*REPORT OF SURVEY CONDUCTED AT*

# IN TOLERANCE
# CEDAR RAPIDS, IA

*JULY 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 In Tolerance, conducted during the week of July 8, 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.

In Tolerance, recognized as one of Iowa's leading precision contract manufacturers, prides itself in having an excellent on-time delivery rate, superior customer service, and a commitment to its employees to provide an outstanding health, safety, and benefits program. Among the best examples were In Tolerance's First Article Inspection, Automated Quotation and Inventory Scheduling System, and Employee Health and Fitness program.

The BMP Program is committed to strengthening the U.S. industrial base. Survey findings in reports such as this one on In Tolerance 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.
*Director*, Best Manufacturing Practices

# Contents

In Tolerance

# Section 1

# *Report Summary*

## *Background*

Founded in 1947 as the Norman Scott Company, Inc., In Tolerance is a small machining company of precision machined parts. The company, located in Cedar Rapids, Iowa, was founded at the request of Arthur Collins (founder of Collins Radio) to fulfill a need for outside manufacturing. Today, In Tolerance is still a prime supplier to Rockwell Collins; however, the company's diverse customer base includes clients throughout the United States and Puerto Rico who represent the medical, aerospace, communications, agricultural, and military industries in particular. In Tolerance has been recognized as one of Iowa's leading precision contract manufacturers, and has received numerous awards from organizations such as the Cedar Rapids Chamber of Commerce, Rockwell Collins, Litton Life Support Systems, Trans Technology Electronics, and Boeing Aircraft.

In Tolerance prides itself in having an over 97% on-time delivery rate while maintaining a quality index for orders shipped of more than 99.9%. In Tolerance is certified ISO 9001:2000, ISO 9002 and meets the requirements of MIL-I-45208. Superior customer service is a "way of life" for In Tolerance and its 30 employees. One of the many outstanding examples of the company's philosophy, "Let's not just please our customers, let's delight them," is in the area of customer response time. The company is committed to giving same-day responses to questions on outstanding orders. To support this commitment, customers are given access to the company's internal job tracking system, enabling them to access the data system via the Web and view the status of their orders on-line. All information in this tracking system is updated every four hours.

In Tolerance is not only dedicated to superior customer service, but also to superior employee service. The company's health, safety, and benefits programs are superior in almost all aspects. In Tolerance has developed an innovative Leisure Credit System for its employees, which allows the employees to earn additional paid time off in addition to normal vacation time. The company believes in helping with the well-being of all employees and their families. Many of the benefits enjoyed by In Tolerance's employees are also enjoyed by their family members. Proof of the success of this focus is the low turn-over rate, with employees averaging more than 16.8 years of service with the company. The BMP survey team considers the practices in this report to be among the best in industry and government.

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# Section 2

# *Best Practices*

## *Test*

### Coordinate Measuring Machine

*In Tolerance implemented a powerful and fully automated Coordinate Measuring Machine that can download CAD models from IGES, STP, and SAT files. The system enables the company to generate a Coordinate Measuring Machine program plan and probe paths without a blueprint or part, resulting in reduced setup and inspection times.*

In Tolerance manufactures a wide variety of precision parts for aerospace, industry, medical, and government/military. These parts range in size from small threaded screws and micro-valves to highly complex heat sinks and housing assemblies for military radios. Quantities range from one-of-a kind to volume production. Dimensions and tolerances must be precisely measured to ensure specifications are met before delivery to the customer. In today's competitive world of achieving high efficiency, economical products, and quick turnaround times, final product acceptance requires optimization of measurement processes. An automated coordinated measuring system offers such a process.

Like many companies, In Tolerance originally invested in a coordinate measurement capability and found the system provided improvements over the manual measurement processes of gage blocks and calipers. Still, data entry, programming, and measurement steps were, for the most part, a semi-manual operation. As parts became increasingly complex, these steps became increasingly more time consuming. In Tolerance invested in a more powerful and fully programmable Coordinate Measuring Machine (CMM), the Zeiss Eclipse Model 700 with added software options. With this system, the company can download CAD models from various formats such as IGES, STP, and SAT files, all used by In Tolerance. The data can then be analyzed, and a CMM program plan and the probe paths can be generated without using a blueprint or a part. When the part is finished in the machining process, it is fixtured on the CMM table, the proper data is measured, the part is checked using the data collected from the CAD file, and the inspection data is saved in a file. The system can measure parts that fit within a 28"W x 40"L x 20"H envelope and hold accuracy to ± 10 microns.

