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A SYSTEMS APPROACH TO INTEGRATING FUTURE
MANUFACTURING TECHNOLOGY WITH THE MUNITIONS
PRODUCTION BASE MODERNIZATION PLANNING

DEFENSE SYSTEMS MANAGEMENT SCHOOL
FORT BELVOIR, VIRGINIA

12 MAY 1976

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DEFENSE SYSTEMS MANAGEMENT SCHOOL



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PROGRAM MANAGEMENT COURSE INDIVIDUAL STUDY PROGRAM

A SYSTEMS APPROACH TO INTEGRATING
FUTURE MANUFACTURING TECHNOLOGY
WITH THE MUNITIONS PRODUCTION
BASE MODERNIZATION PLANNING

STUDY PROJECT REPORT
PMC 76-1

Douglas T. Mears
MAJ USA

FORT BELVOIR, VIRGINIA 22060

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DEFENSE SYSTEMS MANAGEMENT SCHOOL

STUDY TITLE:

A Systems Approach To Integrating Future Manufacturing Technology With The Munitions Production Base Modernization Planning

STUDY PROJECT GOALS:

An attempt to devise a management information system that will provide the planners of projected U.S. Army manufacturing facilities with future manufacturing technology. The system was devised to provide maximum interface between technology advancements and the construction of projected U.S. Army munitions facilities as well as future manufacturing technology project in other commodity areas.

STUDY REPORT ABSTRACT:

The report is the result of interviews with key U.S. Army agencies involved in manufacturing methods technology planning and forecasting. The result was an interactive on-line computer system that integrates a projected U.S. Army Development and Readiness Command Manufacturing Technology Plan with the existing U.S. Army Project Manager for Munitions Production Base Modernization and Expansion Integrated Engineering Plan. The system would provide the latest as well as known and projected Manufacturing Methods and Technology projects categorized by technology areas.

KEY WORDS: MANUFACTURING METHODS AND TECHNOLOGY

MANUFACTURING TECHNOLOGY FORECASTS

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AMMUNITION PLANTS
AMMUNITION
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MODERNIZATION PROGRAMS
PRODUCTION BASE
SYSTEMS ENGINEERING

TECHNOLOGICAL FORECASTS
INFORMATION SYSTEMS

NAME, RANK, SERVICE

Douglas T. Mears, MAJ, USA

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A SYSTEMS APPROACH TO INTEGRATING
FUTURE MANUFACTURING TECHNOLOGY
WITH THE MUNITIONS PRODUCTION
BASE MODERNIZATION PLANNING

Study Project Report
Individual Study Program

Defense Systems Management School
Program Management Course

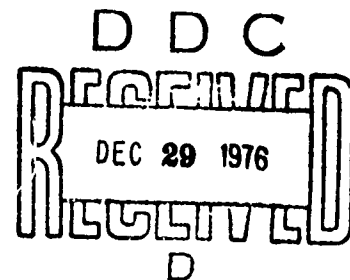
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by
Douglas T. Mears
MAJ USA

May 1976

Study Project Advisor
LCDR Susan F. Anderson, USN



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EXECUTIVE SUMMARY

The purpose of this study is an attempt to devise a management information system that will provide the planners of projected U.S. Army manufacturing facilities with future manufacturing technology. The result was an interactive on-line computer system that integrates a projected U.S. Army Development and Readiness Command Manufacturing Technology Plan with the existing U.S. Army Project Manager for Munitions Production Base Modernization and Expansion Integrated Engineering Plans. The system would provide the latest government and industry technological forecasts as well as known and projected Manufacturing Methods and Technology projects categorized by technology areas.

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I INTRODUCTION

During the next fifteen years the Army is faced with the problem of incorporating the latest manufacturing methods and technology to the manufacturing of ammunition. Maintaining a viable ammunition production base is of prime importance to the defense of this country. To establish a credible deterrent it is essential that our production base must be in the highest state of readiness possible. To obtain this posture there must be a continued modernization program that is based upon not only the present state of the art but also information about future technology. It is the purpose of this study to examine the present management information system in light of integrating timely and appropriate manufacturing technology and forecasts from outside the munitions field.

II BACKGROUND

Lessons learned during the Korean and Vietnam encounters have proven that the staggering requirements for ammunition cannot be supported by the few government arsenals and limited industrial facilities in this field. Further, there are ammunition items which industry is not set up to manufacture, since the military is the only customer and requirements fluctuate so widely that no private industrial firm could afford to gear up for such a varying workload. The government normally procures all ammunition items that the industrial sector can produce. However during periods of mobilization, it has been necessary to produce the preponderance of ammunition in government-financed facilities.

