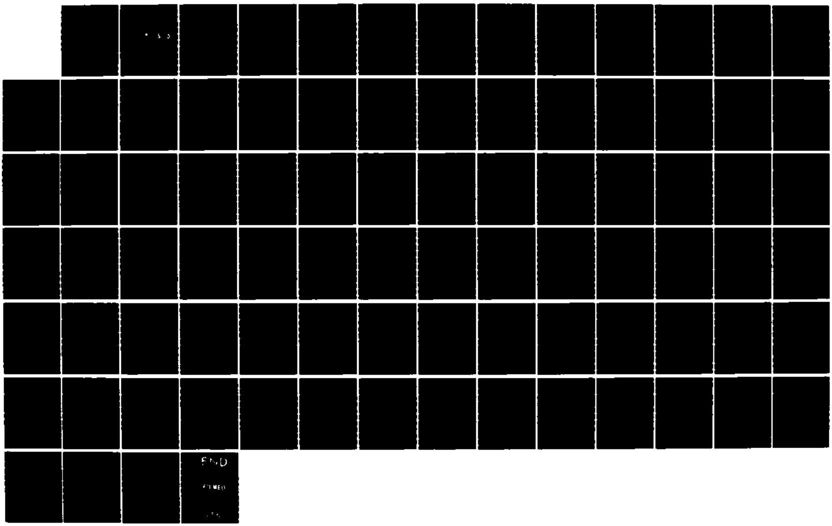
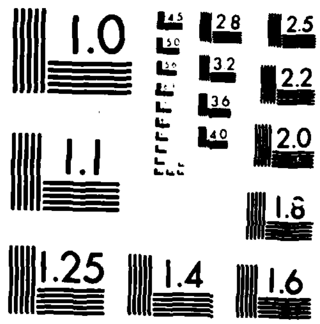
AD-A165 587 RAPID ACQUISITION OF MANUFACTURED PARTS: METHODS OF CONTRACTING AND INCENTIVES FOR INDUSTRY(U) NAVAL POSTGRADUATE SCHOOL MONTEREY CA M M DARBY DEC 85 1/1

UNCLASSIFIED F/G 15/5 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

RAPID ACQUISITION OF MANUFACTURED PARTS:
METHODS OF CONTRACTING AND
INCENTIVES FOR INDUSTRY

by

Michael M. Darby

December 1985

Thesis Advisor: R. W. Smith

Approved for public release; distribution unlimited

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release, distribution unlimited
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION Naval Postgraduate School 6b. OFFICE SYMBOL (If applicable) Code 54	7a. NAME OF MONITORING ORGANIZATION Naval Postgraduate School
6c. ADDRESS (City, State, and ZIP Code) Monterey, California 93943-5004	7b. ADDRESS (City, State, and ZIP Code) Monterey, California 93943-5004
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO / PROJECT NO / TASK NO / WORK UNIT ACCESSION NO

11. TITLE (Include Security Classification)
RAPID ACQUISITION OF MANUFACTURED PARTS: METHODS OF CONTRACTING AND INCENTIVES FOR INDUSTRY

12. PERSONAL AUTHOR(S)
Darby, Michael M.

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Master's thesis	FROM ______ TO ______	1985 December	85

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Contracting; advance manufacturing technology

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This thesis discusses the Navy's Rapid Acquisition of Manufactured Parts (RAMP) program and several procurement related issues. The objectives of RAMP is to reduce the Navy's spare parts supply, stocking, and procurement problems by fabricating spare parts on demand, in small quantities, and at a reasonable cost. RAMP embodies such new technologies as computer-aided design and manufacturing and flexible manufacturing systems. This study examines RAMP's technology transfer process, incentives available to induce industry investment in RAMP technology, implications of RAMP on competitive procurement, and methodologies to be utilized in making RAMP procurements.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL R. W. Smith	22b. TELEPHONE (Include Area Code) (408) 646-2052 22c. OFFICE SYMBOL Code 54Sx

DD FORM 1473, 84 MAR — 83 APR edition may be used until exhausted. All other editions are obsolete

SECURITY CLASSIFICATION OF THIS PAGE

Approved for public release, distribution unlimited

Rapid Acquisition of Manufactured Parts: Methods of Contracting and Incentives for Industry

by

Michael M. Darby
Lieutenant Commander, Supply Corps, United States Navy
B.A., University of South Florida, 1976

Submitted in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
December 1985

Author: ______________________
Michael M. Darby

Approved by: ______________________
R. W. Smith, Thesis Advisor

____
J. W. Creighton, Second Reader

____
Willis R. Greer, Jr., Chairman,
Department of Administrative Sciences

____
Kneale T. Marshall,
Dean of Information and Policy Sciences

ABSTRACT

This thesis discusses the Navy's Rapid Acquisition of Manufactured Parts (RAMP) program and several procurement related issues. The objectives of RAMP is to reduce the Navy's spare parts supply, stocking, and procurement problems by fabricating spare parts on demand, in small quantities, and at a reasonable cost. RAMP embodies such new technologies as computer-aided design and manufacturing and flexible manufacturing systems. This study examines RAMP's technology transfer process, incentives available to induce industry investment in RAMP technology, implications of RAMP on competitive procurement, and methodologies to be utilized in making RAMP procurements.

TABLE OF CONTENTS

I. INTRODUCTION

A. BACKGROUND

This research will examine the US Navy's Rapid Acquisition of Manufactured Parts (RAMP) Program, and several related issues of concern to the Navy contracting community. The objective of RAMP is to reduce the Navy's spare parts supply and procurement problems by fabricating parts in small quantities, on short notice and at a reasonable cost. This new approach is based on technological breakthroughs in computer-aided design (CAD) and computer-aided manufacturing (CAM). These technologies are utilized today in automating both the design and manufacturing of mechanical parts, integrated circuits, and printed wiring assemblies.

RAMP will utilize CAD technology to develop an extensive data base that will contain the digitized design specifications necessary to manufacture spare parts. This data base information will then be utilized by manufacturers with CAM machinery to produce the spare parts.

In order for RAMP to be successful, appropriate contracting mechanisms must be developed which will facilitate the rapid dispersion of information that is inherent in this system. One objective of this research is to develop a contracting methodology to be utilized by RAMP that will allow this rapid transfer of information. Other areas to be addressed by this research include: methods of transferring this new technology to industry, investigation of existing government incentive programs that might encourage capital investment in automated equipment that could be utilized by RAMP, and investigation of RAMP's impact on competitive procurement.

B. RESEARCH OBJECTIVES

The basic research question for this study is, "What contracting methodologies could be utilized for Rapid Acquisition of Manufactured Parts procurements given the current limitations and constraints found within procurement regulations and manufacturing processes?"

The following subsidiary objectives were formulated to further investigate issues surrounding the RAMP program that are of interest to the contracting community.

1. What is the RAMP technology, and how will it reduce the need to hold parts in stock?
2. How will RAMP technology be transferred to private industry?
3. What government incentive programs exist today that could be used to encourage business to invest the capital necessary to become RAMP capable?
4. What are the most promising contracting methods which could be used in contracting for RAMP?
5. What are the constraints and limitations placed on contracting methodologies which would affect RAMP procurement?

C. RESEARCH METHODOLOGY

This research employed a literature search, telephone interviews with government officials and members of industry familiar with RAMP technology, face to face interviews with local industry officials, and participation in a DoD sponsored Research and Development Symposium on the program.

The literature search was used to establish the RAMP technology, the Navy's goals for RAMP and its implementation. Telephone interviews with members of both goverment and industry were conducted to gain further insight into the problems that could be encountered in implementing RAMP and ways in which these problems could be overcome. Face to face interviews with West Coast defense contractors familiar with RAMP or Parts on Demand were also made in order to gain their expert opinion on the subject.

Interviews focused on the following types of questions:

1. How would the RAMP program affect your manufacturing procedures?

2. Do you feel it would be in the best interest of your company to make the capital investment necessary to become RAMP capable?

3. What roadblocks do you foresee that could hinder implementation of RAMP?

4. What contracting methods would you prefer be used when making RAMP buys?

D. SCOPE OF THE THESIS

This study analyzes the contracting methods that could be effectively utilized in procuring spare parts under the RAMP program. It also examines the means of technology transfer, existing government incentive programs that could be implemented to make the program more attractive to industry, and RAMP's effect on competition. The study assumes that all other major program hurdles, such as obtaining data rights and the formation of a suitable database, have been overcome.

E. ORGANIZATION OF THE STUDY

The thesis is organized in a manner that allows the reader to gain a general background into the technologies involved in the RAMP program, incentives that can be used by the government to ensure industry is a participant in the program, RAMP's effect on competition, and lastly, methods that can be utilized in contracting for spare parts produced by RAMP facilities.

Chapter II provides the necessary framework and background to establish a general setting for the remainder of the research. It discusses the technologies involved in the RAMP program, how they are currently being utilized in industry and how it is envisioned that these technologies will be utilized by the Navy. Chapter III discusses how the RAMP technology will be transferred to industry, and incentives that the Navy can utilize to ensure defense contractors and subcontractors become willing RAMP participants. Chapter IV discusses two major issues. First, it investigates the effects of RAMP on the competitive purchasing process. Secondly, it develops a contracting methodology to be employed in the RAMP program, and discusses how this methodology could be effectively incorporated into a competitive environment. Chapter V presents answers to the research questions. The chapter also outlines several additional conclusions and recommendations formulate during the research that were not specifically addressed by the research questions, and suggests areas of study that merit further investigation.

II. WHAT IS RAMP?

A. RAMP OBJECTIVE

The Rapid Acquisition of Manufactured Parts Program (RAMP), is a concept that utilizes advanced computer manufacturing disciplines in order to achieve a reduction in costs and production lead time in the manufacturing of small batches of parts. RAMP is a Naval Supply Systems Command (NAVSUP) sponsored project aimed at achieving the following objectives:

> Establish an inventory manager (ICP) data base and capability to communicate parts requirements and specifications to manufacturing activities using computer data-driven manufacturing technology in order to increase readiness and reduce costs. [Ref. 1:p. 1]

The availability of spare parts for weapons systems has always been a critical element in determining the readiness posture of Naval forces. The long lead times and high costs associated with spare parts procurement has been a critical factor in limiting force readiness. Costs associated with spare parts procurement run annually into the billions of dollars, and lead times can range from 25 to more than 600 days.

B. CURRENT MANUFACTURING TECHNOLOGY

Tailoring current computer manufacturing technology to the Navy's needs should result in lowering the associated procurement and inventory holding costs, and shorten manufacturing lead times. In order to understand how RAMP will achieve these goals, the reader must first understand the manufacturing technologies that surround the RAMP initiatives.

RAMP is a combination of several manufacturing disciplines: Parts on Demand (POD) or Just in Time Production (JIT), Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) and Flexible Manufacturing Systems. This section shall discuss these disciplines, their development history, and their use today in private industry.

