REPORT OF SURVEY CONDUCTED AT

AUTO-VALVE, INC.
DAYTON, OH

OCTOBER 2003

Best Manufacturing Practices

1998 Award Winner

INNOVATIONS IN AMERICAN GOVERNMENT

BEST MANUFACTURING PRACTICES CENTER OF EXCELLENCE
College Park, Maryland
www.bmpcoe.org

Foreword

This report was produced by the Office of Naval Research's Best Manufacturing Practices (BMP) Program, a unique industry and government cooperative technology transfer effort that improves the competitiveness of America's industrial base both here and abroad. Our main goal at BMP is to increase the quality, reliability, and maintainability of goods produced by American firms. The primary objective toward this goal is simple: to identify best practices, document them, and then encourage industry and government to share information about them.

The BMP Program set out in 1985 to help businesses by identifying, researching, and promoting exceptional manufacturing practices, methods, and procedures in design, test, production, facilities, logistics, and management – all areas which are highlighted in the Department of Defense's 4245.7-M, *Transition from Development to Production* manual. By fostering the sharing of information across industry lines, BMP has become a resource in helping companies identify their weak areas and examine how other companies have improved similar situations. This sharing of ideas allows companies to learn from others' attempts and to avoid costly and time-consuming duplication.

BMP identifies and documents best practices by conducting in-depth, voluntary surveys such as this one at Auto-Valve, Inc. conducted during the week of October 27, 2003. Teams of BMP experts work hand-in-hand on-site with the company to examine existing practices, uncover best practices, and identify areas for even better practices.

The final survey report, which details the findings, is distributed electronically and in hard copy to thousands of representatives from industry, government, and academia throughout the U.S. and Canada – *so the knowledge can be shared*. BMP also distributes this information through several interactive services which include CD-ROMs and a World Wide Web Home Page located on the Internet at http://www.bmpcoe.org. The actual exchange of detailed data is between companies at their discretion.

Auto-Valve, Inc. manufactures quality valves and components for fuel systems used by aircraft manufacturers and is ISO 9001 and AS9100 certified. Its facilities include a complete machining, assembly, testing, engineering, and research development center. Among the best examples were Auto-Valve's Product Improvement Team, Manufacturing Resource Planning System, Tool Crib/ Purchasing, and Electronic Data Management.

The BMP Program is committed to strengthening the U.S. industrial base. Survey findings in reports such as this one on Auto-Valve, Inc. expand BMP's contribution toward its goal of a stronger, more competitive, globally-minded, and environmentally-conscious American industrial program.

I encourage your participation and use of this unique resource.

Anne Marie T. SuPrise, Ph.D.

Contents

Auto-Valve, Inc.

Contents (Continued)

Auto-Valve, Inc.

Figures

Auto-Valve, Inc.

Section 1

Report Summary

Background

Located in Dayton, Ohio, Auto-Valve, Inc. (AVI) was founded in 1947 by A. C. Bacus to manufacture quality valves and components for fuel systems used by aircraft manufacturers. The earlier valves were used primarily to drain water condensation from fuel tanks. The company has since grown to approximately $5M in annual sales and is presently qualified to manufacture more than 5,000 different valves. Currently, AVI continues to manufacture fuel system valves, but the company's expertise and product lines have expanded over the years to include oil, hydraulic, water, and air system valves and assemblies.

Customer satisfaction is key to AVI's success. The company boasts on-time delivery of more than 99%, and a product return rate from its customers of less than 1%. All valve assemblies undergo a stringent 100% functional testing and certification process. The company's philosophy is that product safety and performance are most important in satisfying customers' needs.

The valve systems designed and manufactured by AVI are used in more than 75% of all commercial aircraft manufactured in the United States, and in more than 98% of all military aircraft. Many of AVI's products are used in foreign-built aircraft. AVI is ISO 9001 and AS 9100 certified, and plans to submit an application for the Malcolm Baldridge Award in 2004. AVI's facilities include a complete machining, assembly, testing, engineering, and research and development center. AVI utilizes its unique Manufacturing Resource Planning system to its fullest capabilities. The system enables the company to carry a complete stock of components used in final assemblies while not maintaining on-hand inventory of finished goods. All of AVI's on-hand parts are sold prior to manufacture. Because many of the parts are used on various assemblies, AVI can have more than 3,000 different part numbers on-hand at any given time, and the quantity of these part numbers can be more than two million pieces. The scheduling module of the Manufacturing Resource Planning system allows AVI to perform detailed part scheduling based on sold material on-hand and next need date for more piece parts. By having control of on-hand materials, AVI eliminated the need for yearly inventory counts and reconciliation.

The company maintains a philosophy of continuous improvement, and with the innovation and dedication of all employees, has succeeded in eliminating waste in daily activities. AVI's employees have a stake in the future success of the company and constantly strive to improve their areas of impact. AVI's development and implementation of its Product Improvement Team, Supplier Review Program, Electronic Data Management, and Employee Training Program have enabled the company to quickly respond to changing aerospace demands. The BMP survey team considers the practices in this report to be among the best in industry and government.

Point of Contact:

For further information on items in this report, please contact:

Mr. Robert Hale
Operations Manager
Auto-Valve, Inc.
1707 Guenther Road
Dayton, Ohio 45427
Phone: (937) 854-3037
Fax: (937) 854-3039
E-mail: haleb@autovalve.com
Web Site: www.autovalve.com

Section 2

Best Practices

Design

Product Improvement Team

Auto-Valve, Inc. takes a proactive approach to identifying and correcting design issues that affect product performance, cost, schedule, and customer satisfaction with its Product Improvement Team process. The Product Improvement Team process uses a formalized Design Review Process to capture and keep data organized and to optimize the Product Improvement Team's overall effectiveness.

Auto-Valve, Inc. (AVI) takes a proactive approach to identifying and correcting design problems that affect product performance, cost, schedule, and customer satisfaction with its Product Improvement Team (PIT) process. The PIT process supplements AVI's current Continuous Improvement Program (CIP) and uses a formalized Design Review Process to optimize its overall effectiveness.

Typically, product design improvements are driven by internal requirements that make the product more producible to reduce cost, increase performance, and improve reliability and safety. Other improvements that address a specific problem or a unique specification requirement may be customer driven. In the past, AVI's PIT only addressed customers' concerns to get assemblies shipped, usually resulting in quick fixes. Design changes and approval were limited to the Engineering and Operations managers with no input from other employees. Product design improvements in addressing internal requirements were reactive, not proactive. Often, opportunities for product improvements that impacted the company's bottom line fell by the wayside. The standard practice was to make design changes only if there was a failure or a product return.

For many reasons and to meet the criteria for AS 9100 certification, AVI formalized its PIT process. In doing so, the company discovered the benefits of improving the PIT process and making it more proactive in serving the design improvement needs of the company and its customers. In April 2002, the new process was implemented incorporating AVI's Design Review Process to optimize overall effectiveness. The Design Review Process collects product requirements, establishes design verification and validation plans, defines design change requests and evaluations, and documents design review updates, meeting guidelines, and meeting records. All contribute to the overall effectiveness of the PIT process to capture necessary data and keep it organized, something that was overlooked in the past. The PIT is cross-functional. The process and monthly meetings include Quality Assurance, Engineering, and Operations. Each design improvement opportunity is now an entry into the Design Review Process and is tracked through completion.

The PIT, better known internally as the "PIT Bulls," follow a well thought out and executable process. The PIT is now more proactive in identifying and correcting design problems that improve the product performance, cost, and schedule, enabling AVI to be more responsive to customer concerns. Since implementing PIT, all departments have become involved, customer service and product acceptance have increased, and product returns have decreased.