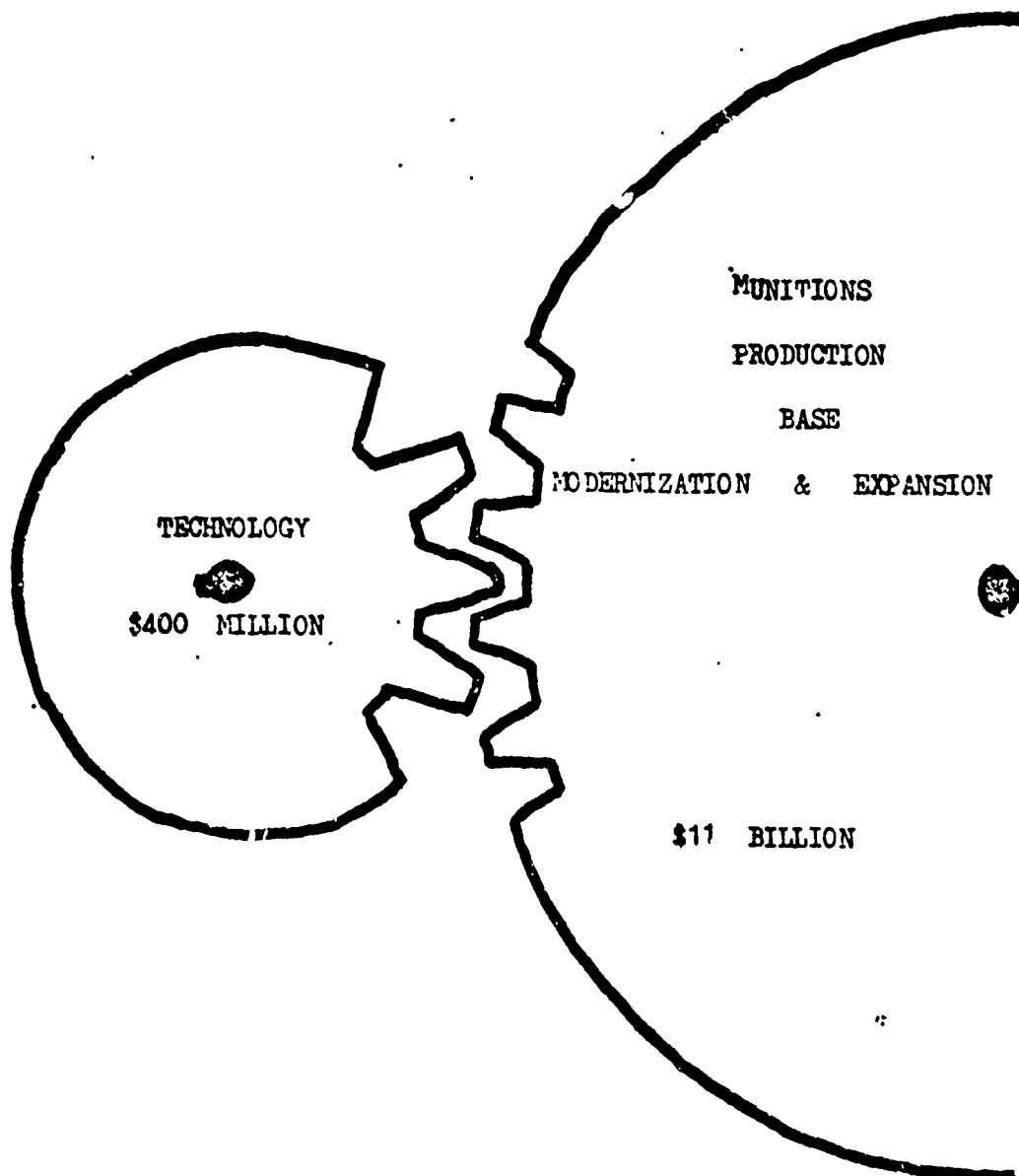
Recently DOD directed that the Army would be the Single Service Manager for the manufacturing and acquisition of ammunition for all services. In recognition of the criticality of the efforts to modernize the production base the Secretary of the Army established a Project Manager (PM) for the management of the Munitions Production Base Modernization and Expansion program. The Program Manager exercises centralized management authority over the planning, direction, control and execution of the production base modernization and expansion program at all U.S. ammunition plants and arsenals and for the government equipment located at contractor-owned and operated facilities included in the program.

Most of the facilities comprising the base were acquired or constructed during World War II mobilization. These obsolete and in some instances deteriorated facilities produced ammunition for the last three wars. At the peak of the Southeast Asian conflict, the high cost of sustaining day-to-day operations at these facilities persuaded concerned DA and DOD officials of the need to completely overhaul and modernize the production base. The program to do this is now in its fifth year and will be completed in the early 1990's at a cost in excess of \$11 Billion (excluding inflationary growth). As currently structured, the program is made up of about 600 individual projects and 400 engineering projects in support thereof.

Along with every other consumer, the Army has been hit hard in the pocketbook by the inflationary economy. The effects of inflation must be counteracted by increased productivity. Historically,

increased productivity has been achieved by installing processes incorporating the latest and best technology. This is the basis for the driving technology associated with this expensive program.