1. Parts on Demand

Parts on Demand (POD) is an inventory control method utilized by industry in order to reduce the size of both manufactured and purchased parts inventories. The philosophy behind POD is that idle inventories are wasteful and that they should be reduced to a minimum. This is accomplished by intensively managing the timing of parts movement, both within the factory and when receiving purchased parts, so that they arrive in small lots immediately before consumption.

The leading exponent of POD has been the Toyota Motor Compnay of Japan. The system Toyota designed is a simple manual system for parts order control that does not utilize computers. Toyota has termed the system the "KANBAN System", which is Japanese for "sign post". Many other companies now utilize variations of the KANBAN System, but the basic principles remain the same.

A KANBAN is a small card on which information about a particular part is noted. These cards are used to control the entire manufacturing process. In a system such as this, units needed by the next manufacturing process are "pulled" from the previous process as they are required. This is the signal for the previous process to produce enough units to replace those withdrawn. The KANBAN card becomes the connector that links the different manufacturing processes together.

The Just in Time approach is a pull system as opposed to a push system. [Ref. 2:p. 322] In other words, downstream work centers, or manufacturing facilities, authorize upstream work centers to provide them with parts and materials. A set-up and a production run of a part is initiated only when it is required in the next process. This results in the manufacturing of only those units required, not larger quantities or some other part in order to keep the work center from being idle.

The typical production scheduling system used in the United States is referred to as a push system, which is simply a schedule-based system. [Ref. 2:p. 322] A master production schedule for future requirements is developed. This is then exploded, generating detailed schedules for making or buying component parts. It is a push system because the master schedule "pushes" the release of work orders to work centers and then pushes the components on to the next process. Push systems require demand to be estimated in advanced, and poor estimates can quickly cause inventory to build up.

The ultimate goal of POD is to achieve zero work in process and a lot size equal to one. Thus, POD is designed to reduce the risk of inventory build up and the extremely high costs that are usually associated with carrying inventory.

2. Computer-Aided Design/Computer-Aided Manufacturing

Computers are being used by industry more and more in the design and manufacturing of component parts. The development of the CAD/CAM technology was first undertaken in the United States and has found some of its greatest proponents in defense related industries. CAD/CAM is essentially two distinct disciplines that were logically combined as technology advanced. The two areas were developed separately, but today have become associated with each other.

a. Computer-Aided Design (CAD)

CAD is essentially designing, drafting and analyzing with computer graphics displayed on a screen. Any task that a draftsman would normally perform can be dome mathematically within the computer system. CAD speeds up the laborious drafting process and enables designers to analyze the resulting product on a computer screeen. The technology also allows a designer to test the design, subjecting it to possible temperature variations, mechanical stresses, and other unusual conditions to which the product might be subjected.

One of the earliest attempts to develop a CAD technology was the result of a joint effort by General Motors Corporation and the International Business Machine Corporation.

These two companies set out to develop a system that they envisioned as a sophisticated drafting tool.

The original GM/IBM system worked as follows. The designer used a keyboard to specify numerical information about the part under design and then used a light stylus to draw directly on the screen of a computer terminal in order to enter geometric data into the computer. Although the use of the stylus would result in only a rough sketch of the part, the computer was programmed to interpret the sketch and transfer the design into a precise engineering drawing.

Once engineering drawings were entered and stored in the computer, a drawing could be recalled at any time it was required. The designer could add and delete features at will, and the computer automatically updated the design. This enabled the designers to recall a design and use it as a starting point in designing a similar component. New design parameters such as weight limitations, stress factors, and changes in size and shape were entered, and the CAD system designed the new part.

Current technology is now developed well enough to allow a designer to draw a rough design on the computer screen with his light stylus, and have it instantly recalled when he needs it later. It is capable of straightening lines, smoothing curved sufaces and reproducing the improved sketch. Boeing's SYNTHA VISION CAD System is capable of generating a three dimensional model of a part in design, and display it on a computer screen with the realism of a photograph. "The Part can be sliced through at any point, from any angle, rotated in space, exploded, and used to create lined or shaded drawings." [Ref. 2:p. 90] Since the system creates a solid representation of the model, it can be used to calculate the components weight and other properties.

It has been shown that through the application of computer-aided design, production in the drafting room can be improved by a factor of three or more. [Ref. 3:p. 121] By utilizing CAD, General Motors has reduced the time it requires to redesign an automobile model from 24 to 14 months. Another firm utilizing CAD was able to reduce the time necessary to design custom valves from six months to one.

b. Computer-Aided Manufacturing

The other half of CAD/CAM is the application of computer-aided technology to the manufacturing process. CAM covers a wide spectrum of machine systems, numerically controlled machines, robots, automated batch manufacturing systems, and flexible manufacturing systems.

CAM was a natural extension of the computer-aided design process.

> The information specifying the geometry of a part is also needed to determine how a cutting machine, such as a lathe, must be operated to shape the part. Traditionally, the machinist set up his machine accoridng to drawings supplied by the designer; when numerically controlled machine tools were introduced, the programmer, who prepared the sequence of instructions still obtained geometric information from drawings. Designers and programmers soon recognized, however, that the programmer would get the part geometry directly from the data base after it was entered into a

> computer by the designer, and engineering drawings could be eliminated. Indeed, in many circumstances, the programming of machine tool operations is so routine that little human intervention is necessary once the part geometry is known. [Ref. 3:p. 117]

It was this need for similar information in designing a part and in programming a machine tool to make it that led to the fusion of CAD and CAM technology.

One of the greatest savings realized by firms utilizing CAD has been found during the final assembly of parts. The better design effort and higher quality of components makes assembly faster and easier. McDonnell Douglas used to design and bend tubing for F-15 fighters by hand. Out of the number of tubes required in the assembly of an F-15, often as many as 100 tubes per aircraft did not fit properly. McDonnell Douglas reduced the number of poorly fitting tubes per aircraft to four with the introduction of computer-aided designed and manufactured tubing.

(1) Numerically Controlled (N/C) Machines

> The term numerically controlled comes from the fact that a machine's instruction program is based on mathematical relationships which tell the machine how far to advance its tools, how many cuts to take, to what depth and the like. [Ref. 4:p. 440]

N/C metal cutting machinery is becoming commonplace in today's factories and job shops. The machines are well-suited for complicated component manufacturing that will be made in small to medium sized lots.

The N/C machine obtains its command by means of instructions on floppy discs, paper tape, mag tape, etc.

The instructions enable the machine to carry out the following instructions:

- Select cutting tools and insert them into the machine.
- Determine and set machine's operating speed.
- Control machine reaction and cutting path of tools.
- Sequencing of commands, changes tools and machine motions until all operations have been carried out.

N/C machines do require manual labor for moving the component being manufactured to the machine, loading it on the machine and unloading it when the operation is completed.

The advantages of N/C machines are numerous. Once a process has been programmed, the operator must only load and unload the component. N/C machines perform tasks much faster and more accurately than manual operators. Once a set-up has been designed and recorded on a floppy disc, it can be stored and kept for future use.

As is true with all CAD/CAM development, the aerospace and defense industries have been major proponents of numerically controlled machines. This is a result of the emphasis that the Department of Defense has placed on advancing manufacturing automation and productivity improvements.

c. Flexible Manufacturing Systems (FMS)

Flexible manufacturing systems have been termed factories of the 21st century. They utilize CAD/CAM technology in parts design and machine set-up, but because the systems are so highly automated, they drastically reduce the amount of manual labor required. A Flexible Manufacturing System is an automated set of programmable machine tools that is capable of performing many more machining operations on a component than is a numerically controlled machine. The important difference between FMS and CAM is that CAM utilizes a single machine while FMS is an entire manufacturing process, capable of producing entire families or groups of similar products.

Hendrick and Moore provide a simplified explanation of an FMS in their text Production/Operations Management:

> An unfinished part, say a steel casting or forging, is fastened to a conveyor which moves on a stop and go basis from one machine to the next. The part stops long enough at each machine to have one or more operations performed on it. Separate machines, performing successive operations, are lined up on each side of a conveyor, and, as the conveyor stops, each machine automatically reaches out and performs its operation on the part. As the operating parts on the various machines move back and out of the way, the conveyor moves another step, and the performance is repeated on the next units. The machines, though actually separated, operate together as if they were parts of a very complex single-purpose machine. Such machine groupings eliminate all product handling except the little that is needed before the first and after the last operation. [Ref. 4:p. 444]

First introduced in the 1970's, the FMS concept is slowly being accepted in the U.S. The reasons for its slow acceptance is the extremely high capital outlay required and the fact that it is a radical change in how U.S. industry is accustomed to managing a production line. Introduction of an FMS changes the requirements for factory space, labor force, and methods of purchasing, scheduling, material handling and inventory.

In spite of the radical departures from normal manufacturing practices, FMS is the wave of the future for batch manufacturers.

> The potential users, particularly manufacturers that use machine tools to drill, tap, bore, groove or cut a metal part in batches of less than fifty, cut a great swath across U.S. industry. [Ref. 5:p. 65]

FMS is particularly well-suited to medium and small batch manufacturing, the production lot sizes usually being associated with defense industries.

FMS's are economically able to simultaneously manufacture small batches of different parts. This is because of the system's ability to make changes in cutting and forming tools on machines virtually at will. Automated tool magazines containing different tools are attached to FMS machines. These tools can be quickly drawn from the magazine, inserted and made ready for use on command from the central computer used to run the FMS. This incredible reduction in set-up time and increased flexibility allows companies to manufacture customized parts almost as cheaply as mass produced parts.

Standardization is important in designing parts to be manufactured with an FMS. The system's flexibility does have some limitations and cannot accommodate major product variations.

> An FMS cannot produce bicycles one week and refrigerators the next. [Ref. 5:p. 67]

But by designing families of products with common design characteristics, companies can achieve maximum utilization of their FMS.

C. RAMP'S UTILIZATION OF CURRENT TECHNOLOGY

RAMP draws on all of the technologies previously outlined. Following is a discussion of how the Navy has combined these disciplines to form the RAMP Program.

1. Parts on Demand

A study released by NAVSUP and the Office of Naval Research in February 1984 indicated that the Navy's spare parts inventory was valued at over $10 billion. It was calculated that 65% of that enormous inventory was stagnant (no demands). A monetary breakdown showed that $7.5 billion of the total inventory was for Mark Zero (low demand insurance items) and $6.6 billion of those items were considered dormant. The Navy calculates the holding cost associated with this inventory to be approximately $2 billion annually. The number of line items managed by inventory investment, with the Aviation Supply Office (ASO) alone managing 240,000 separate line items.

One goal of RAMP is to reduce the number of spare parts that must be held in inventory. Utilization of the "Just in Time" concept of inventory management, i.e., ordering spares from the manufacturer as needed, could drastically reduce the dollar values of inventories. But for a system such as this to work while at the same time not affecting readiness, both administrative and manufacturing lead times must be greatly compressed.

How would such a system work? Like the KANBAN system, it would be a pull system, the initial requirement for the parts production being generated by the end user. The end user (ship or aircraft squadron) would transmit its requirement to the ICP. The parts requirement would then be automatically or semi-automatically transmitted from the ICP to the production facility. It is envisioned that multiple production facilities would be utilized in order to reduce transportation time and costs and also to enhance competition among competitors.

