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BY THE COMPTROLLER GENERAL

# Report To The Congress

OF THE UNITED STATES

## Military Standard On Work Measurement--A Way To Control Cost And Increase Productivity

The Air Force's Military Standard 1567 work measurement holds the key to significant improvements in contractors' productivity and cost control. One Air Force study pegged the potential savings for acquisition of Air Force major weapon systems at \$1 billion in future years.

Implementation of Military Standard 1567 by the Air Force has been slow; but, where implemented, manufacturing labor productivity improvements have exceeded 20 percent. Adoption of the standard on a Defense-wide basis has been pursued since 1974 with limited success. GAO wants the Secretary of Defense to support the program and believes the concept ought to be applied to all major defense contractors--Army, Navy, and Air Force.



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PSAD-80-46  
JUNE 3, 1980

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

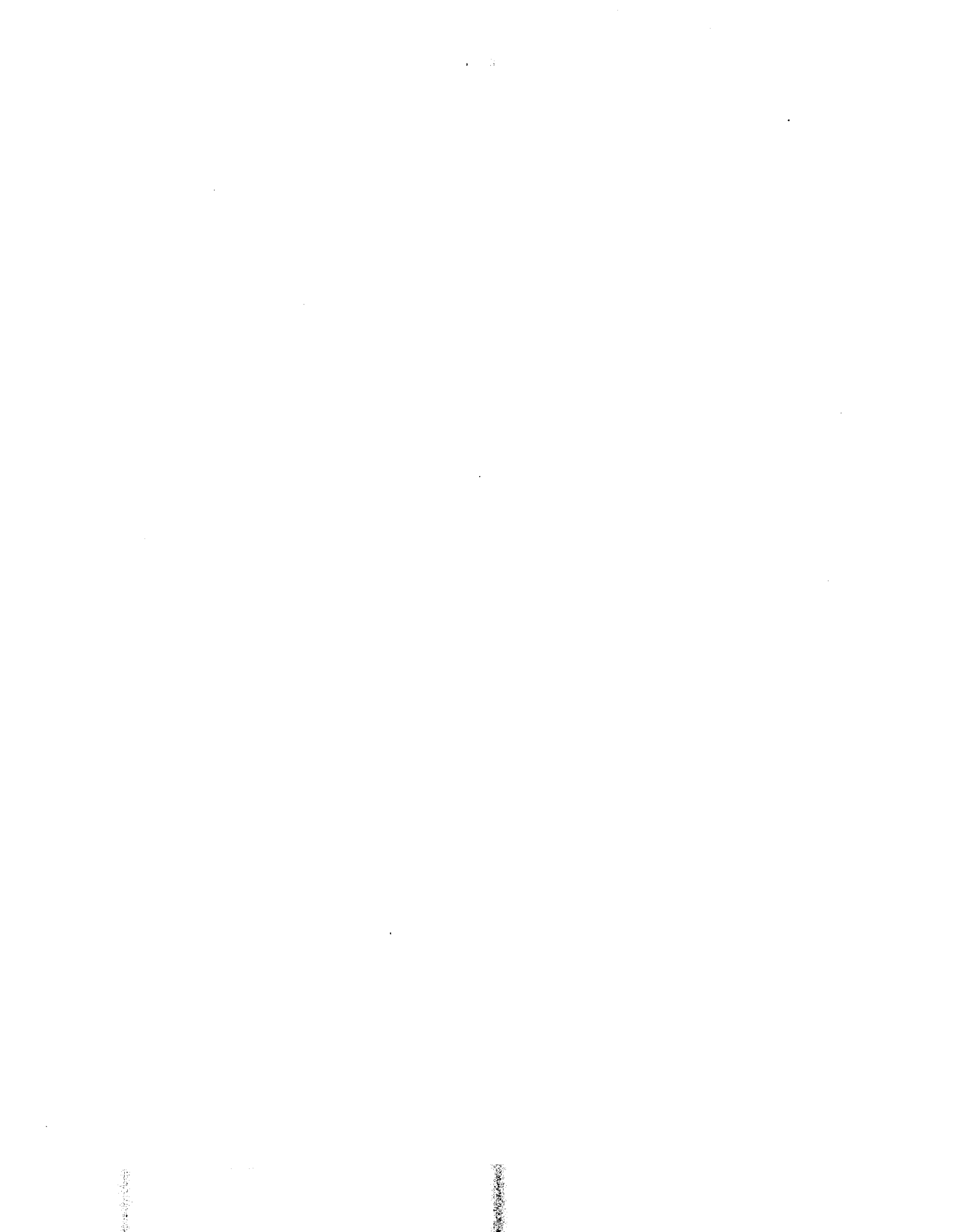
This report recommends that a successful program the Air Force developed to improve the productivity and cost control of contractors be adopted by the other military services on major weapon systems acquisition contracts.

We made this review to determine whether the Air Force work measurement program was being effectively implemented and whether the other military services could effectively use the program on contracts for their weapon systems. The program is just beginning to be effective in the Air Force, and the other military services are beginning to take action to implement the program. Implementation on a Defense-wide basis could result in significant savings.

Copies of this report are being sent to the Director, Office of Management and Budget; the Secretaries of Defense, the Army, the Navy, and the Air Force; and the contractors identified in the report.

A handwritten signature in black ink, appearing to read "James A. Stacks".