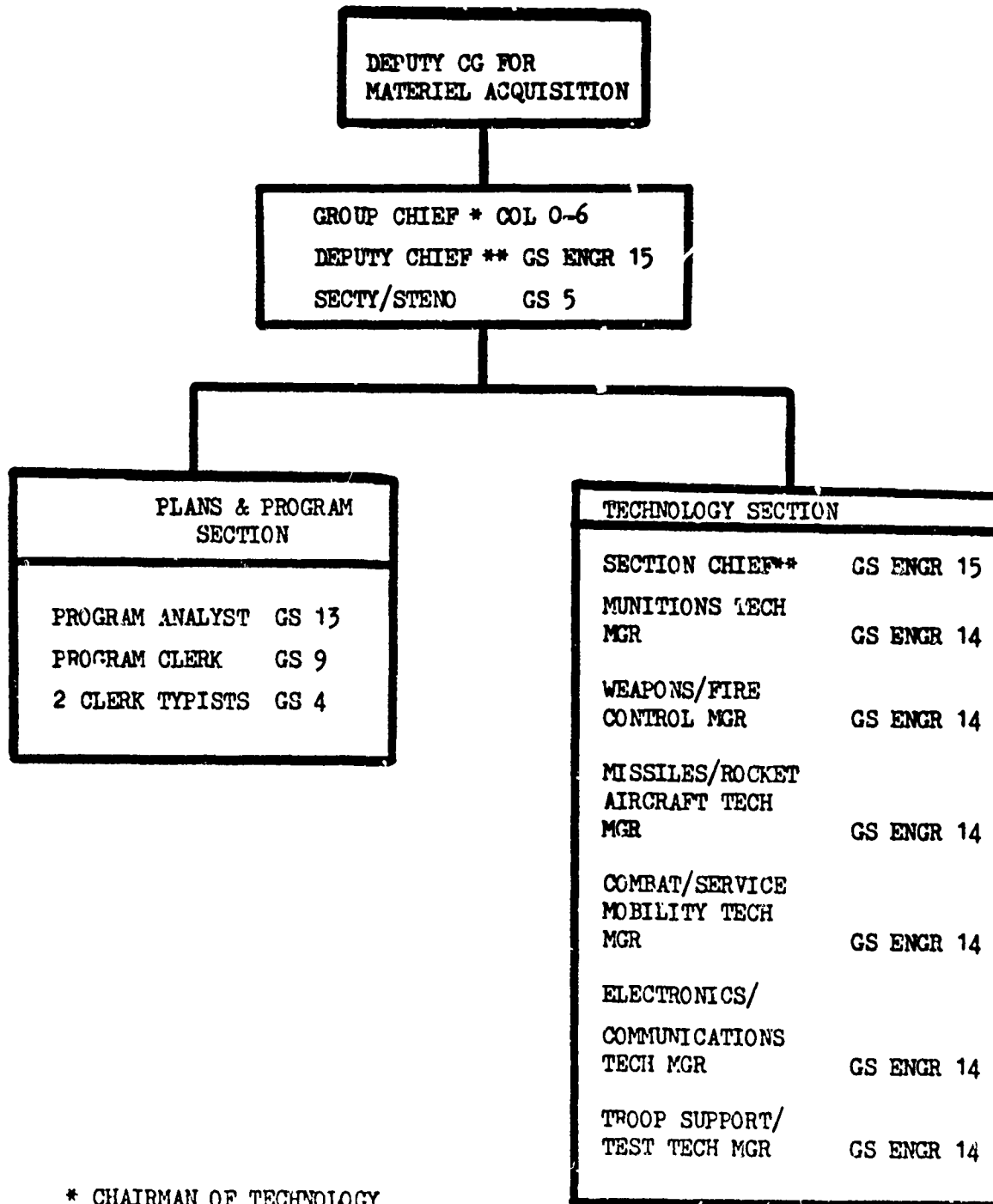
(See Figure 1)



The importance of the Manufacturing Technology Program was recently recognized by the establishment of the Manufacturing Technology Management Group at Development and Readiness Group (DARCOM) HQs. to provide staff supervision over manufacturing technology. Presently this organization has been approved but not fully staffed (Figure 2). This group could play a very key role in integrating manufacturing technology and forecasts to all commodity commands and program managers.

Figure 2

MANUFACTURING TECHNOLOGY MANAGEMENT GROUP



* CHAIRMAN OF TECHNOLOGY
EVALUATION BOARD

** DEPUTY CHIEF ACTING IN A DUAL CAPACITY

Figure 3 depicts the location of the STAFF in the Department of Army Structure. To illustrate the significance of the Munitions Manufacturing Methods and Technology Program, it represented 63% or \$157.8 million of a total Army program of \$251.4 million during the period FY 70-75. It is estimated that an additional \$400 million will be spent on Munitions Manufacturing Methods and Technology (MM&TE) projects during the next fifteen years. This is another reason why it is imperative that these projects are in tune with the latest manufacturing technology and forecasts being made by government and industry. Figure 4.