A centralized database containing parts descriptions and production specifications would have to be maintained in order to provide the manufacturing facility with the information necessary to manufacture the part. This information would automatically be transferred to the production facility concurrently with the request for production.

The manufacturer would then utilize CAD/CAM and flexible manufacturing systems capable of reading the production specifications and translating them into instructions for the numerically controlled machines.

2. The Computer-Aided Design Process

Implementing RAMP will require two separate CAD efforts: one approach will be developed for parts currently in the Navy's inventory, the other for future parts that are designated RAMP parts at the time they are designed into new weapon systems.

For current parts, it must be assumed that sufficient data will not be available to manufacture them using numerically controlled or flexible machining systems. Thus, one objective of RAMP is to identify parts currently in inventory that are RAMP candidates. These parts would then be subjected to a reverse engineering process utilizing computer-aided design techniques to build the data base necessary to later produce them.

Parts used in future weapons systems will be designated RAMP parts as early in the acquisition process as possible. Information concerning design, fabrication and assembly, i.e., the data necessary to produce the part using N/C machines or a FMS would be entered into the RAMP data base. The future success of the RAMP Program depends upon policy implementation encouraging defense contractors and Navy Program Managers to utilize CAD initially in the design of new parts. The specifications resulting from this design effort would then be suitable for inclusion in the RAMP data base. This process would also have other positive side effects. It would increase part standardization and enhance the use of "families" of similar parts. It would reduce the variety of similar but non-substitutable items and would reduce the variety of spares that must be held in inventory. [Ref. 6:p. 45]

3. <u>The Computer-Aided Manufacturing/FMS Process</u>

Once steps have been taken to create the RAMP data base, the next step is to utilize the data base in the computer-aided manufacturing of needed spares. As requirements are generated, they would be transmitted to the appropriate RAMP facility for production. Information passed to the producer would include the machine readable commands necessary for N/C or FMS equipment to manufacture the item. The manufacturer would then schedule production on the correct N/C machine, or if an FMS is utilized, the requirement could simply be put into the master computer system which would automatically schedule the spare for production.

a. Types of Parts Producable When Utilizing RAMP Technology

The most well-known uses of CAM technology are associated with the manufacturing of machined metal parts. The use of computer-aided lathes and milling machines is now commonplace in industry. Thus RAMP has placed a great deal of emphasis on manufacturing metalic spare parts utilizing these techniques. FMS's are presently used by Caterpillar, Hughes and Ingersoll-Rand, and have repertoires of 50 to 200 different part designs.

The technology to produce other types of spare parts currently exists and the RAMP Program is pursuing these areas. Today integrated circuits are designed utilizing computer technology. A considerable data base containing design specifications of previously designed circuits also exists. CAM technology is under development at this time, but presently processes utilizing optical masks and manual labor remain more efficient. But, because of the multitude of possible designs that could be produced using the same production system, it is felt that computer-aided manufacturing of integrated circuits is both desirable and attainable in the near future. RAMP intends to utilize this technology as it becomes available.

D. RAMP CASE STUDY AND PRODUCTION DEMONSTRATION

The reactivation of the Battleship New Jersey several years ago afforded the Navy the opportunity to design and manufacture a part utilizing CAD/CAM technology. The test was conducted in association with the National Bureau of Standards (NBS) Automated Manufacturing Research Facility (AMRF). The test was conducted to determine if utilization of CAD/CAM technology was a practical method to obtain needed spare parts, and to determine if the methods were cost effective.

The test used a part that was needed for the recently reactivated USS New Jersey, an oil flinger governor for a steam turbine engine. This part was not available in any Navy inventory, nor could any source of supply be located. The oil flinger had originally been manufactured in the late 1930's or early 1940's, and no records concerning the part specifications were available.

NBS was tasked with the job of designing and manufacturing the part utilizing the CAD/CAM equipment at their AMRF.

Because of a lack of the specified steel, NBS was initially only able to produce a prototype of the oil flinger. Successful production of this replica indicated that the technical data package could be reproduced utilizing CAD, and that the production process could be recreated. When the proper steel was later obtained, NBS was able to manufacture four oil flingers to satisfy the Navy's requirements.

A cost comparison was conducted to determine if obtaining the part utilizing RAMP technology was economically practical. The only purchase of the oil flinger prior to the test was made in 1981. At that time, SPCC contracted with the Northern Ordnance Division of FMC Corporation to manufacture the part at a cost of $1,240.44. NBS calculated their total costs of designing and producing the four oil flingers utilizing their limited CAD/CAM capability at $3,816.00 or a unit cost of $954.00. The NBS cost comparison went one step further and estimated the manufacturing costs only, assuming the design specifications necessary for production were already available in a RAMP data base. Their conclusions indicated that if design specifications had already been available, first unit production costs would have been 17% below manual production costs. When additional units were added into the analysis, the reductions in cost were more dramatic. Additional unit production costs using N/C machines were estimated to be less than one-third that of producing the part manually.

Use of Flexible Manufacturing Systems in parts production should result in even greater cost savings. Greater reductions in set-up and first unit production costs would be obtained because of the reduced time and labor involved in these efforts. As noted earlier, unlike N/C machines which still require a fair amount of human interaction, an FMS is capable of performing many labor intensive operations automatically.

E. SUMMARY

The successful use of CAD/CAM and FMS technology in private industry indicates that the RAMP program is a step in the right direction in ensuring that the Navy fulfills its logistics goals. RAMP aims to improve logistical support within the military spare parts supply system by reducing the need to carry large inventories while at the same time providing a rapid response to spare parts requirements. Utilization of such a modern production base would furthermore enhance readiness, sustainability, and the ability to surge or mobilize.

RAMP can be integrated into current logistical philosophy and can be utilized to obtain weapons systems spare parts, items for inventory resupply and parts critically needed by operating units. RAMP technology will allow the design and production of a wide range of parts including mechanical (machined), electronic (integrated circuits), and electrical parts in a fraction of the time it now takes, and at lower costs. Increasingly long lead times, diminished sources of supply, and a need for parts out of production have plagued the Navy for years. Implementation of RAMP technology will offer additional flexibility in dealing with these problems and better enable the Navy to sustain their fleets at sea.

III. TECHNOLOGY TRANSFER AND INCENTIVES FOR INDUSTRY PARTICIPATION

A. INTRODUCTION

For RAMP to be successful, tow things must occur. First, there must be a well-planned program for transferring RAMP technology to industry. Secondly, the Navy must provide incentives to contractors to encourage them to invest in the equipment necessary to become a RAMP participant.

Today, there are many efforts underway in both industry and government to develop more efficient design and manufacturing systems. It is imperative that the Navy take the lead in this development process to ensure that future industrial base improvements implemented by industry are compatible with RAMP's goals. For the program to be successful, contractors must invest in equipment that is capable of interfacing with the Navy data bases containing the specifications necessary to manufacture RAMP designated parts. The first part of this chapter will discuss the Navy's plan to ensure that this transfer of technology to industry occurs in an orderly fashion.

The way the Department of Defense has traditionally conducted business with defense contractors has often inhibited modernization. One problem is that under certain circumstances, the cost based profit policy utilized in DOD acquisitions penalizes contractors for productivity improvements.

However, proper application of the productivity award that is part of the weighted guidelines could alleviate part of the problem. Profit policies provide for this, but contracting officers have been inconsistent in applying this element of the weighted guidelines. Typically, profit is based on cost. This means that any attempts made by the contractor to reduce costs may ultimately result in his profits being reduced. Another problem concerns the lack of stability the defense industry perceives in its relationship with the government. Contractors are often not willing to make long term commitments such as economic order quantities of raw materials, or investment in new machinery when they are not sure of future business.

These problems, which are inherent in the acquisition process, are now well documented, and several programs have been developed to overcome the disincentives discussed above. The second half of this chapter will briefly discuss investment theories and relate them to the programs that can be utilized by the Navy to encourage contractors to make the investment necessary to participate in RAMP.

B. TECHNOLOGY TRANSFER

The proliferation of CAD/CAM systems has generated a need for product definition data to be presented in a new and different format. Information that was previously contained on engineering drawings must now be formulated and stored electronically. This means that data required for parts being manufactured under the RAMP program must have design specifications in a digitized form.

The problem today is that no universal format for communicating specifications between the RAMP data base and the numerous manufacturers' CAD/CAM systems exists. This problem is currently being addressed by the National Bureau of Standards (NBS). NBS is developing a public domain neutral specification format that is designed to interface with virtually all CAD/CAM systems. This NBS specification is entitled International Graphics Exchange Specification (IGES). [Ref. 7:p. 9]

1. <u>The IGES Concept</u>

The IGES program was initiated because of industry's needs for a means of interfacing CAD/CAM systems. Typically, each CAD/CAM vendor developed a unique and proprietary "native" format for the representation of data. For different systems to interface, a "translator" that is capable of translating information from one machine to another had to be developed and used. This is a viable approach for interfacing two or three different systems. But as new CAD/CAM systems continue to proliferate, the use of translators becomes impractical as more and more of these systems are expected to interface with each other.

In an attempt to circumvent this customized translator development problem, NBS developed IGES, a neutral specification that can be used to link dissimilar systems.

The following is a description of how IGES works:

> The sending system produces a data file in IGES format which is then transferred to and read by the receiving system. This is accomplished by using a computer program called an IGES pre-processor, which translates the product definition from the original format into IGES format. Similarly, IGES post-processor software automatically translates product definition data in IGES format into the format used by the receiving system. These pre- and post-processor software programs are system dependent and are supplied by the CAD/CAM system vendor, or in some cases, developed by the system user. [Ref. 8:p. 2-2]

The IGES system has undergone extensive testing and continues to evolve. A test of IGES was conducted in 1983 using 12 different CAD/CAM systems. The results indicated that IGES is capable of CAD to CAD information exchange, however, problems still exist that must be overcome for the system to be fully implemented. The primary problem associated with IGES is the system's inability to represent some curved surfaces correctly. Additionally, IGES may be too flexible in its current form. The flexibility inherent in the system may lead to a loss of information during translation. This requires a substantial amount of post-processor interpretation and may result in inconsistent results.

These problems are being addressed and will be solved as the IGES concept continues to evolve. Each revision of IGES expands its capabilities, and in the long run will supply solid geometry interpretation capabilities to industry.

RAMP program managers are deeply involved in the development of IGES. For RAMP to be successful, parts manufacturing data must be captured in a format that can be utilized by all of industry. The introduction of the IGES public domain data format will allow all interested contractors to interface with the RAMP data base and to participate in the program. This standardization will ensure that all lower tier suppliers will be able to participate in the program without a major investment in additional equipment. This standardization issue is of major importance, not only because of its effects on the capability of contractors to participate in RAMP, but also because it will heighten competition in the procurement of spare parts. This issue will be further discussed in Chapter 4.

C. INCENTIVES TO ENCOURAGE INDUSTRY PARTICIPATION

Improving productivity of defense contractors is of paramount concern to DOD. Improving productivity is a critical factor, not only in enhancing the overall defense posture, but also in reducing procurement costs.