Production

Computer Numeric Control Programming

Auto-Valve, Inc. uses a standardized Computer Numeric Control programming interface which allows operators to program all machines. The operators receive ownership of the Computer Numeric Control process, which results in a more refined program, simplified operations, less special tooling, and low start-up costs.

To program Computer Numeric Control (CNC) machines, Auto-Valve, Inc. (AVI) used the system of "tribal knowledge," where the shop manager programmed the CNC machines as needed. This left the operators with a lack of understanding of the CNC software. Moreover, edits became an onerous task because of the lack of the operator's knowl-

edge. Without the operator's full programming control, parts were made in a single, inefficient operation with multiple tools and fixtures, and frequent disagreements on methods and tooling. This resulted in high start-up costs for new parts, which discouraged more complex designs. In 1999, AVI proved only 78 new programs.

Now, AVI has standardized the CNC programming function. Operators are certified to program all machines using the Mazatrol Conversational control, and all programming is done on the shop floor. When it is time to generate the CNC program, the operator writes the program, selects the tools, contributes to process planning, edits, and suggests process improvements. The results have been simplified operations and less special tooling. Because the operator now has ownership of the CNC process, morale is high and process improvements are continuous. New program start-up costs are considerably lower, and customer requirements are often exceeded. In 2003, AVI proved 350 new programs — a 349% increase since 1999.

Manufacturing Resource Planning System

Auto-Valve, Inc. reduced the number of people required for production planning and improved delivery performance to more than 99% with the implementation of its Manufacturing Resource Planning system.

Prior to 1999, Auto-Valve, Inc. (AVI) did not have a manufacturing planning system other than DOS-based accounting software. Annual inventory counts, which consisted of approximately 3,000 different part numbers with a total part count of approximately two million pieces, were performed manually. Process control and documentation controls did not exist, except for the bills of material and manufacturing costs. The burden rate could not be collected for the shop. Manual scheduling was used based on estimates rather than historical data from actual orders, resulting in excess and obsolete inventory. From 1995 to 1998, on-time delivery performance declined annually from 75% to 65%.

In 1999, AVI implemented Industrios' Manufacturing Resource Planning (MRP) software to help solve some of the existing problems. The total cost of this system, including software, training, and customization, was approximately $100,000. The use of the MRP software eliminated the manual inventory counts (other than spot-checks by the Quality department) and detailed process planning. The MRP system contains raw material requirements and automatically generates requisitions, which can be turned into purchase orders with a click of the mouse. Job cost summaries and work-in-process costs are readily available. The production scheduling module allows detailed part scheduling to occur based on specific time periods, eliminating the production of unwanted inventory. Only parts that are required for sold orders are produced and put into stock. On-time delivery performance for AVI is over 99%.

Supplier Review Program

Auto-Valve, Inc. implemented the quality program, AS 9100, and developed a Supplier Review Program to meet the requirements. The Supplier Review Program provides significant benefits in quality and delivery improvements and cost reductions.

Prior to implementing the Aerospace Standard, AS 9100, Auto-Valve, Inc. (AVI) neither tracked supplier data nor had performance criteria for suppliers. Quality requirements were not being passed down to the suppliers, nor were expectations and feedback being communicated. There were no alternative suppliers identified when the original supplier could not deliver parts. Price increases were being accepted as unavoidable, and suppliers were not held to delivery schedules. AVI was unable to meet any of the ISO/AS requirements.

In March 2003, AVI implemented its Supplier Review Program to meet AS 9100 quality system requirements. Suppliers are audited bi-annually, and from data continuously collected, they are rated on quality, delivery, and cost. Quality requirements are passed down to all suppliers, and feedback is provided through annual ratings and audits. Suppliers are rated on a weighted scale of 40% for quality, 40% for delivery, and 20% for price. In order to remain an AVI supplier, a rating of at least .80 must be maintained. Those not maintaining the .80 rating must provide written corrective action and prove that the corrective action is being followed through the audit process. A database of alternative suppliers is maintained for potential problems. Prices are negotiated for a one-year period and, since suppliers are being held accountable for delivery sched-

ules, delivery is quicker and more reliable. With the implementation of the Supplier Review Program and AS 9100, the number of AVI's suppliers has been reduced from more than 350 to 91.

Tool Crib/Purchasing

Auto-Valve, Inc. converged its tool crib replenishment and purchasing functions into one function utilizing Dayton Supply and Tool Company's integrated Cribware software. This process allowed the number of purchase orders to be cut in half, and tooling and supply costs to be reduced approximately 25%.

Prior to implementing AS 9100, Auto-Valve, Inc. (AVI) had more than 350 suppliers, resulting in an average of 1,200 purchase orders being processed annually with seven days processing time per purchase order. Between 1997 and 2000, supply costs rose with increases of about 16% (Figure 2-1). Dedicated purchasing, inventory management, and