Comptroller General  
of the United States





to evaluate areas of low productivity for the early identification of potential improvements in personnel planning, scheduling, manufacturing, budgeting, performance evaluation, methods improvements, and cost control.

Almost universally, studies in the early 1970s showed relatively low levels of manufacturing efficiency in major aerospace contractor plants. The Air Force found that some of its contractors had work measurement systems and 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. Consequently, in June 1975 the Air Force issued MIL-STD-1567 to be incorporated in selected major weapon system contracts.

Officials who developed MIL-STD in 1974 and 1975 estimated improved work measurement systems would increase direct labor productivity in their contractor plants by 10 to 30 percent, resulting in an overall 5-percent reduction in major weapon system acquisition costs or more than \$1 billion savings in future years. (See p. 8.)

Prior to implementation, Air Force officials attempted to coordinate implementation on a DOD-wide basis, but Army and Navy officials believed that it would be too expensive, duplicated existing systems, might cause labor problems, and intruded into contractor management.

#### AIR FORCE IMPLEMENTATION-- SLOW BUT SUCCESSFUL

Because of a limited management commitment by top-level Air Force officials, progress between 1975 and 1978 in implementing MIL-STD-1567 into major acquisitions contracts was painfully slow. However, in 1978 a management policy letter was issued requiring MIL-STD in all applicable major acquisitions. More progress is now being achieved.

Productivity improvements and cost savings are being realized at contractor plants in which

MIL-STD has been applied. For example, Boeing Aerospace Company incorporated MIL-STD requirements into a work measurement system. In one shop, average performance to standard increased 20 percent in about 2 years. The Air Force estimates that Boeing achieved a gross savings of about \$31.3 million with an investment to implement the system of about \$1.8 million--a return on investment of about 17 to 1. (See p. 14.)

Another triservice coordination effort to implement MIL-STD on a DOD-wide basis was studied by a subpanel on work measurement chartered by the Joint Logistics Commanders. Subpanel representatives from each of the services confirmed the need for a DOD standard and regulation and recommended triservice implementation, but initial responses from Army and Navy officials indicated that implementation efforts will have to be followed closely by DOD.

#### RECOMMENDATIONS

GAO recommends that the Secretary of Defense institute firm measures to insure that implementation of MIL-STD in major acquisition contracts of all services will be aggressively pursued and actively promoted by all service secretaries and managers of buying activities. (See pp. 20 and 21.) Some measures the Secretary of Defense should take include:

- Issue a firm commitment supporting the recommendations by the Joint Logistics Commanders' subpanel on work measurement for triservice adoption of MIL-STD-1567.
- Require the Joint Logistics Commanders to follow up on implementation efforts of the service buying activities.

#### DOD COMMENTS

DOD concurs with the general content and thrust of this report and promised to assure that MIL-STD-1567 is implemented in appropriate acquisition programs. (See app. I.)





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ABBREVIATIONS

ACE	Acquisition Cost Evaluation
DOD	Department of Defense
GAO	General Accounting Office

ABBREVIATIONS

JLC	Joint Logistics Commanders
MIL-STD	military standard
USAF	U.S. Air Force

## CHAPTER 1

### INTRODUCTION

This report takes a look at a successful program instituted by the U.S. Air Force (USAF) to achieve improved productivity and cost control by contractors in the acquisition of major weapon systems. The program involves the development and implementation of Military Standard (MIL-STD) 1567 (USAF)--work measurement, a contractual requirement for contractors to use disciplined, integrated work measurement systems in their manufacturing operations. We evaluated USAF success to date in implementing MIL-STD-1567 in major Air Force acquisition contracts and its attempts to encourage other services to implement it on a Department of Defense (DOD) wide basis in their acquisition contracts.

#### WHAT IS WORK MEASUREMENT?

Work measurement is a technique for collecting data on work hours and production of work units to determine the relationship between work performed and work hours expended. It includes the use of recognized industrial engineering techniques, such as time studies, standard data, work sampling, or predetermined time systems, to set labor time standards for performing work of an acceptable quality.

Management uses the resulting data--the relationship of actual versus standard--to evaluate areas of low productivity for the early identification of potential improvements in personnel planning, scheduling, manufacturing, budgeting, performance evaluation, methods improvements, and cost control.

In layman's terms, work measurement tells

--how long it has taken and

--how long it should take

to do a piece of work or perform a service or task. The question of how long is one of three questions, whether expressed or not, that arises for any person when given a new assignment, task, or job to perform. Answers are customarily supplied to the first two questions:

--What is to be done?

--How well is it to be done?

But often, reliable answers are not given for the third question:

--How long?

The more specific the answers to these questions, the better. In being specific about what is to be done, a statement of method is involved. Increasing productivity with work measurement systems does not mean working the labor force harder, but rather more effectively. For this reason, one cannot divorce methods improvement studies from work measurement but must be concerned with both methods and measurement in a given situation. In being specific about how long it has taken to produce a product or service, a statement of work measurement is involved.

Even the simplest type of activity requires a knowledge of how long it takes and what is the best way to do a job in order to plan and control the workload and manufacturing costs. As an organization increases in size and complexity, this basic information becomes of greater importance to management.

It would be folly for management to attempt to manage without at least a knowledge of the most efficient and effective manufacturing methods and how long it should take to perform work, be it producing a product such as tanks, ships, or airplanes or providing support activity such as maintenance or administration. Therefore, considerations concerning the application of work measurement as a management tool should not be whether work measurement should be used, but rather what type of work measurement and to what extent it should be applied.