Unfortunately, a large portion of the defense industrial base employs outdated and inefficient capital equipment [Ref. 9:p. V-6]. This point has become more and more apparent as lead times associated with parts production have lengthened and as procurement costs have risen. Several initiatives are now being pursued by DOD in an attempt to head off this problem and encourage additional capital investment by defense contractors. Although none of these programs were initiated with RAMP in mind, they hold a potential for encouraging contractors to invest in the equipment necessary to become RAMP participants.

Next to be discussed is the investment theory upon which these incentive programs are based, and the programs themselves.

1. Investment Theory

A brief discussion of investment theory is in order so that the reader may have a better understanding of why government incentives are effective. First, what is investment?

> Investment is the purchase of new productive physical assets which will in turn be used to produce other products. [Ref. 10:p. 15]

Two different investment theories explain why companies invest capital in new equipment.

(a) Accelerator Principle

> This is probably the best known investment theory. The accelerator principle relates increases in capital investment to changes in the level of sales. It surmises that as sales increase, so does capital investment; and as sales decrease, investment also decreases. Thus, capital investment is a direct result of the financial health and well being of a particular industry.

(b) Cost of Investment Funds

> This theory generally relates to interest rates, implying that investment is highly dependent upon the level of the interest rate. But more important to this discussion is the fact that firms are usually willing to invest in new capital equipment as long as the rate of return on the investment is greater than the cost of financing the investment, i.e., the firm will derive benefit from making the investment.

a. Investment Determinants

There are several factors that motivate corporations to invest capital:

(1) Expected Returns. If a firm expects to derive more from an investment than they put into it, they will usually proceed with the plan.

(2) Sales Backlog. This stems from the accelerator principal, i.e., if a sales backlog exists, firms will respond by increasing their investment in new equipment in order to cope with the backlog.

(3) Technological Change. In some instances, firms are forced to invest in new technology or take the chance of becoming non-competitive. On the other hand, firms may be unwilling to invest in new technology because of their fear that something better may soon be introduced. It is important to note that when investing in technologically advanced manufacturing equipment, companies are gambling on the future, which may be their overriding investment factor. This is the reasoning behind the Navy's decision to provide a generic RAMP data base that can be utilized by virtually all CAD/CAM equipment. It encourages firms to invest in equipment that best suits their needs, while still allowing them to participate in the RAMP program.

(4) Capacity Utilization. Excess capacity offsets the accelerator principle since increases in sales can be accommodated through the utilization of idle equipment already on hand. This assumes that the idle equipment is technologically current and is cost efficient [Ref. 10:p. 15].

The two incentive programs proposed as a means of encouraging contractors to invest in RAMP equipment are the Industrial Modernization Incentives Program (IMIP) and multi-year procurement (MYP). These two programs are not only used to reduce costs, but are more importantly used as a means of providing firms with the incentives necessary to invest in new capital in order to strengthen the industrial base. As will be seen, the two programs take different approaches to solving the same problem. IMIP utilizes the cost of investment fund theory as its basis for incentives.

It encourages capital investment by providing a contractor with a high enough rate of return to induce him to make new investments. Multi-year procurement, on the other hand, utilizes the accelerator principle for providing its incentive. It is assumed that the assured increase in sales that are inherent in the MYP will induce the contractor to invest in more cost efficient production equipment.

2. Industrial Modernization Incentives Program

The decline in the rate of productivity in the defense industrial base and its associated consequences has become a major focus of attention in government in recent years. This decline in productivity has been attributed to many factors. The reason most often mentioned has been limited capital investment in productivity enhancing equipment.

The DOD has become very concerned withb this decline in productivity because it is considered to be one of the predominant factors behind the rapid escalation in costs associated with both weapons systems and spare parts procurement. In an attempt to reverse the decline in productivity, DOD instituted a test program in 1982 designed to increase the rate of capital investment by defense contractors. The program, IMIP, intends to encourage defense industry capital investment by offering incentives to contractors while at the same time removing some of the disincentives associated with doing business with the DOD.

IMIP was developed after the Air Force had a great deal of success with a similar program called the Technology Mondernization Program (TECHMOD). TECHMOD achieved its objectives by inducing capital investment through the use of "seed money". The Air Force funded studies that assisted contractors in making investment decisions and would encourage them to invest their own dollars in new technology. If a contractor took part in such an arrangement, a business agreement was drawn up between the service and the contractor. This agreement allowed the contractor to share in the savings that resulted from its productivity enhancing investment.

Like TECHMOD, IMIP relies on a business agreement between the government and the contractor that allows both parties to share in savings resulting from capital equipment investment made by the contractor. The purpose of this sharing arrangement is to allow the contractor to benefit from current and future savings that result from the investment and allow him to realize a fair and reasonable return. Unlike TECHMOD, Navy IMIP arrangements do not usually utilize seed money. The Navy has been hesitant to provide such funding, preferring to rely on contractors to make investment decisions on their own. The Navy feels that government investment in this program is neither necessary nor desirable. IMIP intends to provide a return on investment that is attractive enough to encourage contractors to expend the capital on their own. Furthermore, investment of government funds in this program would limit participation to those select contractors receiving the seed money.

a. IMIP Policy

At the time of this writing, the test phase of the IMIP program is just concluding. Mr. Richard Stimson, DOD's Director of Industrial Productivity, recently stated, "The Industrial Modernization Incentives Program proved to be very successful as a test." According to Rear Admiral Joseph Sansone, who chaired the IMIP steering committee, "The test phase shows IMIP to be the most important and productive initiative ever undertaken by the DOD acquisition community."

A formal coordination draft, DOD Directive No. 5000.XX is currently being circulated. That directive outlines IMIP policy as follows [Ref. 11:p. 2]:

> 1. It is DOD policy to provide industrial modernization incentives as described in the DOD FAR Supplement, Section 15.872, encouraging contractors, subcontractors and vendors, to:
>
> a. Enhance productivity, reduce acquisition and other life-cycle costs, and improve product quality and reliability as a function of the manufacturing process.
>
> b. Invest in improved processes, methods, techniques, facilities, equipment, software and organization(s), including the improved utilization of human resources, for the most efficient and economical production of quality defense material.
>
> c. Shorten lead time and increase industry surge and mobilization capacity.
>
> d. Accelerate the development and implementation of advanced manufacturing technology and provide maximum distribution of the results.

e. Implement manufacturing systems and related engineering and management improvements based on a long-term perspective and a plant-wide total systems analysis.

As can be seen, RAMP and IMIP share many of the same goals. In order to meet the goals previously outlined, DOD components have been given great flexibility in fashioning IMIP arrangements. IMIP is viewed as a departure from normal DOD business practices. This is a critical element of the program. IMIP's objective is to negotiate a business agreement that makes sense to both parties and would have otherwise been impossible. Deviation from accepted business practices are acceptable under IMIP as long as acquisition costs are reduced.

b. Formulation of the IMIP Agreement

IMIP agreements can be utilized as long as:

(1) Covered assets consist of severable plant equipment with a unit value in excess of $10,000.

(2) The capital investment would not have otherwise been made by the contractor.

(3) Government savings exceed the related investment costs by a sufficient margin to make the acquisition economically viable.

(4) The savings will be reflected in the pricing of individual contracts.

Primary IMIP emphasis is on Modernization Investment Projects (MIPs), i.e., capital investment in productivity-enhancing equipment. For MIPs, the incentive to the contractor is provided through a productivity savings reward (PSR). The PSR is primarily determined by means of an internal rate of return (IRR) analysis. This analysis is used in negotiating the amount of PSR to be awarded to the contractor. To determine a fair reward, a discounted cash flow model has been developed. The purpose of this model is to ensure that incentives paid are reasonable, but still provide the contractor an adequate monetary return to justify his investment while also ensuring that the goverment benefits through lower acquisition costs. PSR's are paid to the contractor out of the net savings that accumulate because of the investment.

The PSR is applied to the current contract being negotiated. It also applies to future contracts for a predetermined time period which is negotiated between the government and the contractor. On future contracts the lower estimated cost that is a result of the MIP is used in determining cost of performance and the sharing factor is then added in to determine the final contract price.*

c. How IMIP Arrangement Will Induce Investment in RAMP Technology

This section addresses two questions. First, how will IMIP benefit RAMP? Secondly, how will IMIP arrangements be implemented with subcontractors and vendors?

IMIP business agreements can be made with any defense contractor as long as it will result in reduced costs and productivity improvements that will benefit both the

---

*For an in-depth explanation of how to negotiate IMIP agreements, refer to Draft DOD Guide 5000.XX-G, OSD August 1985.

government and the contractor. The majority of IMIP agreements that have been implemented so far have been in conjunction with major weapon system acquisitions. Furthermore, to date IMIP arrangements have been limited to prime contractors and a few large subcontractors.

IMIP agreements have been associated with major weapon system acquisitions because of the dollar value of the contracts involved and the return available. IMIPs must be tied to rather large contracts in order to make the arrangement worthwhile to both the government and the contractor. This is mainly because of the high administration costs associated with negotiating and administering an IMIP agreement. Because of this it is highly unlikely that the government or a contractor involved only in spare parts production could derive benefits from IMIP.

It is highly probable that once RAMP is introduced into the major weapon system acquisition process, (i.e., policies established that require data for parts of newly designed weapon systems to be presented in a digitized format so that RAMP technology can later be utilized in the procurement of spare parts.) IMIP arrangements will be an excellent method for incentivizing contractors to invest in machinery and flexible manufacturing systems that can later be used by the RAMP program.

Implementation of policies requiring RAMP technology to be utilized in major weapon system design and production is easily justified. Utilization of this technology will result in lower design costs and lower initial manufacturing costs. It will also reduce the total life cycle costs and increase readiness of the weapon system by lowering inventory carrying costs and allowing for the manufacture of small batches of repair parts on demand.

Like RAMP, IMIP is intended to be used by all levels of the defense industrial base, including primes, subcontractors and vendors. During the test phase, IMIP implementors have wrestled with the problem of how to make the benefits of the program flow down to the lower tiers of the defense industrial base. This problem arises because of the limited interaction that occurs between the government and subcontractors/vendors in the major weapon system acquisition process. Since RAMP will utilize many small contractors, it is imperative that IMIP incentives be pushed down as far as possible into the defense industrial base.

Two separate strategies have evolved for implementing IMIP at the subcontractor level: "industry" and "programatic" approaches are discussed in the proposed DOD Guide 5000.XX-G.