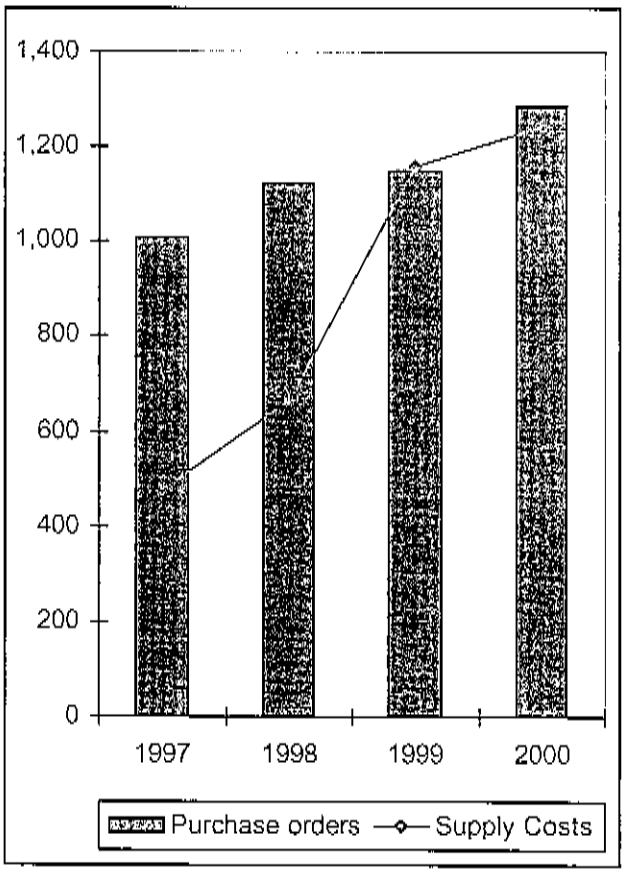


Figure 2-1. Tool Crib/Purchasing - Previous Conditions

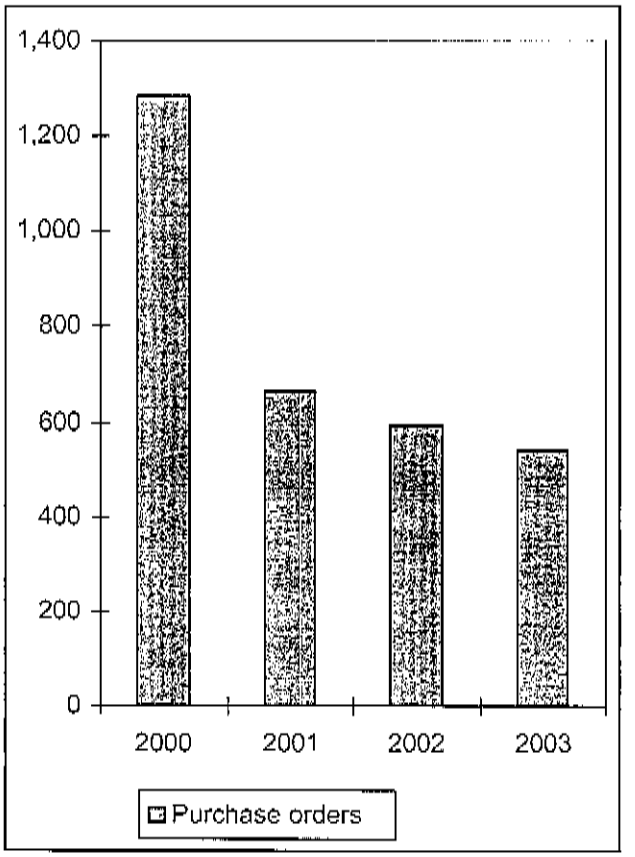


Figure 2-2. Tool Crib/Purchasing - Current Conditions

scheduling positions were required to complete each task. The system failed to provide performance metrics and track price variations. Because of its size, AVI lacked technical support from tooling manufacturers.

During mid-2000, AVI entered into an integrated supply agreement with Dayton Supply and Tool Company (DST), which included the installation and maintenance of Cribware software to control inventory supply and document the tooling requirements associated with specific jobs. DST provided the software, user training, and system implementation, and worked with AVI to update its existing tooling database, barcode the tooling inventory, and streamline its purchasing process.

Since implementation of the Cribware software, AVI's vendor base has narrowed to 91 suppliers. The company now processes an average of 600 purchase orders annually (Figure 2-2). The software also provides vendor performance metrics and a supplier database, and affords AVI the opportunity to negotiate fixed prices at the beginning of the year. There

is no longer the need for dedicated purchasing, inventory, and scheduling positions, thus only one detailed invoice is received each month. AVI leverages its relationship with DST to receive manufacturer technical support and new product demonstrations. This process allowed the number of purchase orders to be cut in half, and tooling and supply costs to be reduced approximately 25%.

DST's Cribware software provided tool-tracking capability and enabled AVI to identify usage by department, task, and work center. This led to a significantly reduced expendable cost per manufacturing hour and improved job estimating capability. The integrated software platform and purchasing agreement resulted in significant savings for AVI.

Management

Continuous Improvement Program

Auto-Valve, Inc. (AVI) implemented a Bucks for Betterment process to improve its Continuous Improvement Process by recognizing employee participants. This process significantly increased employee involvement to more than 90%, resulting in improvements in products, safety, and processes.

Auto-Valve, Inc. (AVI) has had a formalized Continuous Improvement Process (CIP) since 2001. In the early stages of the CIP, employees were encouraged to submit ideas that could improve an area of the workplace, but because of the lack of recognition from management (rewards or feedback), only a few employees were involved in the CIP. Changes were implemented only if they addressed a major problem or violation. In 2002, AVI identified the need to improve its CIP by recognizing employee participants, and implemented a Bucks for Betterment (B4B) process.

Employees now submit ideas on a completed B4B form to their managers. The B4B administrator enters the ideas into a database for control and tracking while the manager determines the feasibility and cost/benefit of the suggestion. The suggestions approved by managers are discussed at monthly B4B team meetings and then implemented. The team consists of five employees (department representatives) and two senior staff members. The B4B team selects noteworthy suggestions highlighted at prize drawings. Two $100.00 prize drawings are held monthly based on the number of entries and employees. A third drawing for $100.00 is held if 90% or more of the employees participate.

The B4B process has enabled AVI to significantly increase employee involvement to more than 90%, resulting in improvements in products, safety, and processes. An overwhelming number of suggestions include process improvements. Because of product improvement in manufacturability and reliability since implementation of the B4B program, customer returns have decreased by approximately 80%. The 13.5% of cross-functional suggestions has encouraged interaction between departments.

Electronic Data Management

With Electronic Data Manager, Auto-Valve, Inc. can locate any drawing in minutes. By providing quicker quote turn-around and reducing time to market, the company has improved supply chain responsiveness and won new business.

Since 1947, Auto-Valve, Inc. (AVI) has been designing and manufacturing quality valves and components required by military and commercial aircraft. Over time, the company accumulated more than 5,000 designs, of which 2,800 were qualified valve assemblies. Each year the company produced 400 to 500 different valve assemblies and introduced new valve assemblies. Early valve assemblies were designed and documented using 2-D board drawings. Later, AVI used AutoCAD 3-D drawings. Currently the company uses 3-D Solid Works Modeling for designs. As software evolved from 2-D drawings to 3-D Solid Modeling, the need for good model management became evident as designers struggled to retrieve design documentation. Considering that each part within an assembly undergoes change over time, the CAD designer must assign revision levels to the parts, and decide if the revision merits changing the parts list for upper level assembly. In some cases, the revisions force updates to multiple drawings in the documentation set. The updates to the revised part create challenges for the design team in modifying the part-naming scheme to include various part revisions. Revisions must be archived to keep track of the various revised parts. Revisions complicate the management of 3-D files and the thorough tracking of the revisions.

Prior to implementation of the Electronic Data Manager, AVI manually performed configuration management. No comprehensive search capability existed to retrieve drawings produced from three

separate systems — 2-D board drawings, 3-D AutoCAD, and 3-D Solid Works Models. The older drawings did not carry revision data; therefore, history was lost, or at least difficult to rebuild. As a result, the retrieval of specific drawings and their revisions from the vast repository of design documents was time consuming and costly. The introduction of new designs was often met with the inability to take advantage of reusing old designs and avoiding quality testing. AVI implemented the Electronic Data Manager in June 2001 and began organizing and consolidating the entire repository of valve assemblies and component drawings, regardless of which system was used to generate them over the years. AVI employed the SmarTeam File Manager, Version 4.0 Service Pack 6 software, which has a strong file management component with searchable attributes. This software allows automatic revision management, keeps the latest release version in tact, and allows more than one person to work on the same part, but informs the user if someone else is working on a design. This approach makes data easy to find and permits the reuse of models to avoid recreating what already exists.

As a result of the Electronic Data Manager, AVI's design process has been streamlined, and the company has gained greater efficiency for future design projects. Drawings can be located in minutes, increasing responsiveness to customers in quoting and production start-up. The electronic search capability has optimized AVI's re-use of parts for new designs, which has reduced design time and quick quote turn-around and has improved responsiveness to the customer. During the past year, AVI doubled the number of quotes from the previous year. AVI plans to integrate the Electronic Data Manager with the company's Manufacturing Resource Planning (MRP) system.

Employee Training Program

Auto-Valve, Inc. implemented an Employee Training Program enabling employee involvement to significantly increase to 100%.

For many years, Auto-Valve, Inc. (AVI) had only a few employees who requested and ultimately received training. This was primarily because of AVI's lack of a training budget. Many AVI orders fell behind schedule from the lack of cross-training. The company identified the need to set aside a training budget for all employees.

In 2002, AVI implemented a formalized employee training program that met ISO 9000:2000 and AS 9100 certification requirements. The training schedule is based on company, customer, and employee needs. All employees, based on their job description, must fulfill a designated amount of training. AVI also focuses on cross-training to allow employees to understand other work areas. All employees have a quarterly training review with their managers where they are rated by skill based on the requirements of the job description. Employees are expected to obtain a rating of 80% or higher; if the rating is lower, the managers assign more training for that particular skill. AVI also encourages employees to obtain a Bachelor's or Master's Degree that is related to their job. If the degree is relevant, the company pays 100% of the tuition, depending on the type of university and grade attained. AVI's owner makes the final decision in determining if an employee is eligible for such training.