#### WHY WORK MEASUREMENT IS IMPORTANT

The annual productivity growth rate in the United States has slowed significantly in recent years. Among 12 major industrial nations, the United States has consistently ranked at the bottom of the list with the lowest average productivity growth. Gains have averaged 1.6 percent during the last decade--a discouragingly low figure compared to the 3.2-percent average of the first two decades in the post-World War II period and compared to the 5- and 6-percent figures of our major trading partners. Growth during 1978 and 1979 slipped below an annual rate of 1 percent.

Increasing the Nation's productivity is an important tool in the control of inflation, described by the President's anti-inflation chief as "the most serious

domestic problem we have." Finding solutions appears to be as difficult as isolating its causes, but productivity gains would provide immediate relief and perhaps a longrun cure for a substantial portion of today's inflation. Without positive measures to turn around the decline in productivity growth, it may continue indefinitely. In addition, productivity gains allow business to become more competitive. More competition generally means lower prices--both are desperately needed by DOD in the acquisition of major weapons systems with the fiscal constraints today.

While there are many social and economic reasons that may account for some of this productivity decline, the Government has available techniques, such as MIL-STD-1567, which can and should be used to assist the Nation in improving productivity.

#### PURPOSE AND SCOPE

We initiated this review to

- evaluate the Air Force's development and implementation of a military standard for work measurement systems in contractor plants,
- determine if the purpose of improving productivity and efficiency is being achieved when implemented, and
- consider applications of this Air Force program to all DOD contractors.

We performed our work at Headquarters, Air Force Systems Command, Washington, D.C., and at two of its subordinate activities, the Air Force Contract Management Division in Albuquerque, New Mexico, and the former Space and Missile Systems Organization in Los Angeles, California. In addition, we reviewed the progress of implementing disciplined, integrated work measurement systems at two Air Force contractors' plants. We also talked with representatives of Headquarters, USAF, and the Naval Air Systems Command relating to the implementation of MIL-STD on a DOD-wide basis.

## CHAPTER 2

### MIL-STD-1567--BENEFITS

#### AND POTENTIAL FOR COST SAVINGS

Among DOD contracting agencies, the Air Force has taken the lead in the field of improving productivity and achieving significant cost savings in defense contractor plants through MIL-STD-1567, a contractual requirement for integrated and disciplined work measurement systems in manufacturing operations. Air Force officials who developed MIL-STD in 1974 and 1975 estimated improved work measurement systems would increase direct labor productivity in their contractor plants by 10 to 30 percent, resulting in an overall reduction of about 5 percent in major weapon systems acquisition costs. At that time, with major Air Force programs costing about \$25 billion, officials estimated that a 5-percent reduction would amount to more than a \$1 billion savings in future years.

#### PROJECT ACQUISITION COST EVALUATION

Air Force systems acquisition activities during the early 1970s were faced with a serious problem of increasing weapon systems costs together with decreasing buying power. In addition, DOD's portion of the national budget had declined steadily during the previous decade. This, coupled with increasing personnel costs, limited the funds available to procure new weapon systems. Acquisition costs were rising much faster than the rate of national inflation. Between 1961 and 1971, industrial commodity costs increased 22 percent, while weapon systems costs increased about 300 percent.

The seriousness of the problem led the Air Force to conduct a search to find ways to significantly reduce the cost of acquiring and operating new systems. The effort, completed in mid-1973, was the Project Acquisition Cost Evaluation (ACE). Among its many findings, Project ACE identified an opportunity for potentially significant savings in direct manufacturing labor costs in the production of major weapon systems at contractors' plants.

Specifically, the Project ACE report stated in part that:

"Manufacturing labor contributes a sizeable portion of the total direct costs on typical weapon system production contracts. It is believed that a

significant portion of the current labor cost is nonproductive because of manufacturing inefficiencies."

\* \* \* \* \*

"Effective work measurement programs throughout the Defense industry would identify areas of low efficiency, improve work methods, and provide realistic productivity goals; thus contributing to significant cost reduction in the acquisition of defense systems."

The action plan consisted of establishing a team to consider development of a MIL-STD to describe an acceptable work measurement program.

Prior studies supported the Project ACE conclusion. One, completed in 1972, indicated that even when production reaches the 1,000th aircraft, 45 percent of the time was nonproductive. Additionally, surveys at Air Force contractor plants showed that most plants had work measurement systems and labor standards but that

- they were poorly conceived and developed,
- they were not applied in accordance with the intent or objectives of labor standards in some instances,
- audit trails were practically nonexistent, and
- data was not used to develop budgets or price proposals.

Also, an Air Force review of practices in private industry disclosed that adoption of a disciplined work measurement system led to substantial productivity improvement.

#### REQUIREMENTS OF MIL-STD-1567

As a result of the Project ACE action plan, the Air Force Contract Management Division was tasked to develop a MIL-STD for work measurement systems in contractor plants. MIL-STD-1567, as eventually issued, specifies certain minimum requirements which must be met for a contractor's work measurement system to be considered acceptable. To allow maximum flexibility in the application of MIL-STD, it specifies criteria to be met rather than the method by which this should be accomplished. Its purpose is to assist in achieving increased discipline in contractors' work measurement programs with the objective of improved productivity and efficiency in contractor industrial operations.