> An industry approach involves a program to modernize a targeted industry or sector of the industrial base (e.g., travelling wave tubes, forgings, composites, etc.). Another term for the industrial approach is "horizontal". Vendor relationship is most appropriate for industry related IMIP, since a single prime contractor may not deal directly with the entire industry. The programatic approach, on the other hand, involves a program to modernize the subtier base of a given program or weapon system such as the F-16. In this approach, prime contractor

> involvement is appropriate but not mandatory. . . . Another term for the programatic approach is "vertical". [Ref. 12:p. 9]

To date, the most successful use of IMIP in conjunction with lower tier contractors has been through the use of the vertical approach. The Air Force and General Dynamics are responsible for the most aggressive of these programs. General Dynamics' F-16 program management team has encouraged subcontractors to invest in flexible manufacturing systems and robotics in order to increase their productivity and reduce costs. General Dynamics acts as the program manager in instituting and administering these arrangements, and also shares in the cost savings. This three-way cost savings arrangement between the Air Force, General Dynamics, and the subcontractor provides the motivation to the prime contractor to aggressively promote IMIP agreements with its subcontractors. Subcontractors have been very eager to take part in the program. The increased productivity that results from their investment not only creates an incentive payment to the company, but since most of the equipment being purchased is of a general nature, the subcontractor is able to utilize it on commercial work as well. This tends to strengthen the subcontractors competitive position and may allow him to make a higher profit on commercial work. [Ref. 13:p. 3]

Investment and savings figures indicate how successful the F-16 IMIP program has been. Through FY85, projected subcontractor capital investment totaled $267 million. Total projected savings are estimated to be $557 million from this investment. [Ref. 14:p. 8]

The benefits of IMIP to RAMP are obvious. By providing the incentive to invest in design and production equipment that can be utilized by RAMP, the hurdle of ensuring adequate RAMP designated contractors and vendors are available to make the program a success, is overcome.

3. Multi-year Procurement (MYP)

The use of multi-year contracts is another way of providing incentives to contractors and subcontractors to invest in capital equipment that can be utilized by RAMP. The objective of multi-year procurement is to reduce the cost paid for weapon systems and spare parts by allowing for the procurement of long lead-time items and economic order quantities. Another major effect of multi-year procurement is the added stability that is injected into the acquisition process.

The instability that is associated with the defense industrial base has long been recognized as one of the main reasons why contractors, subcontractors, and vendors have dropped out of the defense business. This instability has caused larger contractors to turn to strictly commercial business, while it has forced many smaller contractors into bankruptcy. [Ref. 10:p. 16] Most important to this dicussion is that instability has been one of the driving factors behind the defense industrial base's unwillingness to make the capital investment necessary to improve productivity and reduce costs.

Like IMIP, the incentives provided by MYP would indirectly result in the formation of a production base that could be utilized by RAMP. The major reason for conducting MYP's is to drive down costs and to improve productivity. Often, this is accomplished through investment in CAD/CAM machinery and flexible manufacturing systems that could be utilized by RAMP. Like IMIP, the introduction of policies that encourage Navy program managers and defense contractors to utilize CAD initially in the design of new parts, coupled with the stability associated with MYP, should provide incentives to industry to invest in RAMP equipment. MYP provides contractors a predetermined level of business over a number of years. This allows the contractor to conduct long range planning, and provides assurances that he will have a large enough business base to justify his investment in productivity enhancing equipment.

Lower design costs and lower initial manufacturing costs that are associated with CAD/CAM technology, and lower life-cycle costs that will result through the utilization of RAMP philosophy will provide incentives to the government to pursue MYP's.

a. Types of Programs Conducive to MYP

Six criteria are considered in determining if programs are conducive to multi-year procurement:

(1) Benefits to the Government. A multi-year procurement should result in a substantial reduction in cost, increase in productivity, or other benefits when compared to conventional annual contracting methods.

(2) Stability of Requirement. The minimum need is expected to remain unchanged or vary only slightly during the contemplated contracting period.

(3) Stability of Funding. There should be a reasonable expectation that the program is likely to be funded at the required level throughout the contract period.

(4) Stable Configuration. The item should be technically mature, have completed RDT&E with relatively few changes in item design anticipated, and underlying technology should be stable.

(5) Degree of Cost Confidence. There must be a reasonable assurance that cost estimates for both contract costs and anticipated cost avoidances are realistic.

(6) Degree of Confidence in Contractor Capability. There should be confidence that the potential contractor(s) can perform adequately. [Ref. 15:p. 5-40]

MYP can be applied to a variety of programs. It can be used to purchase entire weapon systems or for minor components. The important factor is to meet the six criteria listed above. A general rule of thumb used to determine if a procurement is an MYP candidate is its stability. Programs still in research and development or ones that are going through continuous change are not good candidates for MYP's.

One of the best examples of the successful use of MYP is the Navy's C-2A reprocurement program. This program entailed the purchase of 480 new units over a five-year period. The Navy has estimated that the use of a multi-year contract in procuring the C-2A has saved the US taxpayers $89 million over the five-year period. These savings resulted in a great deal of new capital investment, both by the prime contractor and the subcontractors [Ref. 16:p. 192].

D. SUMMARY

This chapter discussed two key issues: the information flow mechanism to be utilized in the technology transfer issue, and what incentives can be used to encourage investment that will later lead to development of an industrial base that can utilize RAMP technology in the production of spare parts.

The technology transfer issue takes a very common sense approach. The RAMP data base is being designed in such a manner that virtually any computerized manufacturing system will be able to interface with it. This "generic" data base is being created so that RAMP participation will not be restricted, and also in an effort to hold down costs for lower tier contractors by allowing them to use their existing equipment. The data base will be able to provide similar parts manufacturing information to contractors not possessing computerized facilities.

The two major incentives to be used to encourage RAMP investment that were discussed are the DOD's Industrial Modernization Incentives Program and the use of multi-year procurement. The discussion states that RAMP would benefit from these incentives through the establishment of policy requiring RAMP to become an integral part of the major weapon system acquisition process. The earlier new parts are designated as RAMP candidates, the sooner they can be introduced into the RAMP data base.

IMIP will encourage investment in new capital equipment that can later be utilized by RAMP in the reprocurement of spare parts. Use of IMIP through the major weapon systems process will enhance the industrial base that RAMP will later employ in the manufacturing of needed spare parts.

Multi-year procurement is another method of encouraging investment in more productive capital equipment that was discussed. The increased stability that surrounds multi-year procurements encourages contractors at all levels to seek out more efficient methods of manufacturing their products.

IV. EFFECTS OF COMPETITION AND CONTRACTING METHODOLOGY

A. INTRODUCTION

This chapter discusses two issues that directly impact the RAMP program. How will RAMP affect the Navy's efforts to increase competition, and what contract methodologies should be utilized when making RAMP procurements?

The passage of the Competition in Contracting Act of 1984 increased the pressure on government agencies to adhere to the principle of making purchases competitively. A program as new and different as RAMP leaves most informed readers with the impression that the program may inhibit competition. This chapter will explore this issue and show how competition can be achieved in a RAMP environment.

The question of how to contract for RAMP parts also brings up interesting points. The procurement system DOD utilizes is restrictive and not overly conducive to innovation. A possible contracting plan for RAMP procurements will also be discussed in this chapter.

B. RAMP PROCUREMENT SCENARIO

To understand the effects of RAMP on competition, and the contracting mechanisms that may be used, the reader must first understand the procurement process that is envisioned to be used in making RAMP procurements. The scenario begins after a requirement for a RAMP designated part has been submitted and it is determined that the part is not in stock and must be manufactured.

The RAMP procurement process will be highly automated, using a sophisticated computerized procurement system. The RAMP Program Plan Summary outlines this scenario.

> The RAMP procurement activity will electronically notify registered and qualified RAMP manufacturers of the part requirement via an "electronic bulletin board". This is a technique whereby an activity with a modem and a dumb terminal, micro-computer, mini-computer, or mainframe computer communicates with another activity, and based on passwords and other security methods, receives information applicable to that particular activity. In this case, the RAMP manufacturers would receive information on the RAMP part procurement, such as the National Stock Number, quantity required, purchase document number, date the material is required, and the cut-off date for the contract award. Additional data on the part, such as parts characteristics, specifications and shipping instructions will also be available via the electronic bulletin board. RAMP manufacturers will also use the electronic bulletin board to submit their price bid, including quantity, schedule for delivery, and any other special information of use to the buyer.
>
> Based on price, quantity, and proposed delivery schedules, the procurement activity buyer or computer will select a RAMP manufacturer to supply the item and will electronically notify the manufacturer of the award. [Ref. 7:p. 5]

Electronic procurement systems similar to the one just described now exist within DOD. The Navy's Automation of Procurement and Accounting Data Entry System (APADE), which is being developed for Naval Supply Systems Command (NAVSUP) field procurement activities provides a format which can be built upon to enable the Navy to meet the objectives of the RAMP scenario described above.

1. APADE Description

APADE is being developed to enable NAVSUP field procurement activities to provide more effective and efficient procurement services. More responsive procurement services will be realized by reducing the time necessary to fill customers' requests, while at the same time not increasing costs to the customer or inhibiting the competitive environment associated with field procurement.

APADE in no way attempts to change the current procurement rules and regulations that must be adhered to by purchasing activities. It is designed to apply the capabilities of automated data processing and automated word processing to the procurement process. In short, it is an effort to automate the procurement process as it now exists. The following is a simplified overview of how the APADE system functions. The entire APADE process is divided into seven functional areas, four of which pertain to this discussion.

(a) Requisition Input. The procurement process is initiated when a requisition is received. The first process carried out by the buyer is to input the request into the APADE system via a CRT terminal.

(b) Pre-award Processing Function. During this phase, the buyer performs a manual review to determine the appropriate method of obtaining the needed supplies (small/large purchase). This function helps the buyer determine the correct purchasing method, prepares pre-award documents, and solicitation documents based on the automated bidder's mailing list located in the APADE system. These solicitation are then mailed to contractors in order for them to bid on the purchase. If required, a synopsis for inclusion in the Commerce Business Daily (CBD) is also generated.

(c) Award Processing Function. Once the buyer has received quotations and has determined the awardee, the APADE system automatically generates the documentation needed to award the contract.

(d) Contract Management Processing. Information entered into the APADE system up to this point, remains available to the buyer in order to effectively manage the outstanding contract. The system can generate status requests, contract modifications, and a myriad of other information that may be helpful in administering the contract. [Ref. 17:p. 2-12]

2. Adapting APADE to RAMP

As can be seen from this simplified explanation of the APADE system, it contains the essential elements necessary to provide a means of making RAMP procurements. The process is not automated to the point that it will allow direct interface between the purchasing activity and the RAMP facility, but the technology is available today that would allow this capability to be incorporated into APADE. As an example of this technology, systems similar to the electronic bulletin board described in the RAMP Program Plan Summary, are today becoming commonplace and are used for such functions as home shopping, and bill paying by computer.

The use of electronic bulletin boards that allow prospective bidders to interface with the purchasing activities computer system would enable a bidder to determine if there are any outstanding solicitations that he may wish to respond to. A business that participated in this program would be issued an identification number allowing it to access the computerized bulletin board. The business would utilize its micro or mini computer to establish a link with the procuring activities computer, and its ID number would then be used to identify the company and the types of items it is capable of supplying to the government. Contracts that the vendor might have an interest in would then be displayed. The vendor would be free to peruse the outstanding solicitations in order to determine which, if any of the contracts it would like to bid on. When a vendor located an IFB that he desired to bid on, the RAMP system would provide the contractor with the digitized drawings contained in the RAMP data base that would be needed by the manufacturer in order to determine its cost of manufacturing the item. After the contractor had determined the price of the part, he would then notify the procuring activity of his bid electronically. The contracting officer, on the date the bids were to be opened, would call up on his computer all of the proposals that had been submitted by contractors. After determining the contract awardee, the contracting officer would key into his computer the award notification, and the appropriate documentation would be electronically transmitted to the contractor.