Figure 3

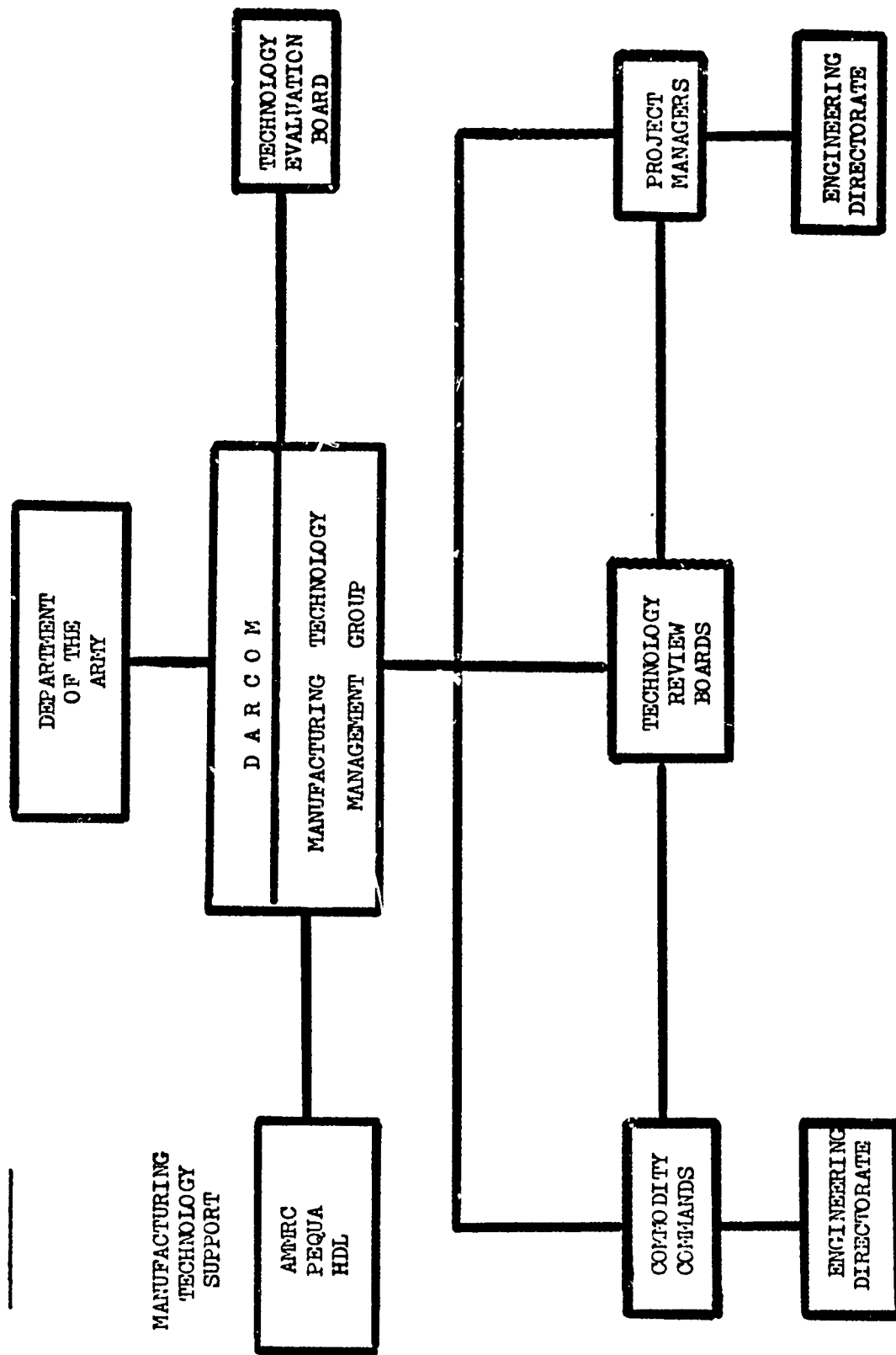


Figure 4

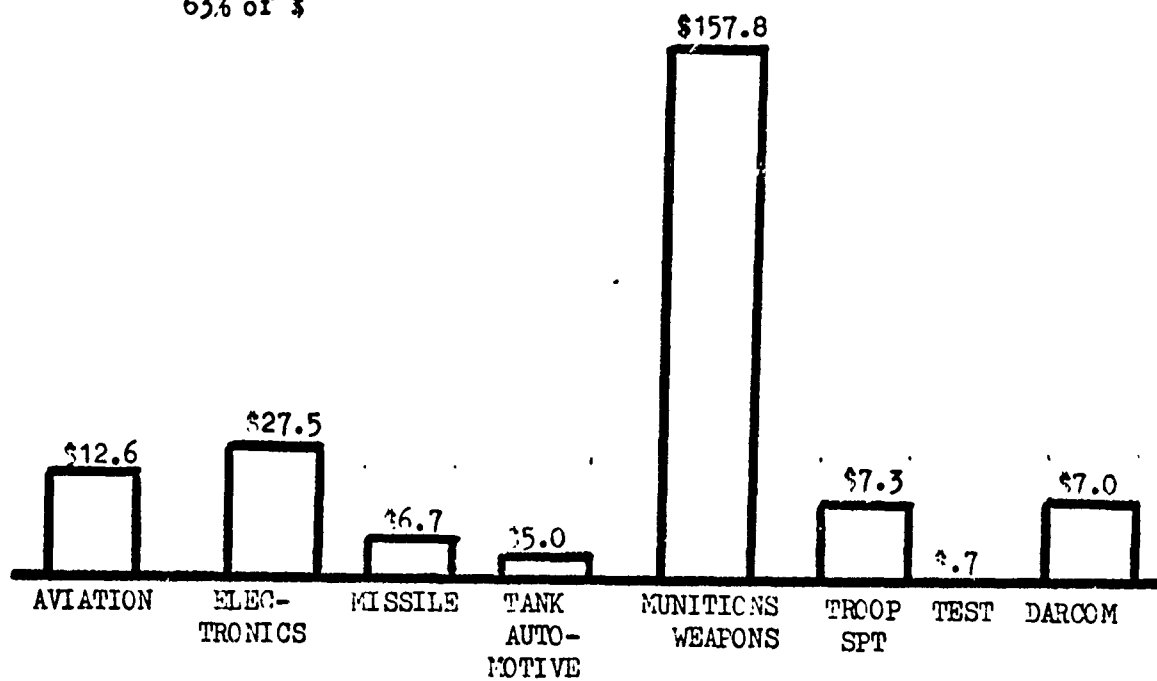
ARMY MM&T FUNDING PROFILE

(FY 70 - 75)

\$ MILLIONS

TOTAL PROGRAM
\$251.4

MUNITIONS
63% of \$



7 (a)

III PRESENT MANAGEMENT INFORMATION SYSTEMS

Presently there are two Interactive Management Information Systems which are being utilized for managing the Munitions Production Base Modernization and Expansion Program. A. The Requirements Analysis for the Modernization and Expansion Plan (RAMEP) is a complicated series of some 30 computer programs, the heart of which are two interactive on-line computer programs. This Management Information System is designed to produce a current updated Modernization and Expansion Plan that, in addition to many other things, will assist in protecting the Project Manager from scheduling a project before the project is technologically available. This system is dedicated to the more than six hundred projects that are scheduled for some twenty Army ammunition plants and many other commercial facilities which are responsible for producing over 400 individual line items. A large driving factor that impacts on the plan is the mobilization levels of ammunition as required by the services over the next fifteen years.