The standard applies to major Air Force system acquisition contracts--those of \$20 million annually or a total of \$100 million. It also applies to full-scale development contracts of \$100 million or more that precede a major production contract. It is required to be applied to certain subcontracts, although this may be waived. Construction, facilities, off-the-shelf commodity, time and materials, research, study, other development, and any firm fixed-price contracts are excluded.

MIL-STD requires that contractors have and use a documented, disciplined, integrated work measurement system in their manufacturing operations. The general requirements are

- a work measurement plan and supporting procedures;
- a clear designation of the organization and personnel responsible for executing the system;
- a plan to establish and maintain engineered labor standards of a known accuracy;
- a plan of continued improved work methods in connection with the established labor standards; and
- a defined plan for the use of labor standards as an input to budgeting, estimating, production, planning, and touch labor l/ performance evaluation.

The system evolves from the use of engineered labor standards in most phases of the manufacturing operation. A labor standard is the time allowed for a normally skilled operator who follows a prescribed method, working at a normal all-day level of effort, to complete a defined task with acceptable quality. An engineered standard is one established using a recognized technique, such as time study, work sampling, standard data, or a recognized predetermined time system, to derive at least 90 percent of the total time associated with the labor effort covered by the standard.

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l/Touch labor: production labor which can be reasonably and consistently related directly to a unit of work being manufactured, processed, or tested. It involves work affecting the composition, condition, or production of a product; it may also be referred to as hands-on labor or factory labor. It includes such functions as machining, welding, fabricating, cleaning, painting, assembling, and functional testing of production articles.



Nonengineered standards are those not meeting the above criteria and are usually determined by estimates or based on historical data. Specific requirements to be met in establishing standards under MIL-STD are:

- Provisions for a time-phased schedule to achieve 80-percent coverage of all categories of touch labor by engineered standards (nonengineered standards are acceptable for initial coverage).
- An accuracy of at least  $\pm 25$  percent, with a confidence level of 90 percent for engineered standards.
- Development of personal, fatigue, and unavoidable delay allowances as part of the standard.
- Identification of each element of a realization factor (ratio of actual time taken to the standard time) that modifies a labor standard.
- Review of standards for accuracy when changes are made in the manufacturing process.
- Submission of periodic reports on labor performance and variance analysis on an exception basis.
- Provision for internal audit of the system.

#### BENEFITS OF A WORK MEASUREMENT PROGRAM

Experience has shown that excess labor costs and lost time can be identified and reduced and continued improvements made regularly where work measurement programs have been implemented and conscientiously pursued. Among the benefits which can accrue as a result of these programs are

- achieving greater output from a given amount of resources;
- obtaining lower unit cost because production is more efficient at all levels;
- reducing the amount of waste time in performing operations;
- encouraging continued attention to methods and process analysis because of the necessity for achieving improved performance;

- improving the budgeting process and providing a basis for price estimating;
- acting as a basis for planning for long-term personnel, equipment, and capital requirements;
- improving production control activities and delivery time estimates;
- focusing continual attention on cost reduction and cost control; and
- helping in solving layout and materials handling problems by providing accurate figures for planning and utilization of such equipment.

#### POTENTIAL FOR SAVINGS

The following excerpt from the paper titled, "MIL-STD-1567 (USAF): The Billion Dollar Payoff," given at the 1977 Defense Procurement Research Symposium does not appear unreasonable and shows the tremendous potential for savings:

"The face value of major AFSC [Air Force Systems Command] contracts is about \$38 billion. Of these major contracts, the vast majority are for production or full-scale development efforts, certainly \$25 billion or more. Of this \$25 billion, more than 30% represents the burdened value of direct manufacturing. Positive influence on at least two-thirds of this direct manufacturing effort seems feasible. A twenty percent savings or improvement potential still appears reasonable. This would create a savings of  $(\$25B \times .20 \times .20)$ --at least \$1 billion. \* \* \* In addition, about 40% of the face values are used for procurement. About a five percent savings should be made in these expenditures. \* \* \* This 5% savings, which is somewhat understated, would total  $(\$25B \times .40 \times .05)$ --an additional \$1/2 billion."

A study by the manufacturing committee of the Aerospace Industries Association had shown earlier that benefit-to-cost ratios to implement and operate the system or improve existing systems would range from 2 to 1 to 5 to 1.

On a DOD-wide basis, the potential for savings through improved productivity is even more impressive. In March 1979 DOD had 82 major weapon systems, estimated to eventually cost

about \$296 billion, in various phases of acquisition; that is, somewhere between early development and production of the system. These 82 major acquisitions will require future funding of over \$180 billion. A 20-percent improvement in manufacturing productivity could save billions in future weapon system acquisition costs.

#### COORDINATION OF MIL-STD-1567 WITH INDUSTRY, DOD, AND SERVICES

The Air Force Contract Management Division staff completed its initial draft of the standard in early 1974 and furnished it to industry and the other services for review and comment. The comments and reactions received were mixed, varying from rejection to acceptance.

Industry response, through the Council of Defense and Space Industry Associations, recognized and concurred with the objective of obtaining maximum productivity and cost effectiveness while fulfilling contractual requirements. However, the association objected that the standard was (1) vaguely specified, (2) structurally complex, (3) burdensome to install and maintain, (4) administratively expensive, (5) redundant to existing contractually required management systems, and (6) contrary to DOD-expressed policy concerning limited involvement in contractors' management systems. More recently similar opinions were expressed by many contractors we contacted directly in 1979.