AVI's Employee Training Program has increased employee involvement to 100%. Employees average 70 hours of training per year, which exceeds the company's goal by 30 hours. By cross-training, choke points at work areas including shipping, testing, and customer service can be prevented by having several qualified employees.

New Project Review

Auto-Valve, Inc. implemented a New Project Review process that optimizes the quality of response and response time turn-around to existing and potential customers. The process of identifying leads, following-up on quotes and contracts, and accepting orders has been streamlined and is now seamless as a result of well executed tracking and communications tools.

Obtaining work orders is a serious business for Auto-Valve, Inc. (AVI), and responding to existing and potential customers is a top priority. The process of identifying leads, following-up on quotes and contracts, and accepting orders has been streamlined and is now seamless as a result of a well executed New Project Review process that optimizes the quality of response and response time turn-around.

Most orders originate from existing customers but may contain new requirements that must be reviewed and engineered, and new quotes established. However, potential new orders can result from new

customers requiring off-the-shelf designs and/or new designs. Whether the orders are existing or potential, they are treated as new leads and executed with the New Project Review process. Prior to 2001, the tasks of following-up on new leads, providing quotes, establishing contracts, and accepting orders were managed by the Sales Manager. All information from the customers regarding production definition, specifications, quantities, and schedules traveled through a single point source, the Sales Manager, who in turn routed the tasking to various departments within AVI. In a small company, this process becomes a problem when one person is the single throughput source for disbursement. As a result, updates and responses to customers could be delayed for weeks. At times, there was not even a follow-up. Only a few new customers and projects actually developed into orders.

In 2001, AVI's goal was to respond to all possible opportunities for orders regardless of whether they were existing or potential customers. All new leads are now entered on an Excel spreadsheet where the customer, project name, and requirement descriptions are listed. Each entry also lists the customer's key point of contact for a specific project, and assigns the project owner within AVI who is responsible for follow-up. The spreadsheet contains an information column denoting action items for each project, another column listing a promise date (if established), and a final column for internal notes. Only the Sales Manager enters the data; however, all managers and the AVI President have access to view the spreadsheet. Bi-weekly summary updates are distributed internally. A New Valve Definition form was employed for use with each project to capture salient features of potential orders (e.g., valve functional description, method of operation, outside envelope dimensions, operating fluid). This form serves as an excellent communication tool between AVI and the customer to ensure all features have been identified and both parties have communicated properly. Customers now communicate directly with AVI's Quality, Contracts, Operations, and Engineering Managers without the requirement of going through the Sales Manager, thus eliminating the choke point that once existed.

As a result of AVI's New Project Review process, all opportunities to follow-up on new leads for potential orders receive immediate and thorough attention. Management and project owners know the exact status of each project in the review cycle and what actions are required. Better up-front information is extracted and conveyed from the customer to AVI, which has contributed to faster response and quote turn-around times. Additionally, the number of projects quoted in 2003 has increased by 30%, and six new customers and two new markets have been added.

Section 3

Information

Design

Three Dimensional Modeling

Auto-Valve, Inc. implemented a 3-D software called Solid Works, which has decreased the time to design and redesign valve assemblies.

Auto-Valve, Inc. (AVI) produces 400 to 500 different valve assemblies per year, with about 30% of these assemblies consisting of design changes. AVI previously made these changes using AutoCAD, a 2-D drawing software, which required engineers to make changes to all of the different views and sections of an assembly. In 2000, AVI acquired Solid Works, a 3-D modeling software that alleviated the time consuming task the engineers previously experienced.

AVI imported its AutoCAD drawings into the Solid Works software and created 3-D models. The models contain features showing the relationship to other parts. When changes are made in one, all other views and sections are automatically updated. Solid Works has two incorporated software tools: COSMOS and eDrawing. COSMOS is used to perform Finite Element Analysis on 3-D models, while eDrawing allows users to e-mail 3-D models to customers. The e-mailed files contain animated 3-D models with options to stop an animation or rotate a model. These files can be used to conduct design reviews with the customer over the phone. Solid Works can also be used in conjunction with the File Manager software, SmarTeam. AVI uses SmarTeam to manage all of its valve assembly drawings and revisions. The files in SmarTeam contain scanned assembly images, AutoCAD drawings, and Solid Works models.

Since Solid Works was implemented, AVI has created 20% more valve assembly drawings per week, increasing efficiency and decreasing the time needed to design and redesign assemblies, resulting in faster customer response turn-around time.

Production

Process Planning System

In 2000, Auto-Valve, Inc. implemented an effective Process Planning System, which helped the company earn ISO/AS certification and decreased set-up costs approximately 25% annually.

Auto-Valve, Inc.'s (AVI's) former process planning system lacked job pre-planning, cost estimates, capacity requirements, and process and/or program documentation. The company used a system of "tribal knowledge" where the seasoned operator created the process and then taught other operators. Often fixtures and special tooling were misplaced, duplicated, or simply forgotten. Most employees were excluded from this planning process, and operators were discouraged from providing feedback for improvement. This resulted in poor direct labor ratios (machine hours to labor hours) of approximately 60% and a costly set-up process which increased annually.

AVI's current Process Planning system was implemented in 2000 and has proven very effective. It is linked to the company's Manufacturing Resource Planning (MRP) system. All jobs are pre-planned for manufacturability and special tooling. Documentation is included in all processes, programs, tool packages, and fixtures. Job boxes are used for special tooling and fixtures for easy reference. The system provides data for accurate cost estimates and capacity planning. The responsibility of the operators has also changed, involving them in process planning and execution. Operators may choose tools, program machines, and suggest improvements. AVI's Process Planning system helped the company realize a direct labor ratio of more than 100%, a more efficient labor force, and decreased set-up costs.

Stockroom/Inventory Management

Auto-Valve, Inc. implemented a Manufacturing Resource Planning system that has provided control of the company's inventory for a better organized stockroom.

Previously, Auto-Valve, Inc.(AVI) did not have adequate control over parts in its stockroom. Parts were randomly stored by category in an unsecured area. Springs were stored with other springs, fittings were stored with other fittings, and mixed parts were a frequent occurrence. An assembly's bill of material did not document the quantities of each part required, which meant that the assembly drawing had to be pulled to determine how many parts were required for a kit. Elastomers were not tracked for age, and parts were not identified to the batch from which they were produced. Families of parts were not grouped, and obsolete parts were not identified.

In 1999, AVI implemented a Manufacturing Resource Planning (MRP) system, which facilitated the organization of parts in the stockroom. Parts are now stored in a secured facility, arranged numerically by part number, and segregated to avoid mix-ups. Quantities on the bill of material are automatically generated by the MRP system, and elastomers have a process for age control. The part batch is identified on a stock card and kept in the stockroom to allow tracking of problems to the correct batch. Obsolete parts are continuously identified and removed from the stockroom.

Implementation of the MRP system allowed AVI to gain control of its parts inventory and reduced the size of its stockroom by a factor of three. In addition, the need for yearly inventory counts has been eliminated.