B. The Integrated Engineering Plan is the second interactive Management Information System which is devoted to Manufacturing Methods and Technology (MM&TE) projects related to the manufacturing of ammunition. This system is the key factor in assuming that present and scheduled projects are finished in time to be incorporated into the facility projects being tracked by RAMEP. It is the author's intention to define this system and show how MM&TE information and technology forecasts might be incorporated to allow for timely program decisions that could possibly preclude large expenditures that

could result in new obsolescent facilities.

IV INTEGRATED ENGINEERING PLAN

As mentioned above the Integrated Engineering Plan is devoted to Manufacturing Methods and Technology (MM&TE) Projects in support of the Munitions Modernization and Expansion Program. AR 700-90, dated 4 August 1975, states: "Manufacturing Technology refers to any action undertaken which has as its objectives --

- (1.) The timely establishment or improvement of the manufacturing processes, techniques, or equipment required to support current and projected programs.
- (2.) The assurance of the ability to produce, reduce leadtimes, insure economic availability of end items, reduce costs, increase efficiency, improve reliability and or to enhance safety and antipollution.

In light of this definition the Integrated Engineering Plan is a Management Information System which is presently being used by the Army to assist in managing two hundred and fifty five (255) such technology projects. Figure 5 depicts what type of data is being maintained on each project. It should be noted that a sort can be performed as to any item below the project number i.e. all projects in a given year, specific work site Functional Subdivision, technology category etc.

With regards to technology and facilities there are four areas in the system that are key to this proposal. These items are: Technology categories, related facility projects, facility relationship and facility project critical date. The following is a breakout of each of these areas:

A. Technology categories - These are categories of technology

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INTEGRATED ENGINEERING PLAN BY PROJECT

MM+TE PROJECT TITLE
REMARKS

02 PROTO EQUIP CONT AUTO PRDD SOLV
MULTI BASE CANNON PROP

RESPONSIBLE INSTALLATION
ICATINNY ARSENAL
WORK SITE
RADFORD AAP
FUNCTIONAL CATEGORY
PROPELLANTS MULTI-BASE
FUNCTIONAL SUBDIVISION
TECHNOLOGY CATEGORIES
CONTINUOUS PROCESS
AUTOMATED MANUFACTURE
CHEMICAL MFG/PROCESSING
PROCESS CONTROL
MATERIAL HANDLING
SAFETY

(IN M I L L I O N S)											
FY	FY	FY	FY	FY	FY	FY	FY	FY	FY	FY	FY
69	70	71	72	73	74	75	76	77	78	79	80

.600 2.520 1.005 .342 PROJECT TOTAL 4.467

RELATED FACILITY PROJECTS)
YEAR PROJECT SUFFIX
KEY ITEM C KEY ITEM C KEY ITEM C

MM+TE COMPLETION DATE
FACILITY PROJECT CRITICAL DATE
FACILITY PBM ENGINEER
RADFORD AAP LAIBSON
OCT
JUN 76

MM+TE RELATED DIRECTLY TO A SPECIFIC FACILITY
PROJECT(S). DESIGN CRITERIA COMPLETION OR INITIATION
OF PROJECT DEPENDENT UPON MM+TE COMPLETION. FACILITY
PROJECT CANNOT PROCEED WITHOUT THIS MM+TE AND SLIPPAGE
OF MM+TE WILL CAUSE DIRECT SLIPPAGE IN FACILITY PROJEC

FIGURE 5

that are being used to categorize various MM&TE projects to establish applicability to various facility projects and to track the dollars being spent in these particular technology categories. Presently included in these categories are:

1. Process control
2. Inspection
3. Quality assurance
4. Test
5. Continuous process
6. Automated manufacture
7. Computer aided design
8. Computer aided manufacture
9. Materiel Handling
10. Packaging
11. Propellant Extrusion
12. Propellant Bending and Coating
13. Filtration
14. Nitrolysis
15. Recrystallization
16. Chemical Purification
17. Chemical Filling
18. Chemical MFG/Processing
19. Casting
20. Forging
21. Machining
22. Drawing
23. Heat Treating
24. Finishing
25. General Metal Forming
26. Safety
27. Explosive Protection Containment
28. Health
29. Pollution Abatement
30. Energy
31. Miscellaneous
32. Industrial Readiness Optimization
33. Modeling and Simulation
34. Filling
35. Demilitarization
36. Press Loading
37. Mixing

In many cases a particular MM&TE project may come under more than one

category i.e. : Chemical filling, Safety and Pollution Abatement. It is key to note that most of these technology categories can be applied to just about any commodity other than ammunition and therefore this system should be easily integrated into a centrally controlled broader management information system.

B. Related Facility Projects - This is a listing of any known facility (Plant) project that might utilize the technology that may be the product of the particular MM&TE project. These Projects are listed by the RAMEP codes which provide the interface between the two Management Information Systems and provides the tie in of the key line items supported as well as the name of the particular facilities (Plants) that are impacted on by the particular MM&TE project.

C. Facility Relationship - This describes the relationship between the MM&TE project and the facility projects listed above. There are four relationships that are categorized as follows:

1. Direct Relationship - This means that the MM&TE is a driving factor on the new or modernized facility project. That is the design criteria completion or initiation of the facility project is completely dependent upon the MM&TE completion date and success. The facility project cannot proceed without MM&TE and slippage of MM&TE will cause direct slippage in facility project.
2. Indirect(One) - In this case there are identified facility projects which will use the particular MM&TE technology. However the facility project can proceed without the technology even though it may be highly beneficial.
3. Indirect (Two) - In this case there is identified projects which will use the particular MM&TE technology but the facility projects can proceed without slippage. If the technology is incorporated it will be done on a retrofit basis.