The system just described assumes that manufacturers interested in being RAMP participants will have computerized systems that are capable of interacting in such an environment. In the short term, this may not be the case. Most firms probably already possess the capability to utilize an electronic bulletin board system that would allow them to access outstanding solicitations. However, many of these same contractors may not possess the sophisticated manufacturing machinery that would allow them to fully utilize the digitized manufacturing instructions that the RAMP system would also provide. Thus, for the foreseeable future, a parts manufacturing specification will still be made available in hard copy to a manufacturer if he desires it [Ref. 18]. This will allow manufacturers who do not possess highly automated systems to participate in the program. This is done to foster competition and to encourage maximum participation in the program. As hese manufacturers modernize their plants through the addition of new automated machinery, they will be able to more fully utilize the digitized information available through the RAMP data base.

C. COMPETITION AND RAMP

Competition is the process of allowing prospective contractors and vendors to contend against one another to determine which can most satisfactorily meet the requirement at hand. Government policy establishes competition as the preferred method of acquiring needed materials and services.

Many people are of the impression that a program as progressive as RAMP may inhibit competition. This is because of the assumption that the changes inherent in this program will limit participation to those privileged few who curently possess the advanced technology described thus far. This section will discuss the government's views on competition, the different levels of competition required for different dollar value procurements, and the efforts that are being made by RAMP program managers to ensure that participation is not limited and competition will exist when RAMP comes on-line.

1. Rationale and Reasoning for Utilizing Competition

Competition in government procurement is required by statute, regulation, and policy. The requirement to seek competition is a continuing legal obligation that all procurement activities must adhere to.

What are the reasons for competition? Foremost, competition is utilized to help the government reduce costs. The Navy is faced with the basic economic fact that its resources are limited by the funding authorized by Congress. To be able to afford our defense requirements, we must keep costs to a minimum. One of the most effective ways of doing this is through the use of competition.

2. Ensuring Competition

RAMP program managers have determined that the vast majority of RAMP procurements will have a relatively low dollar value, the average procurement being in the $1,500 to $3,000 range. This will allow RAMP procuring activities to utilize simplified small purchase procedures. These simplified procedures, which may be used for purchases under $25,000, require competition in varying degrees depending upon the dollar value of the particular purchase action.

One important point concerning competition should be brought out at this time. Simplified small purchasing procedures do not require the use of "full and open competition" as defined by the Competition in Contracting Act. Full and open competition means that all responsible sources are permitted to compete. The CICA provides methods for simplifying contracting procedures when making small purchases in order to "promote efficiency and economy in contracting". This simplification of small purchase procedures in no way infers that they are not competitive. To the contrary the CICA requires agencies to promote competition at all levels to the fullest extent possible. Simplification simply means that the amount of competition is commensurate with the dollar value of the procurement.

As will be seen, RAMP will be able to comply with these competitive requirements. Listed below are the dollar thresholds that govern the extent of competition required for small purchases.

a. Purchases under $1,000

Purchases under $1,000 can be made without solicitation from multiple sources as long as the procuring activity can determine that prices are considered to be fair and reasonable, and similar purchases can be equitably distributed among suppliers. Thus, to satisfy competition requirements for RAMP purchases valued under $1,000 is relatively simple. The procuring activity need only to rotate these procurements between RAM and other qualified suppliers in an equitable manner.

b. Purchases over $1,000, but Less than $5,000

This is the category that most RAMP procurements will fall into. Purchases of this dollar value require that quotations from a reasonable number of sources (usually defined as three or more) be solicited to ensure the government receives a fair and reasonable price. In an attempt to maximize competition and minimize costs, time permitting, purchasing activities have been encouraged to post a notice of the impending procurement in a public place. In this particular category, RAMP procurements could meet the competitive requirements by simply obtaining electronic quotations from three or more sources, and making a determination as to a fair and reasonable price. The use of electronic bulletin boards by procuring activities as a means of more widely disseminating information concerning upcoming procurements to interested suppliers, would provide a higher degree of competition than is currently required.

c. Purchase over $5,000 but Less than $10,000

The requirements for these purchases are similar to those between $1,000 to $5,000, except that the purchasing activity is required to post a notice of the intended procurement. Again, the use of electronic bulletin boards in this category would fulfill the requirement of posting a notice in a public place, and would again provide a higher level of competition by providing a method of more widely publicizing the contract action.

d. Purchases over $10,000 but Less than $25,000

These procurements require virtually the same rules that are required for large purchases (in excess of $25,000). This is done to further increase competition and to ensure the maximum number of suppliers are aware of the upcoming purchase. To meet these stricter requirements, these procurements must be synopsized in the Commerce Business Daily and posted in a public place at least 15 days prior to issuance of the solicitation. [Ref. 27]

It is this particular threshold that will significantly slow down the RAMP procurement process. The requirement for synopsizing the procurement in the CBD will be a limiting factor in making RAMP procurements. The Federal Acquisition Regulation (FAR) requires notice of a contract action to be published in the CBD at least 15 days prior to issuing a solicitation. The FAR also requires the solicitation to remain open for at least 30 days after issuance of the solicitation in the CBD. This thirty day time period is established to allow prospective bidders adequate time to respond to the contract action. When these two time frames are added to the six to ten days it takes to get a notice of contract action published, the total time it would take to issue a RAMP contract would be in excess of 50 days.

Exceptions can be made to the requirement for synopsis of proposed contract actions. Paragraph 5.202 of the FAR states that the contracting officer need not synopsize in the CBD when he determines that:

> The contract action is to fulfill a need for supplies or services that is of such an unusual and compelling urgency that the government would be seriously injured unless the agency is permitted to limit the number of sources from which it solicits bids or proposals and not comply with the time periods specified in 5.203 (publicizing and response time). [Ref. 20:para. 5.202]

The above paragraph allows contracting activites to proceed with procurement actions without synopsizing if a determination is made that the requirement is urgent. Thus, the requirement to synopsize in the CBD will in no way inhibit RAMP procurements for critically needed parts, but routine buys utilizing the RAMP system would have to be synopsized, adding an additional 50 to 55 days to their procurement lead time.

One step that is being considered to reduce the lead time associated with synopsizing in the CBD is to develop a computer accessed CBD that would be similar to the electronic bulletin board. Mr. George T. Nicholas outlined a scenario for this process presented to 1983 Federal Acquisition Research Symposium:

> What is envisioned is that all notices, issued by government contracting offices to the Commerce Business Daily would be available to contractors on terminals located in their sales offices and business offices. The contrac- would be able to call to his screen the items which are being purchased by the government on a given day. He would be able to see all the many items for which the government is soliciting, or for which they are awarding contracts. . . . With the proliferation with computers that is expected within the next two to three years, and with the easy access to computer information via telephone lines, and data centers, even the smallest of contractors will be able to utilize computers in his facilities. Many computers are available on the market for around $1,000, which could accomplish this task. [Ref.·21:p. 14]

Systems such as the one described by Mr. Nicholas now exist and are available through private electronic data base subscriber services. In the future this capability might possibly lead to a shortening of the 30 day bid preparation period for RAMP procurements and others similar to RAMP, since the manufacturer will have instantaneous access to the proposed solicitation and will be able to quickly prepare his bid from the information provided in the RAMP data base.

3. Management Efforts to Ensure RAMP Procurements are Competitive

The RAMP program has evolved during a period in which defense procurement deficiencies have been well publicized. Because of this, RAMP program managers are attuned to the need for competition in the procurement of spare parts in order to ensure the government pays only a fair and reasonable price for supplies. Although RAMP is breaking new ground technologically speaking, the program is being designed so as to have minimum impact on the procurement rules and regulations that must be adhered to.

RAMP intends to utilize the entire industrial base, allowing all manufacturers who are qualified to produce spare parts to participate in the program. It is a well-known fact that many smaller contractors may not at this time possess the computers and automated equipment necessary to fully implement the RAMP system. But many of these manufacturers may own single N/C machines and computers that can be used to access parts of the RAMP system. It must be remembered that RAMP's goal is to produce spare parts on demand. If a small manufacturer who possesses the capability to produce a RAMP part desires to bid on RAMP contracts, he will be free to do so. The limiting factor that applies to all RAMP participants is that they must meet the shorter lead times that will be imposed on all RAMP buys. If a contractor can fulfill all of the requirements outlined above, his limited use of automated manufacturing equipment will in no way affect the award decision. The early stages of RAMP will provide contractors with design specifications in whatever format required: hard copy engineering drawings or computerized formats for direct entry into the firm's computer system.

The use of an electronic bulletin board by the RAMP system should also help to foster competition. All qualified RAMP contractors will be included on a computerized bidder's mailing list. When a requirement arises that they could fill, they would be contacted automatically by the procuring activity's computer system to bid on the contract. Once an adequate number of bids are received, and any applicable time constraints have been met, an award would be made by the procuring activity.

The use of small purchase procedures, which have competition built into them, in themselves will ensure RAMP procurements are made competitively. But the additional efforts being made by RAMP management just described will further enhance competition. These measures will push competition past established small purchase requirements towards more full and open competition.

D. CONTRACTING MECHANISMS FOR MAKING RAMP PROCUREMENTS

This section will discuss the contract mechanisms that may be utilized when making RAMP procurements and how they interact in a competitive environment. The contracting methods outlined below assume no changes in procurement regulations. The two contracting methods being investigated for use by RAMP are the basic ordering agreement and the indefinite delivery contract [Ref. 7:p. 5].

1. Basic Ordering Agreements (BOA)

The RAMP program intends to use the basic ordering agreement in conjunction with firm fixed price contracts as its primary contracting mechanism. This is not a great change in how spare parts are currently procured. Because of the volume of business that is conducted with many spare parts contractors, BOA's have been found to be an ideal mechanism for expediting the contracting process.

The FAR describes a BOA as follows:

> A basic ordering agreement is a written instrument of understanding, negotiated between an agency, contracting activity or contracting office, and a contractor, that contains (1) terms and clauses applying to future contracts (orders) between the parties during its term, (2) a description as specific as practicable of supplies or services to be provided, and (3) methods for pricing, issuing, and delivering future orders under the basic ordering agreement. A basic ordering agreement is not a contract. [Ref. 20:para. 16.703]

The use of a BOA is particularly applicable when it is expected that numerous purchases may be made from one source. As the FAR points out, a BOA is not a contract. It is a method used to expedite contracting for supplies from a source when the specific item, quantities and prices are not known in advance. The BOA allows the government and the contractor to reach agreement in advance on recurring issues that are associated with each procurement action.

When BOA's are written, the following information must be included:

(a) The method of determining prices.

(b) Delivery terms and conditions.

(c) Government activities authorized to use the BOA.