Appendix A

Table of Acronyms

ACRONYM	DEFINITION
AVI	Auto-Valve, Inc.
B4B	Bucks for Betterment
CIP	Continuous Improvement Program
CNC	Computer Numeric Control
MRP	Manufacturing Resource Planning
PIT	Process Improvement Team

Appendix B

BMP Survey Team

Team Member	Activity	Function
Don Hill 317-849-3202	**BMP Field Office-Indianapolis** Indianapolis, IN	**Team Chairman**
	TEAM A	
Larry Halbig 317-891-9901	**BMP Field Office-Indianapolis** Indianapolis, IN	**Team Leader**
Izlay Mercankaya 909-273-4123	**Naval Surface Warfare Center-Corona** Corona, CA	
	TEAM B	
Larry Robertson 812-854-5336	**Naval Surface Warfare Center-Crane** Crane, IN	**Team Leader**
Brock Christoval 909-273-5589	**Naval Surface Warfare Center-Corona** Corona, CA	

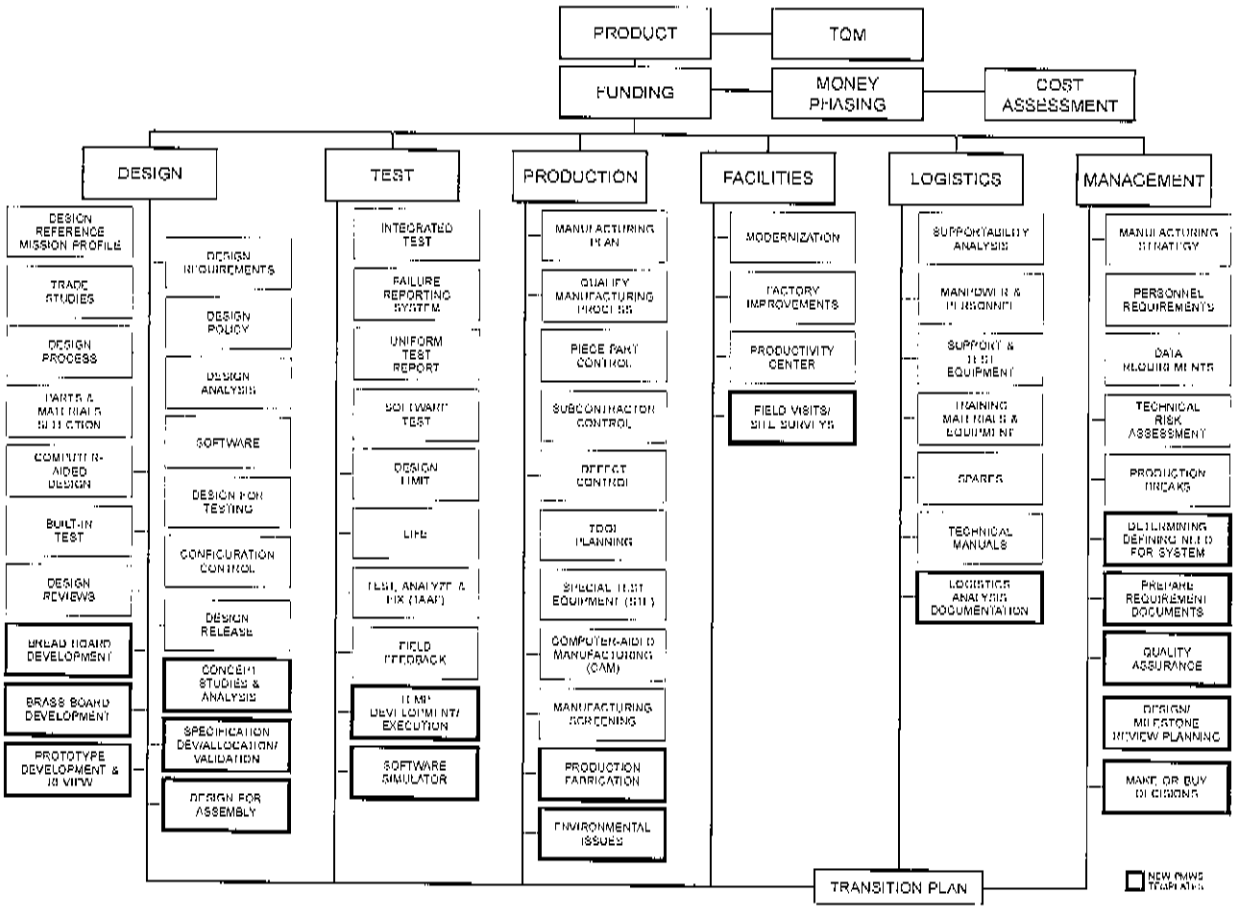
Appendix C

Critical Path Templates and BMP Templates

This survey was structured around and concentrated on the functional areas of design, test, production, facilities, logistics, and management as presented in the Department of Defense 4245.7-M, Transition from Development to Production document. This publication defines the proper tools or templates that constitute the critical path for a successful material acquisition program. It describes techniques for improving the acquisition process by addressing it as an industrial process that focuses on the product's design, test, and production phases which are interrelated and interdependent disciplines.

The BMP program has continued to build on this knowledge base by developing 17 new templates that complement the existing DOD 4245.7-M templates. These BMP templates address new or emerging technologies and processes.

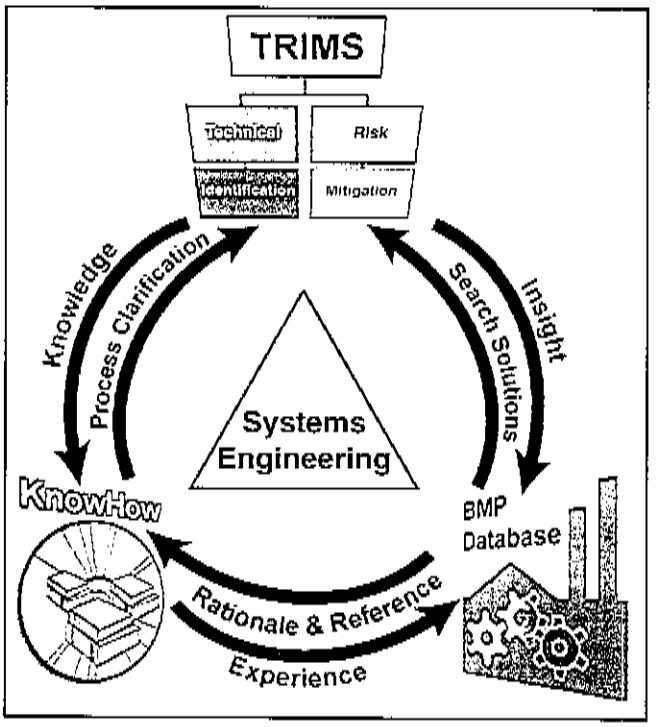
"CRITICAL PATH TEMPLATES FOR TRANSITION FROM DEVELOPMENT TO PRODUCTION"



Appendix D

The Program Manager's WorkStation

The Program Manager's WorkStation (**PMWS**) is an electronic suite of tools designed to provide timely acquisition and engineering information to the user. The main components of PMWS are KnowHow; the Technical Risk Identification and Mitigation System (TRIMS); and the BMP Database. These tools complement one another and provide users with the knowledge, insight, and experience to make informed decisions through all phases of product development, production, and beyond.



KnowHow provides knowledge as an electronic library of technical reference handbooks, guidelines, and acquisition publications which covers a variety of engineering topics including the DOD 5000 series. The electronic collection consists of expert systems and simple digital books. In expert systems, KnowHow prompts the user to answer a series of questions to determine where the user is within a program's development. Recommendations are provided based on the book being used. In simple digital books, KnowHow leads the user through the process via an electronic table of contents to determine which books in the library will be the most helpful. The program also features a fuzzy logic text search capability so users can locate specific information by typing in keywords. KnowHow can reduce document search times by up to 95%.