4. Technology - This means that there is no identified facility project which will use the technology of this MM&T at the present time. The technology may be too advanced or the results are too far down the road to relate it to a known facility project.

D. Facility Project Critical Date - This is the date that the technology must be available for incorporating it into the design of the earliest planned and identified facility project.

The Integrated Engineering Plan is updated on a monthly basis by project engineers in the program office and the interactive process with RAMEP updates.

To summarize the present Integrated Engineering Plan is a Management Information System that relates known vs. Army Sponsored Ammunition Manufacturing Technology Projects to proposed new and modernized ammunition production facilities. These facilities will provide the production base essential to fulfill Air Force, Navy, Army and Marine Corps munitions requirements. Produced at these facilities will be nearly all the explosives, propellants, small caliber ammunition for DOD; load, assemble and pack most of its ammunition; and supply a major portion of heavy forgings for shells. End items include a wide array of sizes and shapes ranging from a tiny 5.56 mm cartridge to massive 8-inch shells.

As previously noted, the munition production base prior to 1970 incorporated 1940 and earlier technologies. Key aspects of the Modernization and Expansion Program are to insure the provision of an improved manufacturing technology to eliminate or minimize crunch points - operations which are labor-intensive or unsafe, processes

which pollute or use critically-short materials or excessive energy, or types of energy for which an adequate supply cannot be assured - and to phase this improved technology into modernization and expansion efforts in a systematic fashion.

The Integrated Engineering Plan is reviewed by a Technology Review Board which meets as a minimum on a Quarterly Basis. The membership and purpose of the board are listed in Figure 6. It is this board that provides the formal interface to the Integrated Engineering Plan for new technology developments that are known to the members through present or proposed Manufacturing Methods and Technology Projects.

Figure 6

TECHNOLOGY REVIEW BOARD

MEMBERSHIP

PBM - DEPUTY PM (CHAIRMAN)
ARMCOM - CHIEF SCIENTIST
ARSENALS - TECHNICAL DIRECTORS
HDL - TECHNICAL DIRECTOR
PEQUA - DIRECTOR
SPECIALIZED CONSULTANTS

PURPOSE

PROVIDE GUIDANCE TO MUNITIONS MM&T PROGRAM
ASSIST IN MAJOR TECHNOLOGY DECISION MAKING
PROVIDE COORDINATED MM&TE EFFORT

V Expansion Of The Management Information System

Under the present system it is not intended to discount the additional management tools which are being used in the Program which augment the Integrated Engineering Plan. These include:

- A. Matrix Analysis Charts
- B. Value Engineering and Cost Reduction
- C. Quarterly project status reports
- D. Monthly milestone and financial reports
- E. Reviews with the commanders
- F. On site visits
- G. Organized Communications
- H. Review of all MM&TE Proposals from the Arsenal and laboratories pertaining to munitions.

Within the Program there is a viable effort utilizing the resources available to keep abreast of present and proposed Munitions Manufacturing Methods and Technology. This is an enormous task which in itself consumes the total resources available for gathering appropriate information. Any information about advancements on other government or industrial areas outside the munitions field must come on a hit or miss basis from within the Army's Armament Command Arsenal, ammunition plants and supporting laboratories. It is not to say that this type of grass roots, bottoms up approach has not provided some effective interface with technology outside the munitions field in the past, but because of the present intensified program to modernize the

production base which has been allowed to deteriorate for the past 30 years there is a need for formal technological interface with all new major developments; real and forecasted in all commodity areas.

In as much as DARCOM has established the new Manufacturing Technology Management Group it is logical that the collection of this information should be gathered and made available to the established Commodity Commands and Program Managers by a similar Management Information System as the Integrated Engineering Plan. The various functional areas, systems and products supported by DARCOM certainly have in common many technological advancements represented in the varied commodity manufacturing methods and technology. This relationship is depicted in Figure 7.

SCOPE (ARMY)