DOD, Army, Navy, and other Air Force Command comments, while not quite so negative, were not completely supportive of issuing the standard on a DOD-wide basis. They generally believed it (1) would be too expensive, (2) was redundant to existing systems, (3) might cause labor problems, and (4) represented an intrusion into contractor management. DOD officials, after meeting with industry representatives, agreed with the Air Force proposition that something needed to be done but advised the Air Force to go slowly in its implementation, starting with a test and evaluation on a specific contract prior to implementation Air Force-wide. According to Air Force officials, there had been no further involvement with MIL-STD at the DOD level since that time. Recently, however, DOD has become involved. (See app. I.)

On the basis of the comments received, some changes were made to the draft MIL-STD, and it was issued on June 30, 1975, as MIL-STD-1567 work measurement (USAF) for application only to Air Force acquisitions. A related Armed Services Procurement Regulations (now Defense Acquisition Regulation) clause providing for use of MIL-STD on a DOD-wide basis had

been prepared but never processed beyond the Air Force. Again, this is changing. (See app. I.)

Subsequent to issuance, an industrial engineering consultant commented on MIL-STD as follows:

"Certainly no industrial engineer can argue with the purpose and the benefits which can accrue from the successful implementation of a work measurement program as described by MIL-STD-1567 (USAF). The objectives are sound, they reflect the 'motherhood of industrial engineering concepts,' and they very much follow an outline of the academic approach to one of the solutions to improving productivity and more effective cost control." 1/

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1/Stan Wolfberg, "Work Measurement: The Flap Over MIL-STD-1567 (USAF)--The Consultant: In Between," Industrial Engineer, Nov. 1976, p. 19.

### CHAPTER 3

#### AIR FORCE IMPLEMENTATION OF MIL-STD-1567

##### SLOW BUT SUCCESSFUL

Because of a limited management commitment by Air Force officials, progress between 1975 and 1978 in contractually implementing MIL-STD-1567 in major acquisition contracts was painfully slow. Progress began to be achieved in contractually implementing MIL-STD on all applicable contracts after issuance of a management policy letter in 1978 requiring its use.

Attempts were again in process in 1979 to coordinate adoption of MIL-STD on a DOD-wide basis. Initial reaction to it was generally negative. However, since we completed our review, MIL-STD has been coordinated with Army and Navy program management activities and recommended for adoption with some changes in terms. Where implemented by the Air Force, anticipated problems by industry, DOD, and all services in getting MIL-STD into contracts have not surfaced and productivity increases and related cost control benefits have been dramatic, even in the early stages of implementation.

##### AIR FORCE IMPLEMENTATION NEEDED A STRONG MANAGEMENT COMMITMENT

Only since management commitment--in the form of a policy directive requiring MIL-STD on all applicable contracts--is full coverage beginning to be attained. Air Force progress in contractually implementing work measurement systems in specific contracts was painfully slow between 1975 and 1978. However, where implemented, the anticipated results are beginning to be achieved. For nearly 3 years Air Force management officials did not aggressively pursue implementation, and by May 1978 MIL-STD was included in contracts for only six acquisition programs. During that period, buying activities missed opportunities for coverage on contracts meeting criteria of the standard.

##### Initial policy--weak and ineffective

In April 1976 the Assistant Deputy Chief of Staff, Procurement and Manufacturing, Air Force Systems Command, in a letter to the command's buying and contract administration activities, advocated implementing MIL-STD and solicited support for including it in development and production contracts. In the same period, the Contract Management

Division was designated as the lead division to promote understanding and implementation.

Personnel at the buying activities identified several systems in which they intended to implement MIL-STD. Some commented that system program directors would be encouraged to implement MIL-STD or to carefully consider its application to future contracts. One stated that it would be considered only if there had been a successful demonstration of its ability to materially improve normal contractor work measurement systems. Some expressed concern in one or more of the following areas in its application to

- low-quantity production programs,
- mature production programs,
- program versus plant-wide implementation, and
- redundancy to existing management systems.

The Contract Management Division, as the Air Force contract administration activity, has no responsibility or authority for preparing specifications or awarding contracts. However, as the lead division to implement MIL-STD, it initiated an extensive program to inform, indoctrinate, educate, and train buying activity officials and its own staff, who would eventually administer implementation of the standard, on the benefits of MIL-STD. However, an official advised the Air Force Systems Command that

"\* \* \* Without assurance that the standard is seriously considered for implementation [by System Program Directors], our promoting understanding and preparing for implementation could prove to be an imprudent and wasteful use of resources."

This Air Force policy of advocacy and encouragement resulted in contractual implementation of MIL-STD on only six systems by May 1978. Opportunities to include MIL-STD on development and production contracts meeting the MIL-STD criteria were missed, due primarily to the concerns expressed earlier by the buying activities. Mature and follow-on program contracts and contracts for programs involving limited production quantities were awarded without MIL-STD.

#### Revised policy--a management commitment

In March 1978 the Deputy Chief of Staff, Procurement and Manufacturing, Air Force Systems Command, issued a

stronger and more significant policy letter to buying activities, which clearly committed the Air Force to the program. Rather than soliciting support for including the standard in development and production contracts, it provided that the standard shall be applied to all new or followup procurements meeting the criteria for application. In addition, it provided for a determination whether MIL-STD would be cost effective if applied to ongoing programs. If determined cost effective, it called for the addition of MIL-STD to the contract.