TRIMS provides insight as a knowledge based tool that manages technical risk rather than cost and schedule. Cost and schedule overruns are downstream indicators of technical problems. Programs generally have had process problems long before the technical problem is identified. To avoid this progression, TRIMS operates as a process-oriented tool based on a solid Systems Engineering approach. Process analysis and monitoring provide the earliest possible indication of potential problems. Early identification provides the time necessary to apply corrective actions, thereby preventing problems and mitigating their impact. TRIMS is extremely user-friendly and tailorable. This tool identifies areas of risk; tracks program goals and responsibilities; and can generate a variety of reports to meet the user's needs.

The **BMP Database** provides experience as a unique, one-of-a-kind resource. This database contains more than 2,500 best practices that have been verified and documented by an independent team of experts during BMP surveys. BMP publishes its findings in survey reports and provides the user with basic background, process descriptions, metrics and lessons learned, and a Point of Contact for further information. The BMP Database features a searching capability so users can locate specific topics by typing in keywords. Users can either view the results on screen or print them as individual abstracts, a single report, or a series of reports. The database can also be downloaded, run on-line, or purchased on CD-ROM from the BMP Center of Excellence. The BMP Database continues to grow as new surveys are completed. Additionally, the database is reviewed every other year by a BMP core team of experts to ensure the information remains current.

For additional information on PMWS, please contact the Help Desk at (301) 405-9963 or visit the BMP web site at http://www.bmpcoe.org.

Appendix E

Best Manufacturing Practices Satellite Centers

There are currently ten Best Manufacturing Practices (BMP) satellite centers that provide representation for and awareness of the BMP Program to regional industry, government and academic institutions. The centers also promote the use of BMP with regional Manufacturing Technology Centers. Regional manufacturers can take advantage of the BMP satellite centers to help resolve problems, as the centers host informative, one-day regional workshops that focus on specific technical issues.

Center representatives also conduct BMP lectures at regional colleges and universities; maintain lists of experts who are potential survey team members; provide team member training; and train regional personnel in the use of BMP resources.

The ten BMP satellite centers include:

California

Chris Matzke
BMP Satellite Center Manager
Naval Surface Warfare Center, Corona Division
Code QA-21, P.O. Box 5000
Corona, CA 92878-5000
(909) 273-4992
FAX: (909) 273-4123
matzkecj@corona.navy.mil

District of Columbia

Geoffrey Gauthier
BMP Satellite Center Manager
U.S. Department of Commerce
Bureau of Industry & Security
14th Street & Constitution Avenue, NW
H3876
Washington, DC 20230
(202) 482-9105
FAX: (202) 482-5650
ggauthie@bis.doc.gov

Illinois

Robert Lindstrom
BMP Satellite Center Manager
Rock Valley College
3301 North Mulford Road
Rockford, IL 61114-5699
(815) 921-2073
FAX: (815) 654-4343
r.lindstrom@rvc.cc.il.us

Iowa

Bruce Concy
BMP Satellite Center Manager
Iowa Procurement Outreach Center
2273 Howe Hall, Suite 2617
Ames, IA 50011
(515) 294-4461
FAX: (515) 294-4483
bruce.concy@ciras.iastate.edu

Louisiana

Alley Butler
BMP Satellite Center Manager
Maritime Environmental Resources & Information Center
Gulf Coast Region Maritime Technology Center
University of New Orleans
UAMTCE, Room 163-Station 122
5100 River Road
New Orleans, LA 70094-2706
(504) 458-6339
FAX: (504) 437-3880
alley.butler@gcrmtc.org

Ohio

Larry Brown
BMP Satellite Center Manager
Edison Welding Institute
1250 Arthur E. Adams Drive
Columbus, Ohio 43221-3585
(614) 688-5080
FAX: (614) 688-5001
larry_brown@ewi.org

Pennsylvania

John W. Lloyd
BMP Satellite Center Manager
MANTEC, Inc.
P.O. Box 5046
York, PA 17405
(717) 843-5054
FAX: (717) 843-0087
lloydjw@mantec.org

South Carolina

Henry E. Watson
BMP Satellite Center Manager
South Carolina Research Authority - Applied Research and Development Institute
100 Fluor Daniel
Clemson, SC 29634
(864) 656-6566
FAX: (843) 767-3367
watson@scra.org

Tennessee

Mike Monnett
Senior Program Manager
Oak Ridge Center for Manufacturing and Materials Science
BWXT Y-12, L.L.C.
P.O. Box 2009
Oak Ridge, TN 37831-8091
(865) 241-5631
FAX: (865) 574-2000
monnettmg@y12.doe.gov

Virginia

William Motley
BMP Satellite Center Manager
DAU Program Director, Manufacturing Manager
Defense Acquisition University
9820 Belvior Road, Suite G3
Ft. Belvior, VA 22060-5565
(703) 805-3763
FAX: (703) 805-3721
bill.motley@dau.mil

Appendix F

Navy Manufacturing Technology Centers of Excellence

The Navy Manufacturing Technology Program has established Centers of Excellence (COEs) to provide focal points for the development and technology transfer of new manufacturing processes and equipment in a cooperative environment with industry, academia, and the Navy industrial facilities and laboratories. These consortium-structured COEs serve as corporate residences of expertise in particular technological areas. The following list provides a description and point of contact for each COE.

Best Manufacturing Practices Center of Excellence

The Best Manufacturing Practices Center of Excellence (BMPCOE) provides a national resource to identify and share best manufacturing and business practices being used throughout government, industry, and academia. The BMPCOE was established by the Office of Naval Research's BMP Program, the Department of Commerce, and the University of Maryland at College Park. By improving the use of existing technology, promoting the introduction of improved technologies, and providing non-competitive means to address common problems, the BMPCOE has become a significant factor to counter foreign competition.

Point of Contact:
Dr. Anne Marie T. SuPrise
Best Manufacturing Practices Center of Excellence
4321 Hartwick Road
Suite 400
College Park, MD 20740
Phone: (301) 405-9990
FAX: (301) 403-8180
E-mail: annemari@bmpcoe.org

Institute for Manufacturing and Sustainment Technologies

The Institute for Manufacturing and Sustainment Technologies (iMAST) is located at the Pennsylvania State University's Applied Research Laboratory. iMAST's primary objective is to address challenges relative to Navy and Marine Corps weapon system platforms in the areas of mechanical drive transmission technologies, materials processing technologies, laser processing technologies, advanced composites technologies, and repair technologies.

Point of Contact:
Mr. Robert Cook
Institute for Manufacturing and Sustainment Technologies
ARL Penn State
P.O. Box 30
State College, PA 16804-0030
Phone: (814) 863-3880
FAX: (814) 863-1183
E-mail: rbc5@psu.edu

Composites Manufacturing Technology Center (Operated by South Carolina Research Authority)

The Composites Manufacturing Technology Center (CMTC) is a Center of Excellence for the Navy's Composites Manufacturing Technology Program. The South Carolina Research Authority (SCRA) operates the CMTC and The Composites Consortium (TCC) serves as the technology resource. The TCC has strong, in-depth knowledge and experience in composites manufacturing technology. The SCRA/CMTC provides a national resource for the development and dissemination of composites manufacturing technology to defense contractors and subcontractors.

