The approach then was not to accept the contractor's proposed costs, which were thought to be excessive because of correctable inefficiencies in its operations, but instead to determine, through a detailed in-depth review of all phases of the contractor's overall operations, what the engines "should cost" if the inefficiencies were corrected.

* This first should-cost review was performed by a team of 43 Government engineers; auditors; contract administrators; and cost, price, and management analysts. The team spent 3 months in the contractor's plant. The total effort cost the Government about \$300,000, and the Navy claimed it saved about \$100 million as a result.

DOD later officially adopted the should-cost concept for wider use by all three services prior to the negotiation of sole-source prime production contracts. The Defense Acquisition Regulation defines should-cost as:

" * * * a concept of contract pricing that employs an integrated team of Government procurement, contract administration, audit, and engineering representatives to conduct a coordinated, in-depth cost analysis at the contractor's plant. The purpose is (1) to identify uneconomical or inefficient practices in the contractor's management and operations and to quantify the findings in terms of their impact on cost, and (2) to develop a realistic price objective which reflects reasonably achievable economies and efficiencies."

DOD should-cost reviews were initially characterized as in-depth evaluations of the efficiency of all phases of production contractors' operations. Except for the initial review by the Navy and some of the early reviews by the Army and Air Force, which were fairly well staffed with industrial engineers, few DOD should-cost reviews have probed deeply into the total efficiency of a contractor's manufacturing operations. We believe that time, talent, and attitudes are the three principal limiting factors.

A thorough professional evaluation of the many factors affecting manufacturing efficiency and the development of

competent assessments of the costs of inefficiencies and their correction is a detailed, painstaking, and time-consuming process. Top rank, experienced industrial engineers are required to do it well. DOD, usually pressed for time, pushes for an early contract award to meet a tight weapon operational capability date. Not only this, but also attitudes toward the relative importance of weapon performance and schedule commitments over cost, generally restrict the time available for the should-cost review. In addition, some contractors tend to see the should-cost reviews--which may bring dozens of Government people into their plants and onto the factory floor for weeks or months at a time--as yet further Government intrusions and may not be overly cooperative in providing what the review teams want to know. Furthermore, according to DOD, few well-qualified industrial engineers are in its ranks, and they are difficult to acquire. The lack of these key technical people serves to restrict the scope of the should-cost reviews and the number of reviews that can be made.

Consequently, we do not see the current DOD should-cost reviews as a strong force in actually causing changes in manufacturing methods, processes, equipment, and facilities which will result in substantial productivity improvements.

This is not to say that the reviews are not worthwhile, for much indicates that they are effective in strengthening the Government's negotiating position.

CONTRACTOR INDEPENDENT RESEARCH AND DEVELOPMENT

Independent research and development (IR&D) is the self-initiated portion of a contractor's research and development program. It is not directly sponsored by or required in the performance of a contract. A contractor directs its resources to any effort it feels is necessary to maintain or advance the company's technology to assure its ability to compete for future business.

DOD believes its support of IR&D encourages the evolution and maintenance of a strong, creative, and competitive technology-based industry that is capable of providing new concepts and rapid responses to defense needs. Specific objectives are (1) the continued availability of technically qualified contractors, willing and able to meet DOD needs by competing for contracts; (2) reduced costs through technically competitive proposals based on IR&D efforts; and (3) superior military capabilities through a choice of competitive technical options originating in IR&D.

DOD treats these IR&D costs as contractor overhead and, subject to certain conditions and restrictions established by the Congress, DOD bears part of the expense as contract costs. Total DOD IR&D cost payments were in the \$500 million range in 1976 and 1977. These payments represented about 39 percent of the IR&D costs incurred by major defense contractors in those years.

The Commission on Government Procurement believed that IR&D was in the Nation's best interest, and it should be recognized as a necessary cost of doing business. The Commission recommended that IR&D should be treated uniformly Government-wide. Contractor allocations should be accepted without question, if the contractor's business is 50-percent or more commercial and fixed-price governmental and the IR&D work is relevant to the agency's missions.

The Office of Federal Procurement Policy is providing guidance for a new regulation under development to adopt the Commission's proposal.