Our review at one buying activity and discussions with Air Force officials indicated that the policy is now being implemented. Ongoing programs are being reviewed, and requests for proposals on all new development or production programs meeting the criteria contain the MIL-STD-1567 requirement for work measurement systems. By mid-1979, MIL-STD was in contracts or subcontracts for 13 Air Force acquisition systems and in requests for proposals or advance change/study notices on an additional 11 systems.

#### Implementation problems not evident

Potential problems expressed earlier by industry and problems raised later by Air Force buying officials in implementing MIL-STD on contracts have not surfaced. The MIL-STD work measurement system requirements are presently a part of requests for proposals or have been incorporated in development and production contracts for mature programs, follow-on production, and those with limited production quantities with equal success. Contractors are implementing work measurement systems on a plant-wide basis, thereby achieving the benefits on all programs under development or in production.

According to an official at the Space and Missile Systems Organization (now the Space Division), contractors have proposed no visible costs to the contractual requirements of MIL-STD. Contract administration officials said that MIL-STD actually makes administration of the contract simpler, easier, and less costly. In addition, they stated that MIL-STD, rather than being redundant to existing management systems such as the Cost/Schedule Control Systems Criteria, is compatible, eliminating some reports and strengthening the data base with more reliable data available more quickly.

#### MIL-STD-1567 PROGRAMS ACHIEVE POSITIVE RESULTS

Productivity improvements and cost savings at Air Force contractor plants where the MIL-STD work measurement system

has been applied are starting to be realized. The following are examples of positive results being achieved early in the implementation phase and results from one ongoing system--one of the two used as a model for development of MIL-STD.

#### Boeing Aerospace Company

Prior to the Air Force issuance of MIL-STD-1567, Boeing Aerospace Company had made a complete review of work measurement activities in support of a computer business system development program. Basic requirements for an integrated work measurement system were defined emphasizing planning and control. An estimate of resources required for this system to integrate labor standards with estimating, budgeting, and forecasting was being prepared in mid-1975 when MIL-STD was issued. Boeing manufacturing officials believed MIL-STD embodied commonly accepted concepts of work measurement and incorporated its criteria in the system planning.

The resulting Boeing Aerospace Company integrated work measurement plan was completed in late 1975. Boeing and Air Force officials held a joint seminar in early 1976 and agreed that the plan substantially met MIL-STD requirements.

Implementation costs during 1976 amounted to about \$450,000, primarily for additional staff. An Air Force analysis of performance reports between July 1975 and September 1976 in Boeing's mechanical shop showed an average direct labor productivity increase of 13.4 percent--from a 59.6-percent average during the first 5 months to a 67.6-percent average in the next 9 months. Based on the manufacturing hours expended during 1976, cost savings were estimated in excess of \$6 million, or a benefit-to-cost ratio of about 13 to 1.

Average performance to standard continued to increase and during calendar year 1977 reached 72 percent--a productivity increase of 20 percent over the base line period in 1975. By the end of 1978, the Air Force estimates that Boeing had achieved a gross savings of about \$31.3 million with an investment to implement the system of about \$1.8 million--a return on investment of about 17 to 1.

Boeing implemented the system on a plant-wide basis without regard to a contractual requirement. Therefore, all current systems in development or production at the time of implementation, with or without an existing contractual work measurement system requirement, have benefited from the im-



proved productivity and cost control resulting from implementation of MIL-STD.

#### General Dynamics Corporation

The Air Force's initial attempt to add MIL-STD to the full-scale development and production contracts for the F-16 aircraft program with General Dynamics began in October 1975. General Dynamics officials contended at the time that they were installing a work measurement system based on the best elements in use in the industry. While not meeting the requirements of MIL-STD, it would conform to its intent and spirit and be less costly. Without specifying an amount, General Dynamics officials stated that implementing MIL-STD would cause a major increase in the cost of the F-16 program.

Negotiations continued with submission of a plan in March 1977 which the Air Force determined to be nonresponsive to the MIL-STD requirements. By August 1977 Air Force contract administration staff estimated that lack of a disciplined work measurement system would result in an increase in the F-16 program costs of about \$50 million. In the following 4 months the Air Force and General Dynamics agreed to implement MIL-STD tailored to corporate organization and practices (but still essentially the basic MIL-STD). A contract modification incorporating MIL-STD was executed at no increased cost to the Government in January 1978.

Air Force records show that, even as the negotiations were in progress, reductions in costs through recognized work measurement techniques had occurred on the F-16 program. The Air Force estimates that productivity improvements through calendar year 1978 resulted in savings of about \$25.4 million. With implementation costs of about \$4.6 million, a benefit-to-cost ratio of about 5.5 to 1 has been achieved.

#### TRW Defense and Space Systems Group

TRW's Defense and Space Systems Group is an extremely low-volume producer of highly complex spacecraft systems. Historically, the maximum quantity of any system shipped in 1 year has been two.

In conjunction with an organizational change made in 1977, the group formulated a new work measurement methods improvement plan for its new manufacturing division. At about the same time, the group received a request for proposal from the Air Force, with the MIL-STD-1567 requirement, for follow-on production of the Fleet Satellite Communications

System. After discussion with Air Force officials, TRW agreed to expand its work measurement plan so that, when implemented, the requirements of MIL-STD would be satisfied. The Air Force reviewed and approved the expanded plan in 1978.