Point of Contact:
Mr. Henry Watson
Applied Research and Development Institute
Composites Manufacturing Technology Center
934-D Old Clemson Highway
Eagles Landing Professional Park
Seneca, SC 29672
Phone: (864) 656-6566
FAX: (864) 653-7434
E-mail: watson@scra.org

Electronics Manufacturing Productivity Facility (Operated by American Competitiveness Institute)

The Electronics Manufacturing Productivity Facility (EMPF) identifies, develops, and transfers innovative electronics manufacturing processes to domestic firms in support of the manufacture of affordable military systems. The EMPF operates as a consortium comprised of government, industry, and academic participants led by the American Competitiveness Institute under a Cooperative Agreement with the Navy.

Point of Contact:
Mr. Michael Frederickson
Electronics Manufacturing Productivity Facility
One International Plaza, Suite 600
Philadelphia, PA 19113
Phone: (610) 362-1200, ext. 215
FAX: (610) 362-1288
E-mail: mfrederickson@aciusa.org

Electro-Optics Center (Operated by The Pennsylvania State University's Applied Research Laboratory)

The Electro-Optics Center (EOC) is a national consortium of electro-optics industrial companies, universities, and government research centers that share their electro-optics expertise and capabilities through project teams focused on Navy requirements. Through its capability for national electronic communication and rapid reaction and response, the EOC can address issues of immediate concern to the Navy Systems Commands. The EOC is managed by the Pennsylvania State University's Applied Research Laboratory.

Point of Contact:
Dr. Karl Harris
Electro-Optics Center
West Hills Industrial Park
77 Glade Drive
Kittanning, PA 16201
Phone: (724) 545-9700
FAX: (724) 545-9797
E-mail: kharris@psu.edu

Navy Joining Center (Operated by Edison Welding Institute)

The Navy Joining Center (NJC) provides a national resource for the development of materials joining expertise and the deployment of emerging manufacturing technologies to Navy contractors, subcontractors, and other activities. The NJC works with the Navy to determine and evaluate joining technology requirements and conduct technology development and deployment projects to address these issues. The NJC is operated by the Edison Welding Institute.

Point of Contact:
Mr. Harvey R. Castner
EWI/Navy Joining Center
1250 Arthur E. Adams Drive
Columbus, OH 43221-3585
Phone: (614) 688-5063
FAX: (614) 688-5001
E-mail: harvey_castner@ewi.org

National Center for Excellence in Metalworking Technology (Operated by Concurrent Technologies Corporation)

The National Center for Excellence in Metalworking Technology (NCEMT) provides a national center for the development, dissemination, and implementation of advanced technologies for metalworking products and processes. Operated by the Concurrent Technologies Corporation, the NCEMT helps the Navy and defense contractors improve manufacturing productivity and part reliability through development, deployment, training, and education for advanced metalworking technologies.

Point of Contact:
Dr. Daniel L. Winterscheidt
National Center for Excellence in Metalworking Technology
c/o Concurrent Technologies Corporation
100 CTC Drive
Johnstown, PA 15904-1935
Phone: (814) 269-6840
FAX: (814) 269-2501
E-mail: winter@ctcgsc.com

Energetics Manufacturing Technology Center

The Energetics Manufacturing Technology Center (EMTC) addresses unique manufacturing processes and problems of the energetics industrial base to ensure the availability of affordable, quality, and safe energetics. The EMTC's focus is on technologies to reduce manufacturing costs, improve product quality and reliability, and develop environmentally benign manufacturing processes. The EMTC is located at the Indian Head Division of the Naval Surface Warfare Center.

Point of Contact:
Mr. John Brough
Naval Surface Warfare Center
Indian Head Division
101 Strauss Avenue
Building D326, Room 227
Indian Head, MD 20640-5035
Phone: (301) 744-4417
DSN: 354-4417
FAX: (301) 744-4187
E-mail: broughja@ih.navy.mil

Center for Naval Shipbuilding Technology

The Center for Naval Shipbuilding Technology (CNST) supports the Navy's ongoing effort to identify, develop and deploy in U.S. shipyards, advanced manufacturing technologies that will reduce the cost and time to build and repair Navy ships. CNST provides a focal point for developing and transferring new manufacturing processes and technologies; benefits that will accrue not only to the Navy, but to industry as well. CNST is operated and managed by ATI in Charleston, South Carolina.

Point of Contact:
Mr. Ron Glover
Center for Naval Shipbuilding Technology
5300 International Blvd.
Charleston, SC 29418
Phone: (843)760-4606
FAX: (843)760-4098
E-mail: glover@aticorp.org

Gulf Coast Region Maritime Technology Center (Operated by University of New Orleans, College of Engineering)

The Gulf Coast Region Maritime Technology Center (GCRMTC) fosters competition in shipbuilding technology through cooperation with the U.S. Navy, representatives of the maritime industries, and various academic and private research centers throughout the country. Located at the University of New Orleans, the GCRMTC focuses on improving design and production technologies for shipbuilding, reducing material costs, reducing total ownership costs, providing education and training, and improving environmental engineering and management.

Point of Contact:
Mr. Frank Bordelon, New Orleans Site Director
Gulf Coast Region Maritime Technology Center
Research and Technology Park
CERM Building, Room 409
University of New Orleans
New Orleans, LA 70148-2200
Phone: (504) 280-5609
FAX: (504) 280-3898
E-mail: fbordelo@uno.edu

Appendix G

Completed Surveys

As of this publication, 137 surveys have been conducted and published by BMP at the companies listed below. Copies of older survey reports may be obtained through DTIC or by accessing the BMP web site. Requests for copies of recent survey reports or inquiries regarding BMP may be directed to:

Best Manufacturing Practices Program
4321 Hartwick Rd., Suite 400
College Park, MD 20740
Attn: Anne Marie T. SuPrise, Ph.D., Director
Telephone: 1-800-789-4267
FAX: (301) 403-8180
annemari@bmpcoe.org

1985	Litton Guidance & Control Systems Division - Woodland Hills, CA
1986	Honeywell, Incorporated Undersea Systems Division - Hopkins, MN (now Alliant TechSystems, Inc.) Texas Instruments Defense Systems & Electronics Group - Lewisville, TX General Dynamics Pomona Division - Pomona, CA Harris Corporation Government Support Systems Division - Syosset, NY IBM Corporation Federal Systems Division - Owego, NY Control Data Corporation Government Systems Division - Minneapolis, MN
1987	Hughes Aircraft Company Radar Systems Group - Los Angeles, CA ITT Avionics Division - Clifton, NJ Rockwell International Corporation Collins Defense Communications - Cedar Rapids, IA UNISYS Computer Systems Division - St. Paul, MN
1988	Motorola Government Electronics Group - Scottsdale, AZ General Dynamics Fort Worth Division - Fort Worth, TX Texas Instruments Defense Systems & Electronics Group - Dallas, TX Hughes Aircraft Company Missile Systems Group - Tucson, AZ Bell Helicopter Textron, Inc. - Fort Worth, TX Litton Data Systems Division - Van Nuys, CA GTE C^3 Systems Sector - Needham Heights, MA
1989	McDonnell-Douglas Corporation McDonnell Aircraft Company - St. Louis, MO Northrop Corporation Aircraft Division - Hawthorne, CA Litton Applied Technology Division - San Jose, CA Litton Amecom Division - College Park, MD (now Northrop Grumman Electronic Systems Division) Standard Industries - LaMirada, CA (now SI Manufacturing) Engineered Circuit Research, Incorporated - Milpitas, CA Teledyne Industries Incorporated Electronics Division - Newbury Park, CA Lockheed Aeronautical Systems Company - Marietta, GA Lockheed Missile Systems Division - Sunnyvale, CA (now Lockheed Martin Missiles and Space) Westinghouse Electronic Systems Group - Baltimore, MD (now Northrop Grumman Corporation) General Electric Naval & Drive Turbine Systems - Fitchburg, MA Rockwell Autonetics Electronics Systems - Anaheim, CA (now Boeing North American A&MSD) TRICOR Systems, Incorporated - Elgin, IL
1990	Hughes Aircraft Company Ground Systems Group - Fullerton, CA TRW Military Electronics and Avionics Division - San Diego, CA MechTronics of Arizona, Inc. - Phoenix, AZ Boeing Aerospace & Electronics - Corinth, TX Technology Matrix Consortium - Traverse City, MI Textron Lycoming - Stratford, CT