The final outcome is uncertain but, in any event, DOD has made, and we expect that it will continue to make, rather substantial IR&D investments toward the advancement of contractor technology. These investments are in addition to directly funded research and development work and DOD's investment in the manufacturing technology program discussed earlier. We have attempted in the past to determine whether the benefits derived from IR&D are worth the cost of DOD's investment, but we have been unable to make such a determination because we could find no way to verify and measure the benefits. One suggested means of increasing the tangible return on DOD's investment in IR&D is to have contractors channel a portion of these funds into weapon manufacturing cost reduction projects. However, neither DOD nor contractors generally favor this approach. They feel that DOD has other programs, such as the manufacturing technology program, that are more suitable for this purpose.

CONCLUSIONS

Several efforts are being sponsored by DOD in an attempt to reduce or control procurement costs. Although the tangible benefits of some of them are difficult to measure, collectively, they appear to be very worthwhile and should be continued--some with even greater emphasis. We do not believe, however, that they can have a truly substantial impact on overall costs.

CHAPTER 5

AGENCY COMMENTS AND OUR EVALUATION

OMB and DOD were asked to comment on this report. OMB comments are included as an appendix to this report. DOD comments were received too late to be included in this report.

According to OMB, our report reasonably describes many problems associated with high weapon systems costs and it is working with DOD to solve the problems.

With regard to our recommendation that the Secretary of Defense accelerate implementation of OMB Circular A-109, OMB feels that DOD has made a strong effort to comply with the provisions of Circular A-109 and that progress is being made. We recognize that some progress has been made; but, while DOD's plan for implementing OMB Circular A-109 was formulated more than 3 years ago, much yet remains to be accomplished. We still believe that more should be done by the Secretary of Defense to add impetus to DOD's implementation.

OMB expressed reservations about our recommendation that the Congress should consider multiyear funding for weapon systems ready for production. OMB is concerned that the advantages of program stability and more economical production practices enabled by multiyear contracting authorization might be outweighed by reduced flexibility in making weapon program changes when faced with changing defense priorities and needs. We agree that multiyear contracting must be handled on a selective basis with thorough consideration of the specific circumstances in each case. As stated on page 15 of this report, we recommended in an earlier report to the Congress that the Office of Federal Procurement Policy should develop appropriate criteria for use of this procurement method. Furthermore, certain provisions of OMB Circular A-109 are specifically designed to improve the definition of DOD missions and the services' roles to make certain that the agency's highest priority major system needs are correctly identified at an early stage. They are also designed to eliminate overlapping missions between services and duplication in weapon systems development. It seems reasonable to expect that, if DOD proceeds with the full implementation of these provisions, the likelihood or frequency of downstream changes in defense priorities and needs would be reduced.

In connection with our recommendation that the Secretary of Defense find ways to relax or modify contract administration requirements, OMB informs us that DOD is anxious to do this and is now reviewing its requirements.



EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

SEP 6 1979

Mr. J. H. Stolarow
Director, Procurement and Systems
Acquisition Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Stolarow:

This is in response to your letter of August 7, 1979 to Mr. McIntyre requesting Office of Management and Budget comments on your draft report, "Impediments to Reducing Costs of Defense Production" (GP-31).

The report reasonably depicts many of the problems associated with Defense procurement such as reduced competition, high unit costs of new weapon systems and increasing operation and support costs. We continue to work with Defense to solve these problems.

As you point out, the Office of Management and Budget developed and issued Circular A-109 on Major Systems Acquisition. DOD has been making a strong effort to comply with its provisions by ensuring that alternative means of satisfying Defense needs receive full consideration at the earliest stages of development. Any such new approach takes time, but we feel that progress is being made.

With regard to your recommendation on contract administration, DOD is currently reviewing its requirements in this area. They are anxious to minimize the red tape and contractor paperwork requirements noted in your report. Finally, we have in the past considered multiyear funding as a possible acquisition strategy. However, the advantages offered by increased program stability still have to be weighed against the real disadvantages resulting from reduced flexibility to meet changing priorities and needs. For this reason, we continue to have reservations about this approach.

I understand the Department of Defense is providing you with detailed comments on specific problem areas and recommendations.

We very much appreciate the opportunity to have reviewed your draft report. Please let me know if we can be of further assistance.

Sincerely,

A handwritten signature in cursive script, appearing to read "David Sitrin".

David Sitrin
Deputy Associate Director
for National Security

(950542)

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