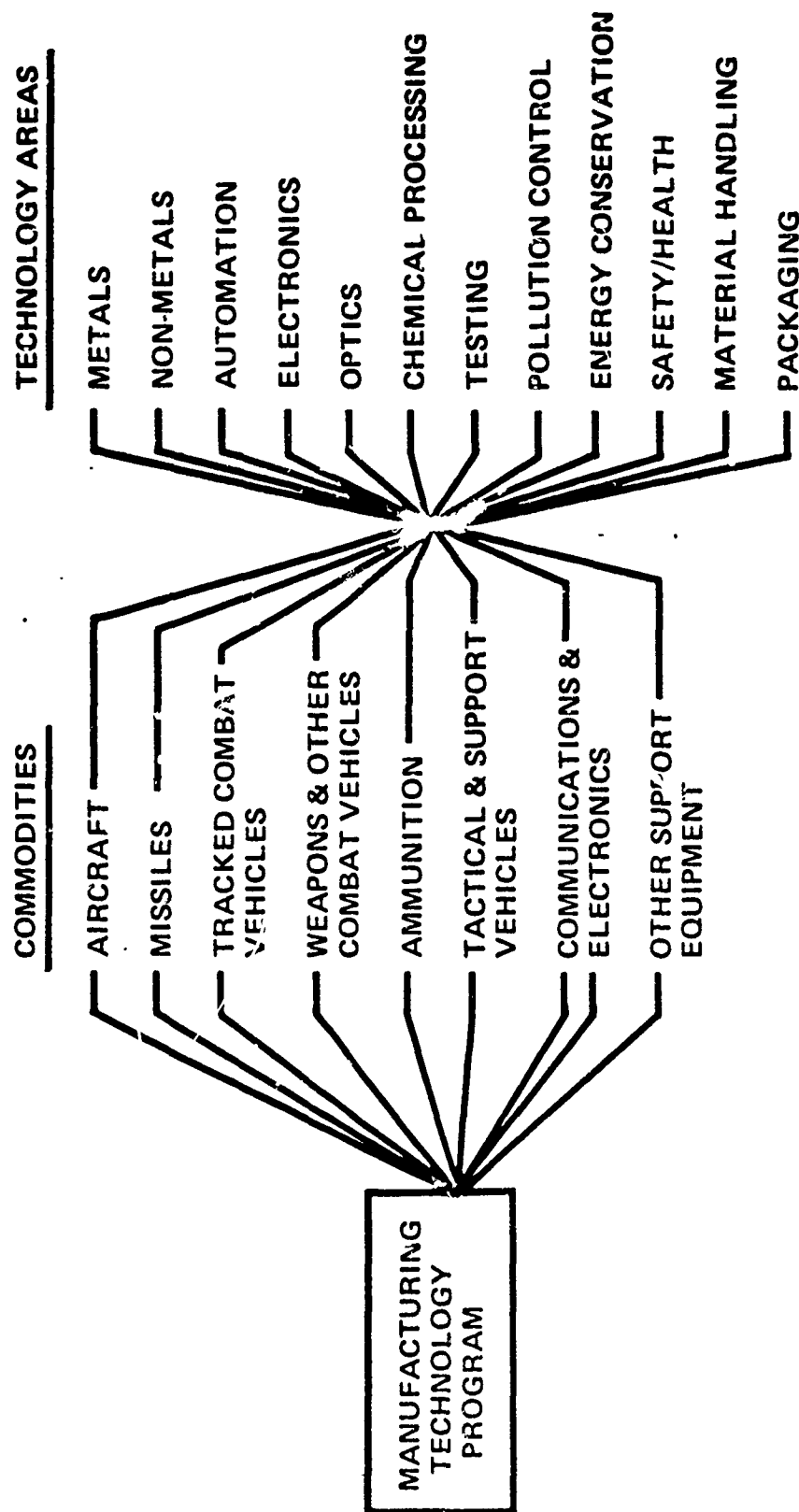


Figure 7

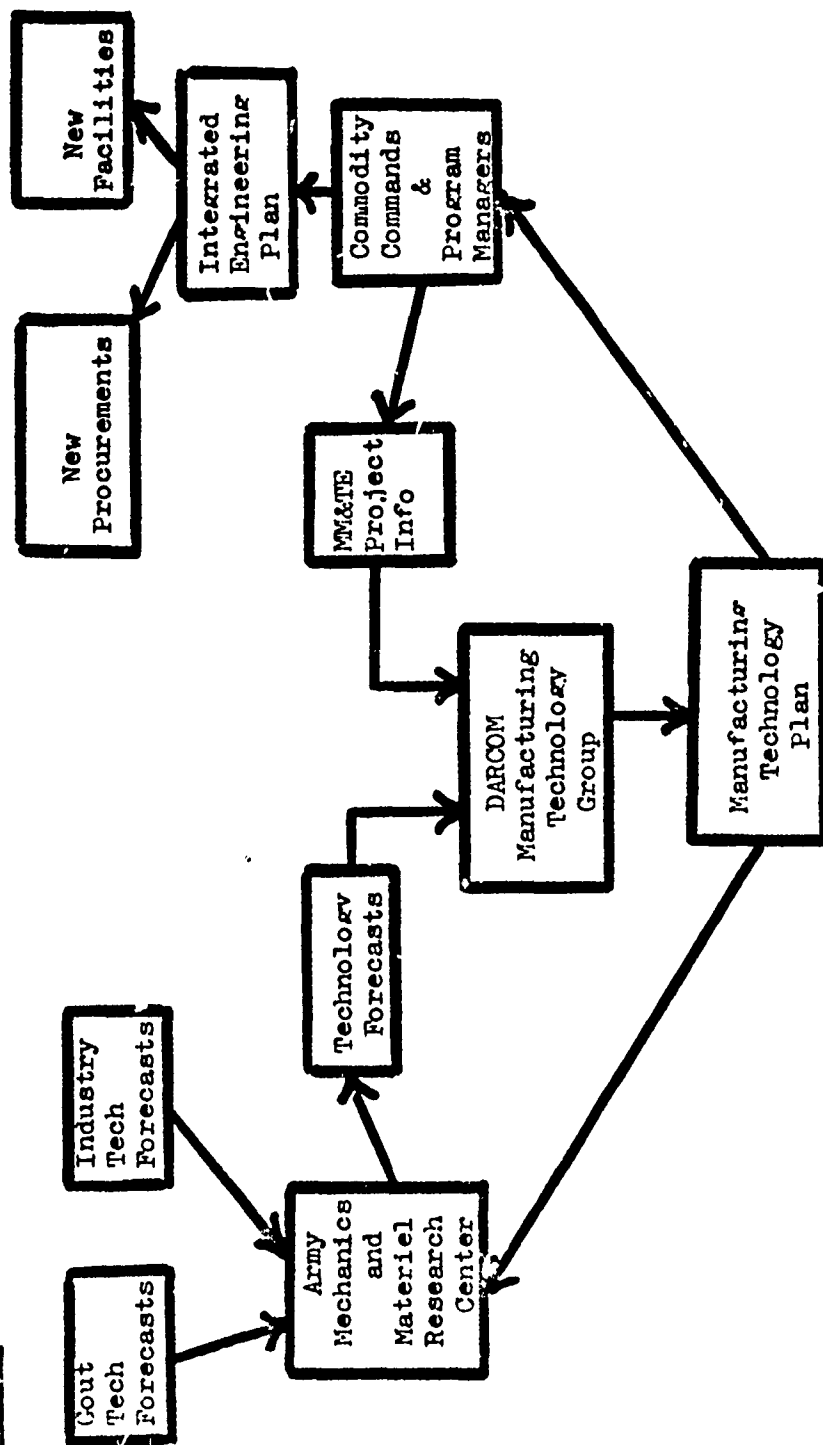
The new Manufacturing Technology Group at DARCOM Headquarters originally planned on establishing a Manufacturing Technology Plan which would show a current and five year projection of all Army MM&TE efforts. By stratifying it by commodities, functional and technological categories the system would interface with the Integrated Engineering Plan allowing access and timely updates concerning those technological advancements that may impact on Munitions. This may seem like putting the horse before the cart, but the Integrated Engineering Plan is a system that is presently established and as mentioned before (Figure 6) the munitions projects have represented 63% of the Army's dollar expenditure for MM&TE projects during the past six fiscal years.