1991	Resurvey of Litton Guidance & Control Systems Division - Woodland Hills, CA Norden Systems, Inc. - Norwalk, CT (now Northrop Grumman Norden Systems) Naval Avionics Center - Indianapolis, IN United Electric Controls - Watertown, MA Kurt Manufacturing Co. - Minneapolis, MN MagneTek Defense Systems - Anaheim, CA (now Power Paragon, Inc.) Raytheon Missile Systems Division - Andover, MA AT&T Federal Systems Advanced Technologies and AT&T Bell Laboratories - Greensboro, NC and Whippany, NJ Resurvey of Texas Instruments Defense Systems & Electronics Group - Lewisville, TX
1992	Tandem Computers - Cupertino, CA Charleston Naval Shipyard - Charleston, SC Conax Florida Corporation - St. Petersburg, FL Texas Instruments Semiconductor Group Military Products - Midland, TX Hewlett-Packard Palo Alto Fabrication Center - Palo Alto, CA Watervliet U.S. Army Arsenal - Watervliet, NY Digital Equipment Company Enclosures Business - Westfield, MA and Maynard, MA Computing Devices International - Minneapolis, MN (now General Dynamics Information Systems) (Resurvey of Control Data Corporation Government Systems Division) Naval Aviation Depot Naval Air Station - Pensacola, FL
1993	NASA Marshall Space Flight Center - Huntsville, AL Naval Aviation Depot Naval Air Station - Jacksonville, FL Department of Energy Oak Ridge Facilities (Operated by Martin Marietta Energy Systems, Inc.) - Oak Ridge, TN McDonnell Douglas Aerospace - Huntington Beach, CA (now Boeing Space Systems) Crane Division Naval Surface Warfare Center - Crane, IN and Louisville, KY Philadelphia Naval Shipyard - Philadelphia, PA R. J. Reynolds Tobacco Company - Winston-Salem, NC Crystal Gateway Marriott Hotel - Arlington, VA Hamilton Standard Electronic Manufacturing Facility - Farmington, CT (now Hamilton Sundstrand) Alpha Industries, Inc. - Methuen, MA
1994	Harris Semiconductor - Palm Bay, FL (now Intersil Corporation) United Defense, L.P. Ground Systems Division - San Jose, CA Naval Undersea Warfare Center Division Keyport - Keyport, WA Mason & Hanger - Silas Mason Co., Inc. - Middletown, IA Kaiser Electronics - San Jose, CA U.S. Army Combat Systems Test Activity - Aberdeen, MD (now Aberdeen Test Center) Stafford County Public Schools - Stafford County, VA
1995	Sandia National Laboratories - Albuquerque, NM Rockwell Collins Avionics & Communications Division - Cedar Rapids, IA (now Rockwell Collins, Inc.) (Resurvey of Rockwell International Corporation Collins Defense Communications) Lockheed Martin Electronics & Missiles - Orlando, FL McDonnell Douglas Aerospace (St. Louis) - St. Louis, MO (now Boeing Aircraft and Missiles) (Resurvey of McDonnell-Douglas Corporation McDonnell Aircraft Company) Dayton Parts, Inc. - Harrisburg, PA Wainwright Industries - St. Peters, MO Lockheed Martin Tactical Aircraft Systems - Fort Worth, TX (Resurvey of General Dynamics Fort Worth Division) Lockheed Martin Government Electronic Systems - Moorestown, NJ Sacramento Manufacturing and Services Division - Sacramento, CA JLG Industries, Inc. - McConnellsburg, PA
1996	City of Chattanooga - Chattanooga, TN Mason & Hanger Corporation - Pantex Plant - Amarillo, TX Nascote Industries, Inc. - Nashville, IL Weirton Steel Corporation - Weirton, WV NASA Kennedy Space Center - Cape Canaveral, FL Resurvey of Department of Energy, Oak Ridge Operations - Oak Ridge, TN

1997	Headquarters, U.S. Army Industrial Operations Command - Rock Island, IL (now Operational Support Command) SAE International and Performance Review Institute - Warrendale, PA Polaroid Corporation - Waltham, MA Cincinnati Milacron, Inc. - Cincinnati, OH Lawrence Livermore National Laboratory - Livermore, CA Sharretts Plating Company, Inc. - Emigsville, PA Thermacore, Inc. - Lancaster, PA Rock Island Arsenal - Rock Island, IL Northrop Grumman Corporation - El Segundo, CA (Resurvey of Northrop Corporation Aircraft Division) Letterkenny Army Depot - Chambersburg, PA Elizabethtown College - Elizabethtown, PA Tooele Army Depot - Tooele, UT
1998	United Electric Controls - Watertown, MA Strite Industries Limited - Cambridge, Ontario, Canada Northrop Grumman Corporation - El Segundo, CA Corpus Christi Army Depot - Corpus Christi, TX Anniston Army Depot - Anniston, AL Naval Air Warfare Center, Lakehurst - Lakehurst, NJ Sierra Army Depot - Herlong, CA ITT Industries Aerospace/Communications Division - Fort Wayne, IN Raytheon Missile Systems Company - Tucson, AZ Naval Aviation Depot North Island - San Diego, CA U.S.S. Carl Vinson (CVN-70) - Commander Naval Air Force, U.S. Pacific Fleet Tobyhanna Army Depot - Tobyhanna, PA
1999	Wilton Armetale - Mount Joy, PA Applied Research Laboratory, Pennsylvania State University - State College, PA Electric Boat Corporation, Quonset Point Facility - North Kingstown, RI Resurvey of NASA Marshall Space Flight Center - Huntsville, AL Orenda Turbines, Division of Magellan Aerospace Corporation - Mississauga, Ontario, Canada
2000	Northrop Grumman, Defensive Systems Division - Rolling Meadows, IL Crane Army Ammunition Activity - Crane, IN Naval Sea Logistics Center, Detachment Protsmouth - Portsmouth, NH Stryker Howmedica Osteonics - Allendale, NJ
2001	The Tri-Cities Tennessee/Virginia Region - Johnson City, TN General Dynamics Armament Systems - Burlington, VT (now General Dynamics Armament and Technical Products) Lockheed Martin Naval Electronics & Surveillance Systems-Surface Systems - Moorestown, NJ Frontier Electronic Systems - Stillwater, OK
2002	U.S. Coast Guard, Maintenance and Logistics Command-Atlantic - Norfolk, VA U.S. Coast Guard, Maintenance and Logistics Command-Pacific - Alameda, CA Directorate for Missiles and Surface Launchers (PEO TSC-M/L) - Arlington, VA General Tool Company - Cincinnati, OH
2003	University of New Orleans, College of Engineering - New Orleans, LA Bender Shipbuilding and Repair Company, Inc. - Mobile, AL ABC Virtual Communications, Inc. - West Des Moines, IA In Tolerance Contract Manufacturing, - Cedar Rapids, IA Resurvey of Electric Boat Corporation, Quonset Point Facility - North Kingstown, RI United Defense, L. P. Ground Systems Division - Aiken, SC Auto-Valve, Inc. - Dayton, OH