(d) The point at which each order becomes a binding contract.

There are specific guidelines laid out in the FAR that dictate the use of BOA's. It is important for procuring activites and contractors to understand that a BOA does not imply any agreement by the government to place future contracts with the contractor. BOA's are also not to be used in any manner that may restrict competition. In other words, the fact that a contractor has a BOA with the government does not imply future government business for the contractor. The company must still compete against other offerors who may or may not have BOA's.

Use of BOA's does not relieve the government of its duty to synopsize purchase actions over $10,000 in the CBD, but as previously mentioned, this requirement can be waived in cases where the requirement is emergent.

In the case of RAMP procurements, BOA's would outline the pricing structure to be utilized on future contracts. Pricing RAMP buys should be a relatively simple matter if these pricing elements have previously been negotiated. If the BOA is with a manufacturer who has a highly automated system, the pricing method might consist of two main elements that have not been previously determined, and are peculiar to each procurement: machine time and raw materials. Since the RAMP part is already in the data base, information detailing the amount of machine time necessary to produce the part would be available both to the manufacturer and the government. Pricing the part would be achieved by applying the machine's hourly rate to the time necessary to produce the item, adding in raw material costs, and applying overhead and profit. In this scenario, the hourly machine rate, and overhead would have been negotiated when the BOA was drawn up.

This type of agreement could be used with smaller contractors who are not required to comply with Cost Accounting Standards (CAS). Larger contractors who do business in excess of $10 million with the government may be hesitant to enter into such pricing agreements since this method of pricing probably would not be consistent with their normal pricing and accounting procedures. In these instances, the

BOA would be modified in order for it to comply with the contractors' normal accounting procedures.

Thus, while the BOA does not identify a contractual arrangement between the procuring activity and the RAMP vendor, it does establish ground rules for the general provisions which will be incorporated into contracts that may be made at a future date. The establishment of BOAs with RAMP qualified vendors would save time when dealing with contractors on a recurring basis, helping to meet the rapid response goal of the RAMP program.

2. Indefinite Delivery Contracts

A second contracting mechanism being considered for use by RAMP program managers is the indefinite delivery contract. This type of contract is most often used when the exact time and/or quantities of an item to be supplied are not known when the contract is awarded.

The FAR describes three types of indefinite delivery contracts: definite quantity, requirements, and indefinite quantity contracts. The type most suited to RAMP procurements is the indefinite quantity contract. The FAR describes this type of contract as follows:

> An indefinite quantity contract provides for an indefinite quantity within stated limits, of specific supplies or services to be furnished during a fixed period, with deliveries to be scheduled by placing orders with the contractor. [Ref. 20:para. 16.504]

Indefinite quantity contracts require the government to order and the contractor to provide a minimum quantity of the supplies contracted for. A maximum quantity is also established that the contractor is obliged to provide. These types of contracts are competed at regular intervals, usually annually.

RAMP would utilize indefinite quantity contracts by negotiating annual contractual agreements with a contractor to supply a minimum quantity of a particular part or a family of parts as the need arises. This would allow the contracting activity to further expedite the manufacturing of RAMP parts since there would be no requirement for the activity to establish a contract for each procurement. As the requirements occur, the RAMP contracting activity would simply place an order against the outstanding indefinite quantity contract.

Indefinite quantity contracts would provide a more expeditious manner of contracting for RAMP parts, but justifying this contracting method may be difficult. First, these procurements may not be as competitive, this issue will be expanded upon in the next section. Secondly, this contracting mechanism requires the establishment of a minimum quantity to be procured during the period of the contract. If this minimum quantity can be determined in advance, it is questionable if the part should in fact be RAMP designated. In a case such as this, when demand can be predicted to some degree, the prudent decision is to rely on established logistics practices to ensure the part is stocked and available to operating units.

3. Competition and Contract Type

There are pros and cons to both BOA's and indefinite quantity contracts. Indefinite quantity contracts would drastically reduce the amount of time it takes to place an order. With this type of arrangement all a procuring activity would have to do is place RAMP orders against the existing contract. Conversely, the use of BOA's would be more time consuming since contracting activities would be required to adhere to normal competitive small purchasing rules and regulations. This process would be stretched out even more if the value of the purchase exceeded $10,000, requiring synopsizing in the CBD.

Because of the reduced lead time involved in utilizing indefinite quantity contracts, it appears that this would be the preferred method of contracting from RAMP parts. But today's increased emphasis on competition causes the validity of this type of contacting to be questioned. Indefinite quantity contracts are usually competed on an annual basis. While this does afford a certain level of competition, it precludes other vendors from obtaining business until the minimum requirements of the indefinite quantity contract have been fulfilled. In the course of a year, it is entirely possible that other contractors would position themselves to become more competitive, offering lower prices and quicker turnaround times on RAMP procurements.

BOAs would ensure competition exists each time a RAMP procurement is made. This method may be more time consuming because of the time constraints involved, but it will ensure RAMP procurements are being made in an extremely competitive environment.

E. SUMMARY

This chapter has discussed two important issues that are of great concern to RAMP management and the Navy contracting community: competition and methods of contracting for RAMP procurements.

The chapter outlined an automated procurement process that could be used as a framework for building a RAMP procurement system. The Navy's APADE system has been under development for many years and holds the potential to revolutionize the way procurement activities do business. Also discussed were the modifications that RAMP would make to current automated procurement systems in order to further reduce the administrative time associated with all procurements. The use of electronic bulletin boards and electronic transfer of design specifications are two functions that are within current technology that would be incorporated by RAMP.

The Competition in Contracting Act of 1984 and the current environment that surrounds defense procurement today have made competitive procurement a necessity. The chapter defined competition and outlined the various dollar thresholds that determine the amount of competition required in making purchases. This section focused on small purchases (under $25,000) since the vast majority of RAMP procurements will fall into this category.

The chapter gave equal coverage to each of the dollar thresholds involved in small purchasing. The requirement to advertise purchases over $5,000 was discussed, as was the requirement to synopsize purchases over $10,000 in the Commerce Business Daily. RAMP procurements will be constrained by these requirements because of the lengthy time periods involved in advertising and synopsizing. Two important points must be stressed concerning this matter. First, most RAMP procurements will not fall into these upper dollar thresholds. Secondly, procedures exist that allow contracting officers to go forward with purchases more expeditiously if the requirement is of an urgent nature. So as can be seen, exceptions to existing policy do exist that will allow RAMP to live within current procurement guidelines.

Lastly, the chapter discussed the two contracting mechanisms that are being advanced by RAMP managers: basic ordering agreements and indefinite quantity contracts. The chapter discussed how these two mechanisms would function and how they would interact with the RAMP program. The chapter closed with a discussion of the competitiveness of these two contracting mechanisms.

V. SUMMARY

A. INTRODUCTION

This chapter answers the research questions set out in Chapter I. It also discusses additional conclusions and recommendations not specifically addressed by the research questions that were formulated during the course of this study, and suggests areas of the study that merit additional investigation.

The research discussed several key issues which are of importance to RAMP management and the contracting community. Areas addressed included:

- Program description and current manufacturing technology.
- How this technology will be made available to industry.
- Programs that might be used to encourage industry investment in the equipment necessary to become a RAMP participant.
- What impact RAMP will have on competitive procurement.
- A description of the RAMP procurement scenario and contract mechanisms that might be utilized in making RAMP procurements.

B. ANSWERS TO RESEARCH QUESTIONS

Subsidiary Question #1. What is the RAMP technology and how will it reduce the need to hold parts in stock? RAMP is a program designed to increase fleet readiness through more efficient production and rapid delivery of spare parts to operating units. The program focuses on research being conducted to adapt existing flexible manufacturing and CAD/CAM techniques to meet the Navy's spare parts production needs. This technology will allow the automated production of a wide range of spare parts including mechanical (machined), electronic (integrated circuits), and electrical parts on demand.

Being able to produce spare parts on demand will permit the Navy to rethink its inventory policies. Increasingly long lead times, diminished sources of supply, and a need for parts out of production have all been problems that have caused the Navy to develop a logistics philosophy that requires a massive spare parts inventory. RAMP, through its capability to rapidly manufacture spare parts, will allow the Navy to reduce the size of its inventories and associated costs.

Subsidiary Question #2. How will RAMP technology be transferred to private industry? Chapter III of this research described a neutrally formatted, public domain computer specification that will provide industry with digitized manufacturing instructions for RAMP parts. This will result in a RAMP data base that can be read and interpreted by virtually any computer system. This specification which is currently being developed by the National Bureau of Standards, is known as IGES. The IGES concept, which is designed to link dissimilar computer systems, centers around two computer programs referred to as pre-processor and post-processor programs. These two programs will translate item definition data from the format utilized by the RAMP database, into the neutral IGES format, and then into the particular format used by the contractor's computer system.

The IGES standard will permit automated manufacturers to utilize their existing machinery and will not require a major investment in any new equipment. The use of this standardized format will help to increase the level of competition in RAMP procurements by ensuring that all manufacturers will have equal access to the RAMP system.

Subsidiary Question #3. What government incentive programs exist today that could be used to encourage business to invest the capital necessary to become RAMP capable? This research identified two methods of encouraging capital investment in equipment that would be utilized by RAMP: the Industrial Modernization Incentives Program (IMIP) and multi-year procurement (MYP). Neither of these programs are aimed at inducing companies to make investments expressly for the purpose of becoming RAMP participants. Instead, RAMP intends to derive its benefits indirectly from capital equipment investments made by contractors and sub-contractors involved in major weapon system procurements.

IMIP and MYP are designed to address two specific problems that are frequently cited as inhibiting investment in productivity-improving equipment. These two problems are: a cost-based profit policy that results in lower fees to contractors as they become more productive, and program instability. IMIP attacks the profit dilemma through the use of incentive agreements that allow the contractor to share in cost savings that result from its productivity improvement investments. MYP encourages investment in new equipment by reducing the instability inherent in conventional annual government contracts. MYP is designed to provide a contractor with a stable business base over the long term, thereby providing incentives to the company to invest in new capital equipment that will result in more cost efficient production.

Subsidiary Question #4. What are the most promising contracting methods which could be used in contracting for RAMP parts? Chapter IV of the research described two contracting methods being considered for use by RAMP management: Basic ordering agreements in association with firm fixed price contracts and indefinite quantity contracts. The research described the two different methods and discussed the pros and cons of each. This researcher encourages RAMP management to utilize BOAs as much as practical and limit their use of indefinite quantity contracts. The current environment in which government procurement exists requires the use of extremely competitive procurement practices. Although indefinite quantity contracts are awarded on a competitive basis, once they go into effect, they can preclude other firms from gaining government business until the minimum quantities established in the contract have been fulfilled.

Establishing BOAs with firms that are likely to have recurring business with the government provides the procuring activity with a means of expediting firm fixed price contracts with these vendors, while at the same time allowing each requirement to be purchased competitively.