The demanding job will not be for DARCOM to categorize the existing and planned MM&TE projects but to integrate into the system a five year and ten year technological forecast by technology categories that could be used by the commodity commands and the program managers. Presently there are many technology forecasts that are being done for many agencies throughout the government and in industry that are not incorporated into a management information system such as the Defense RDT&E on-line system of the Defense Documentation Center. The Director of Army's Mechanic and Materiel Research Center (AMMRC) an agency of DARCOM has been tasked to monitor technology as it applies to DARCOM and therefore should be the focal point for gathering the technology forecasts and assuring they are timely and updated and that a short summary be put into Manufacturing Technology

Plan. A valuable source also is the Technology Assessments Office of the Defense Advanced Research Projects Agency.

The system would be an on-line interactive program that would tie together facility project or procurement relationship and schedule to the latest manufacturing methods and technology. The information flow is depicted in Figure 8.

Figure 6



On a monthly basis AMMRC would obtain recent technology forecasts from government and industry and categorize them using the technology codes of the Integrated Engineering Plan. The names, dates and source of the forecasts along with the codes would be given to DARCOM to be included in the Manufacturing Technology Plan. This update would then attach each forecast title and date to the manufacturing and technology projects in the Manufacturing Technology Plan that carried the category of technology involved. Each individual project page would include the name, date and source of the most recent technology forecasts involved with the related technology that has impact on that manufacturing technology project. This would allow the planners as well as the users to have a quick reference to the latest forecasts. In as much as technology forecasts are solely for planning, it is essential that this interface occur. As an example, if there is an expansive facility being planned for FY 79 for a foreign facility and current forecasts indicate a new breakthrough in metal processing this should be considered by the planners.

The Manufacturing Technology Plan should also include all commodity manufacturing methods and technology projects in existence and proposed. The Program Managers and Commodity Commanders would provide a monthly update with a project page for each project.

By sorting the projects by technological category all projects could be reviewed for duplication of effort and exchange of information. For example there are many projects throughout the Army that involve pollution abatement studies and energy conservation. The planners

and users of the Manufacturing Technology Plan would have access to this information for management purposes.

As in the Integrated Engineering Plan, the Manufacturing Technology Plan would relate the MM&TE's to manufacturing facility projects through the use for the four relationships mentioned earlier. This would allow DARCOM to manage and track those MM&TE projects that are critical to the facility projects.

Presently the Integrated Engineering Plan is a COBOL program with data being stored in a CDC 6600 at Picatinny Arsenal. DARCOM presently has an interactive terminal that can access Picatinny. There should be little problem in programming the Manufacturing Technology Plan to interface with the Integrated Engineering Plan.

VI SUMMARY

In summary there is a definite need to establish an expanded Management Information System which will provide data on manufacturing methods and technology projects and current technology forecasts within DARCOM. By tailoring the proposed Manufacturing Technology Plan after the present Program Manager for Munition Production Base Modernization and Expansion Integrated Engineering Plan the system would maximize the use of existing data and provide management with an effective tool for planning. With the establishment of the new Manufacturing Technology Group at DARCOM Headquarters and the formulation of a Manufacturing Technology Plan it is an opportune time to establish this coordinated management information system.

APPENDIX

PERSONAL CONTACTS

Personal contacts, in the form of both in-person interviews and telephone conversations, were made with the following government organizations to obtain information and data for this study.

U.S. ARMY DEVELOPMENT & READINESS COMMAND HEADQUARTERS
ALEXANDRIA, VA.
David Weller
COL Vinson
Chief DRCMT.

U.S. ARMY MATERIALS AND MECHANICS RESEARCH CENTER
WATERTOWN, MASSACHUSETTS
Ray Farrow
Chief, Technology Directorate

U.S. ARMY, PICATINNY ARSENAL
DOVER, NEW JERSEY
Bernard Cholendorf
Management Information Systems Division

U.S. ARMY PRODUCTION EQUIPMENT AGENCY
ROCK ISLAND, ILLINOIS
James Gallagher
Director

U.S. ARMY PROJECT MANAGER FOR MUNITIONS PRODUCTION BASE MODERNIZATION
AND EXPANSION
DOVER, NEW JERSEY
James Fritchard
Chief, Plans and Analysis Branch
George DeVoe
Operations Research Analyst

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