In 1979 the Air Force analyzed the costs and benefits of improving the existing system to conform to the MIL-STD requirements. There were no direct costs to any program for developing the new system. Indirect costs involving approximately 8 staff months of industrial engineering effort were absorbed into existing overhead budgets. Benefits noted were

- improved performance reporting,
- improved problem identification, and
- improved realization factor (productivity).

Concerning productivity improvement, one organization, Electronic Manufacturing, showed a steady increase in performance to standard from 40 percent, achieved during the 6-month base period in the last quarter of 1976 and first quarter of 1977, to 62 percent during the final quarter of 1978--a 55-percent improvement in about 2 years. The Air Force estimated that cost savings related to this increased productivity amounted to about \$1.4 million.

#### Rockwell International Autonetics Group

The Contract Management Division used the work measurement system of Rockwell International's Autonetics Group as one of the two model systems in developing MIL-STD-1567. After a planning and development period, Rockwell implemented its system in 1968. In April 1976, a group official stated in a paper presented at an association conference that:

"We have experienced a 61 percent improvement in productivity over the last five years as a direct result of instituting a sound work measurement program in combination with an intensive Engineered Production Line effort. These gains were even more dramatic during the first two years of the program; however, the overall improvements are derived from the dynamic application of the total work measurement spectrum \* \* \*."

CURRENT TRISERVICE COORDINATION--  
LITTLE CHANCE FOR SUCCESS WITHOUT  
MANAGEMENT SUPPORT AND COMMITMENT

Air Force coordination in 1974 and 1975 with DOD and the other services, prior to issuance of MIL-STD for Air Force use only, met with minimal success. Another coordination effort to implement MIL-STD on a DOD-wide basis was again underway in late 1979. Although initial reaction by the other services was negative, MIL-STD was recommended for adoption with some changes in terms and application. DOD management is now involved in this current effort.

In September 1977 the Joint Logistics Commanders (JLC) chartered a Joint Service Panel on Manufacturing/Production Management to identify areas of mutual interest and establish subpanels as necessary. A subpanel, consisting of representatives from the Army, Navy, and Air Force, on MIL-STD-1567 was later established. Its mission was to confirm the need for a uniform triservice contractual work measurement requirement and, if needed, to develop a DOD MIL-STD and related regulation clause.

Although the minutes of the subpanel's meeting in October 1978 show that the representatives agreed to recommend triservice coordination, the responses varied. The Army representative stated that comments he had received were generally favorable but that a number of items needed clarification and strengthening before the Army would consider triservice coordination. However, many of the comments indicated an unfavorable attitude toward triservice implementation. Several Army commands expressed problems with the standard in such areas as

- overlap with existing systems, such as the Cost/Schedule Control Systems Criteria;
- inappropriate application to full-scale development contracts;
- increased costs to contractors and to Government for surveillance;
- imposition of another unnecessary Government management system; and
- impact on labor agreements.

The Navy representative stated that he favored triservice coordination but that additional selling would probably be

needed in the Navy. The Commander, Naval Air Systems Command, confirmed this comment the following month when he advised the Air Force Contract Management Division staff, who had been trying to convince the Navy to incorporate MIL-STD in Air Force-administered contracts for the \$14 billion F-18 aircraft system, that the command "does not desire to incorporate MIL-STD into F-18 contracts at this time."

By March 1979 the subpanel members completed their work on a revised MIL-STD and proposed Defense Acquisition Regulations clause and recommended that they be adopted by all the services. The revisions involved changes to the Air Force MIL-STD that raised the subcontract dollar threshold, increased accuracy of engineered standards, and revised the requirement for a formal written analysis which addresses causes and corrections so that such an analysis is to be made only when a significant departure from projected performance goals occurs.

Coordination of the recommendation by each of the panel members with their respective service commands had not been totally completed at the time we finished our review in late 1979. However, as before, initial responses received were varied, again from rejection to acceptance, but with qualifications.

In discussing our draft of this report with DOD officials, we learned that, since our review was completed, the Army and Navy panel members have coordinated the recommendation with their respective service commands. Therefore, the initial negative responses of the Army and Navy procuring commands which were included in our draft of this report have been deleted. The Army concurred in triservice adoption of MIL-STD and the Defense Acquisition Regulation clause subject to several proposed changes in the draft. The Navy concurred in adoption of the standard subject to inclusion of a provision for waiver of prime contractor implementation, if the application of the standard is evaluated as not being effective in a particular application. In addition, the Navy believes that ship construction or ship system contracts which have low-volume, nonrepetitive production runs should be fully exempted from the requirements to implement the standard.

The Navy's belief that ship construction contracts ought to be exempted from work measurement standards is not consistent with the experience of some elements of the shipbuilding industry. An August 1977 report titled, "Improved Planning and Production Control," by the U.S. Department of Commerce,

Maritime Administration, prepared by Bath Iron Works Corporation (shipbuilders and engineers who also build Navy ships), concluded:

- "(a) The use of Engineered Standards in shipyard planning and production control will significantly improve schedule compliance and will increase shipyard productivity. Indeed, the contributions to cost reduction measured by the research far exceeded the rather conservative projections made early in the project.
- "(b) Costs of developing and applying Engineered Standards can be fully recovered on a single ship construction project and still yield net savings in fabrication costs.
- "(c) Shop labor will cooperate fully with the use of Engineered Standards in planning and production control if proper groundwork is laid.
- "(d) A fully informed and supportive shipyard management is essential to effective use of Engineered Standards."