Subsidiary Question #5. What are the constraints and limitations placed on contracting methodologies which would affect RAMP procurement? The main limitation that will be placed on RAMP procurements is the requirement to synopsize procurements over $10,000 in the Commerce Business Daily. This requirement, which will add 50 - 55 days additional procurement lead time, runs contrary to RAMP's objective of rapidly contracting for spare parts and will significantly slow the completion of routine RAMP procurements.

Fortunately, the FAR outlines procedures allowing purchasing activities to waive the requirement to synopsize if the procurement is deemed to be an emergency. When these emergent requirements occur, procurement activities may dispense with synopsizing and may take whatever steps deemed necessary to procure the part. Currently, this often results in the issuance of a sole source contract in an effort to expeditiously fill the requirement. Introduction of RAMP's automated procurement system will still not allow contracting activities to synopsize emergent requirements, but it will allow these emergent purchases to be made competitively. RAMP's ability to rapidly interact with vendors via their computers will enable the procuring activity to quickly seek numerous quotations, injecting competition into a process that was often done previously on a sole source basis.

Primary Research Question. What contracting methodology could be utilized for RAMP procurements given the current limitations and constraints found within procurement regulations and manufacturing processes? RAMP program managers expect the vast majority of all RAMP procuremnts to fall well below the small purchase threshold of $25,000, and the average RAMP buy to range in price from $1,500 to $3,000. Thus, this research suggests the adoption of a contracting methodology that incorporates small purchase procedures into an automated procurement system.

The APADE system currently being developed for NAVSUP field procurement activities provides a framework for an automated procurement system that could be expanded and refined to structure the automated RAMP system. The most significant addition to the RAMP system would be the development of an electronic bulletin board that would allow contracting activities to interface rapidly with the contractor, significantly speeding up the procurement process. This electronic bulletin board would permit the automation of such slow, tedious tasks as bid solicitation and collection, contract award notification, and contract document preparation and transmittal.

The combining of this automated procurement system with simplified small purchase procedures provides a contracting methodology that will both meet RAMP's objective of rapidly responding to the requirements while at the same time preserving a competitive contracting environment.

C. ADDITIONAL CONCLUSIONS

Conclusion #1. The technology exists today to ensure RAMP's future. Three unique technologies are being incorporated to form the RAMP system: automated design and manufacturing, a neutrally formatted computer specification, and an automated procurement system. The successful use of CAD/CAM and flexible manufacturing systems by private industry, and NBS's successful production of the oil flinger for the USS New Jersey have shown that technology exists today that will allow the automated production of spare parts. The IGES specification, which will provide a neutrally formatted, universal RAMP data base, is well into its developmental stages. This specification will allow virtually all contractors to access the RAMP data base irrespective of what type of computerized equipment they utilize. Finally, NAVSUP continues to develop an automated procurement system (APADE) that can be utilized as a base for developing RAMP's automated procurement system. The union of these technologies as RAMP will soon provide the Navy with a means of economically producing small lots of spare parts on demand.

Conclusion #2. RAMP will provide a more competitive environment in which to procure spare parts. One of the major thrusts of this thesis has been RAMP's effect on competition.

The research described several efforts that are being made by RAMP management to ensure RAMP procurements are being made in a competitive environment. The automated procurement system described in Chapter IV will enhance competition by allowing prospective bidders easier access to IFB's. This will be achieved through the use of electronic bulletin boards as a means of advertising these procurement actions. The use of such electronic advertising is expected to heighten the level of competition by obtaining larger numbers of quotations on individual contract actions, and by allowing emergent requirements that must currently be procured on a sole source basis to be bought competitively. Another feature of RAMP that will foster competition is the system's ability to generate design specifications in either digitized or hard copy formats. This will afford contractors of varying degrees of automation equal opportunity to bid on and win RAMP contracts. Finally, RAMP will utilize IGES, a neutral specification that will permit all automated contractors to interface with the RAMP data base.

Conclusion #3. <u>RAMP will help to control the prices paid for spare parts</u>. The 1986 Defense Authorization Act outlined several management deficiencies that have in the past resulted in DOD paying unreasonably high prices for spare parts. RAMP is designed to directly attact and resolve several of these problems.

(1) "Some parts have been purchased in very small and thus highly uneconomical quantities." RAMP addresses this

problem through the utilization of automated machining systems that will allow small order quantities. One of RAMP's main objectives is to reduce the size of economic order quantities, ideally to an order size of one.

(2) "Some parts have not been purchased directly from the manufacturer and thus the government has unnecessarily paid an additional profit to the seller." The RAMP data base will contain a listing of contractors capable of manufacturing each part. This will allow procuring activities to "break out" spare parts, i.e., go directly to the manufacturing source when a need arises, and eliminate the need to work through systems integrators as has been done in the past.

(3) "Some parts have not been purchased through a competitive process." Conclusion #2 of this research addressed this problem. RAMP's ability to directly interface with contractors will increase competition and eliminate the need for procuring emergent requirements on a sole source basis.

D. RECOMMENDATIONS

Recommendation #1. <u>RAMP must be integrated into the early stages of the major weapon system acquisition planning process</u>. One goal of RAMP is to ensure component parts of new weapons are RAMP designated early in the acquisition process. To ensure this goal is met, program managers must be made acutely aware of the benefits of the RAMP program. As defense contractors expand their use of CAD/CAM in designing and manufacturing weapon system components, the opportunity will exist to capture this design data and digitized manufacturing instructions and enter it into the RAMP data base. This will permit logistics planners to take into account early in the system's planning stages the fact that certain spares are RAMP designated, and will allow them to plan their initial provisioning and stocking policies accordingly. Implementing this policy will have a positive influence on life-cycle costs, effectively reducing inventory levels and manufacturing costs of RAMP designated parts.

Recommendation #2. Incentives must be provided to the lower tiers of the industrial base to encourage capital investment in automated manufacturing equipment that can be utilized by RAMP. Since RAMP intends to utilize all levels of the industrial base in manufacturing spare parts, it is important that additional capital investment incentives be provided to lower tier subcontractors and vendors. This goal can be accomplished through more extensive use of IMIP and MYP with subcontractors, and will require additional effort on the part of program managers and contracting officers to ensure major weapon system integrators offer these incentives to their subcontractors.

A new IMIP strategy, the "industry" approach, may also hold promise as a means to reach these lower level manufacturers. This strategy, which was briefly described in Chapter III, would target an entire sector of the industrial base, e.g., travelling wave tubes, forgings, etc., and would result in the government directly entering into IMIP agreements with these small subcontractors and vendors. Use of this IMIP strategy is just an idea at this point, but the method warrants further consideration since the strategy may greatly influence the recapitalization of this depressed sector of the industrial base that RAMP will need to utilize.

E. ADDITIONAL AREAS OF RESEARCH

This study has been restricted to key management issues that are of concern to the contracting community. In compiling this thesis, the research has identified two areas that were beyond the scope of the study but would benefit from further investigation.

The first areas is further investigation into the "industry" approach to IMIP. Industry IMIPs would result in the government directly providing incentives to an entire industry sector such as small spare parts vendors. As this research identified, these lower tier members of the industrial base rarely benefit from IMIP program unless they are involved as a sub-contractor on a major weapon system project. This new approach to IMIP might provide incentives to small specialty houses and "job shops" who are strictly involved in spare parts business to invest in automated equipment that could be utilized by RAMP. Additional study is needed to determine if these agreements could work, and if so, what is the best way to institute them with vendors and small sub-contractors.

The other major area identified requiring further study is the applicaiton and use of the electronic bulletin board. The institution of such a system will have a very positive influence, not only on RAMP but on all aspects of government procurement. Electronic systems similar to this are now commonplace in American business. Further study should concentrate on adapting and refining the systems already in use by industry for use by the government and more specifically by RAMP.

LIST OF REFERENCES

1. Elwood, R. E., Rapid Acquisition of Manufactured Parts, Naval Supply Systems Command, 19 April 1985.

2. Hendrick, T. E., and Moore, F. G., Production/Operations Management, Richard D. Irwin, Inc., 1985.

3. Gunn, T. G., "The Mechanization of Design and Manufacturing," Scientific American, Vol. 247, No. 3, September 1982.

4. Hendrick, Moore, Production/Operations Management.

5. Adkins, L., "FMS Creates a Sci-Fi Factory," Dun's Business Month, Vol. 125, No. 3, March 1985.

6. The Charles Stark Draper Laboratory, Inc., Parts on Demand: Manufacturing Technology and Technology Transfer Assessment, 1983.

7. NAVSUP, RAMP Program Plan Summary, August, 1985.

8. McDonnell Douglas Corporation, Product Definition Data Interface, February, 1984.

9. DOD, Defense Financial and Investment Review, 1985.

10. Raney, Terry, "Multi-Year Procurement to Promote Defense Industry Investment," Program Manager, Vol. 12, No. 1, January-February, 1983.

11. OSD, "DOD Industrial Modernization Incentives Program Guide," (Proposed Draft) 5000.XX, August, 1985.

12. OSD, "DOD Industrial Modernization Incentives Program Guide," (Proposed Draft) 5000.XX-G, August, 1985.

13. General Dynamics Corporation, F-16 Modernization Contracting and Business Arrangement, 1983.

14. ODSD, Status Report, Industrial Modernization Incentives Program, 1985.

15. Defense Systems Management College, Acquisition Strategy Guide, July, 1984.

16. Fromer, H. S., and Sweeney, J. C., "Multi-Year Procurement, A Team Approach," Proceedings of the 1983 Acquisition Research Symposium, December 1983.

17. FMSO, Automation of Procurement and Accounting Data Entry System, 21 June 1985.

18. Elwood, R. E., telephone interview, October 1985.

19. Naval Supply Center, Oakland, CA., Elements of Competitive Buying and Sole Source Procurement, 1982.

20. DOD, GSA, NASA, Federal Acquisition Regulation, April 1985.

21. Nicholas, G. T., "Paperless Solicitation and Contracting," Proceedings of the 1983 Federal Acquisition Symposium, December 1983.

INITIAL DISTRIBUTION LIST

		No. Copies
1.	Defense Technical Information Center Cameron Station Alexandria, Virginia 22304-6145	2
2.	Library, Code 0142 Naval Postgraduate School Monterey, California 93943-5002	2
3.	Defense Logistics Studies Information Exchange U.S. Army Logistics Management Center Fort Lee, Virginia 23801	1
4.	Department Chairman, Code 54 Department of Administrative Sciences Naval Postgraduate School Monterey, California 93943-5004	1
5.	LCDR R. W. Smith, Code 54Sx Department of Administrative Sciences Naval Postgraduate School Monterey, California 93943-5004	1
6.	Professor J. W. Creighton, Code 54Cf Department of Administrative Sciences Naval Postgraduate School Monterey, California 93943-5004	1
7.	Dr. R. E. Elwood PML 5505M1 Naval Supply Systems Command Washington, D.C. 20376	2
8.	LCDR Michael M. Darby 50 Fairgreen Avenue New Smyrna Beach, Florida 32069	2
9.	Professor D. V. Lamm, Code 54Lt Department of Administrative Sciences Naval Postgraduate School Monterey, California 93943-5004	5

END

FILMED

4-86

DTIC