Since the report was prepared in 1977, we contacted the manager of that study in April 1980 to ask what industry acceptance has been. He said that both the original report and a follow-on manual have been extremely well received throughout the shipbuilding industry. Furthermore, he reported that, in a related effort under the Maritime Administration-sponsored National Shipbuilding Research program, six major shipyards now participate in developing and sharing engineered labor standard data.

## CHAPTER 4

### CONCLUSIONS AND RECOMMENDATIONS

#### CONCLUSIONS

Little has changed in the Defense funding arena since the Air Force completed its Project ACE study to find ways to significantly reduce the cost of acquiring new systems--except that perhaps inflation is taking a larger share of the available funds. DOD officials are currently considering reducing quantities of major weapons systems to be acquired in future years; funding trade-offs are under study; and program delivery schedules are being stretched out, deferred, or canceled.

In this budget conscious environment, DOD management should be using all techniques available to insure that its defense acquisition contractors utilize effective management practices in manufacturing operations which provide for increased productivity and improved cost control. Air Force experience to date with MIL-STD-1567 shows that, when applied with positive management commitment, it has been successful in achieving these objectives. In our opinion, early application of MIL-STD to appropriate Army and Navy major weapon systems acquisition contracts can achieve similar success. However, expanded application has been drawn out with limited success so far.

We believe that the potential for achieving significant cost savings in major systems acquisitions has been so well demonstrated under Air Force contracts and the need for controlling inflation is so important that implementation of disciplined, integrated work measurement systems by Army and Navy contractors should not be delayed. However, in our opinion, successful implementation on a DOD-wide basis through the current triservice coordination efforts will only be achieved in a timely manner with commitment and support from top-level DOD and other service management.

#### RECOMMENDATIONS

In view of the potential dollar savings and the potential positive impact on inflation, we recommend that the Secretary of Defense institute firm measures to insure that implementation of MIL-STD-1567 in major acquisition contracts of all services will be aggressively pursued and actively promoted by all military service secretaries and managers. Some measures the Secretary of Defense should take include:

--Issue a firm commitment supporting the recommendations by the JLC subpanel on work measurement for triservice adoption of MIL-STD-1567.

--Require JLC to follow up on implementation efforts of the service buying activities.

#### AGENCY COMMENTS

Although DOD did not provide official written comments on a draft of this report within 30 days, it did provide comments on April 28, 1980. (See app. I.) In the interim, we met with DOD officials and obtained oral comments. DOD and military service representatives indicated general concurrence with the content and thrust of our report. They did not agree that our draft reflected the current status of DOD-wide efforts to implement work measurement standards. DOD officials noted that, since the completion of our study, significant progress has been made in implementing our proposed recommendations.

DOD officials believe that our proposal to have a DOD-level task force follow up on implementation is not appropriate. They agreed that followup is necessary but that it should be at the JLC level because the thrust to apply MIL-STD-1567 would come from JLC.

We have recognized current DOD efforts in chapter 3 of this report. References to the Navy's early, strong negative attitudes have been deleted because the Navy now accepts MIL-STD and plans limited implementation. Our recommendation for a DOD-level task force followup has been changed to require JLC followup in accordance with DOD suggestions.



RESEARCH AND  
ENGINEERING

## THE UNDER SECRETARY OF DEFENSE

WASHINGTON, D.C. 20301

28 APR 1980

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

Dear Mr. Stolarow:

This is in reply to your letter to the Secretary of Defense regarding your draft report dated March 6, 1980, on "Military Standard on Work Measurement --A Way to Control Costs and Increase Productivity" (GAO Code 950460) (OSD Case #5397).

We concur with the general content and thrust of the draft report. However, significant recent actions have been taken toward achieving the objectives of the report which are not reflected in the present draft. These actions were discussed with Messrs. J. A. Rinko and R. Shafer of your office at a meeting on 21 March 1980, and are summarized in the enclosure. It is recommended that the report reflect the progress represented by these actions.

I consider it unnecessary to establish a DoD-level task group to follow-up on implementation effort as recommended on page 40 of the draft report in view of the progress already achieved. We will assure that the military standard on work measurement is implemented in appropriate acquisition programs through normal staff channels.

Enclosure  
a/s

A handwritten signature in cursive script, appearing to read "Walter B. LaSerge".

Walter B. LaSerge  
Principal Deputy



RECENT DOD ACTIONS TOWARD ACHIEVING OBJECTIVES OF  
GAO DRAFT REPORT, DATED MARCH 6, 1980,  
"MILITARY STANDARD ON WORK MEASUREMENT - A WAY  
TO CONTROL COSTS AND INCREASE PRODUCTIVITY"  
(GAO CODE 950460) (OSD CASE 5397)

-- Coordination of MIL-STD-1567 by the Joint Logistics Commanders (JLC) Work Measurement sub-panel is essentially complete. It is expected that the draft, indicating Tri-Service approval, will be submitted to the JLC through the Joint Service Panel on Manufacturing/Production Management before the end of April 1980, and that it will subsequently be issued as a fully coordinated military standard.

-- The specific modifications to appropriate Defense Acquisition Regulation (DAR) clauses which provide for application of work measurement requirements in applicable contracts, have been completed. These clauses will be submitted to the DAR Council for action.

-- Implementation of work measurement requirements has been initiated on a limited basis by the Army and Navy.



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