Previously, an average complex part would require 20 hours to inspect. With implementation of the Ziess CMM, that same part now requires about four hours to program and only 15 minutes to inspect. Approximately 60% to 70% of all jobs are now inspected on the CMM.

### First Article Inspection

*In Tolerance extended the capability of its powerful and fully automated Coordinate Measuring Machine by programming it to send inspection data to an Excel spreadsheet, where other pertinent data can be easily added to create the First Article Inspection reports required by the buyer.*

A First Article Inspection Report is a requirement placed on the supplier by the customer. The report documents and certifies that each first article unit delivered to the buyer was produced and inspected in accordance with the buyer's specifications. The report includes all physical, material, and chemical test data associated with the part. These reports are provided to the buyer and kept on file by the supplier for a minimum of seven years or as required by the buyer.

Generating First Article Inspection reports is a necessary requirement and must be generated by the supplier's qualified personnel. The reports are time consuming and costly to generate. To reduce the cost and improve the efficiency of this requirement, In Tolerance takes advantage of its powerful Coordinate Measuring Machine (CMM). A large portion of the report contains the measurement data taken with the CMM. When the CMM is finished measuring a part, instead of sending the data to the printer, In Tolerance's computer programmer changed the software directing the CMM to send the data to an Excel spreadsheet. From this spreadsheet, In Tolerance can edit the data to add other inspection data (e.g., threads or other characteristics) the CMM cannot measure. The information

can be e-mailed or printed and sent to the customer with the parts. An electronic copy of the inspection record is kept for a minimum of seven years and can be easily accessed at any time.

First Article Inspection reports for parts inspected on the CMM are now generated more efficiently, and the records can be easily accessed allowing quick response to customer inquiries or internal reviews. Customers now receive the reports in a timely manner, either at the time of initial delivery or in some cases, prior to delivery of the first article unit.

## *Management*

### Automated Quotation and Inventory Scheduling System

*The In Tolerance-developed Automated Quotation and Inventory Scheduling System offers an impressive list of manufacturing management tools not normally found in a small business, and could serve as a model for other organizations looking for similar capabilities in the requirements definition phase.*

Approximately two years after the company was purchased in 1986, In Tolerance developed a manufacturing control system — the Automated Quotation and Inventory Scheduling System (AQUISS). It was built in an MS-DOS environment, with the intention of providing common shop floor control features. Over the years, AQUISS has grown into a system that provides a myriad of tools and reports used by every function within the organization. Multiple networked PCs provide access to the databases throughout the facility. The many features provided include:

- Time and attendance
- First article inspection documentation
- Order tracking and status reporting
- Fast turnaround cost estimating
- Limited capacity planning
- Inventory/work in process analysis
- Routing information
- Schedule status
- Invoicing
- Labor reporting by job
- Output to payroll
- Output for Web-based order tracking

AQUISS offers an impressive number of features and management tools and has been tailored to meet In Tolerance's needs. The various AQUISS screens and reports provide the necessary information and quick access to data, contributing factors in providing superior customer service.

In Tolerance recognizes that AQUISS has inherent limitations because it is DOS-based. The need to interface with a Windows-based world has prompted an evaluation of potential AQUISS modifications and alternative software. But regardless of the end solution, AQUISS has already defined many of the future system requirements and collected a wealth of product and performance data that can be carried forward.

### Employee Health and Fitness

*In Tolerance developed and implemented an employee health and fitness program that benefits not only employees, but employees' families, the company, and the community. Through the expansion of a conventional health and fitness program to an overall quality-of-life program, the company has helped ensure a healthy and dedicated workforce.*

In Tolerance developed an employee health and fitness program to assist with the well-being of its employees and their families. The original purpose of the program was to promote good health among employees and minimize sick time usage. The program expanded over time to become a quality-of-life and family enrichment program, which includes spouses, significant others, and family members in the benefits and administration of the program.

One of the first employee health and fitness issues addressed was the initiation of a smoking cessation program for those employees who wished to stop smoking. Realizing it was more difficult for a person to stop smoking whose spouse or significant other smoked, In Tolerance included those family members in the program if they so desired. The company realized that not everyone stops smoking on the first, second, or even third try. Therefore, In Tolerance did not limit the smoking cessation initiative to just once; instead, it pays for repeated cessation programs. Another health and fitness initiative undertaken was to build and equip a fitness center for all employees and their families. Personal trainers were hired to help the employees and family members develop fitness programs and

learn the proper use of the equipment. Recognizing that quality-of-life issues outside of work have an effect on the physical well being of the employee, In Tolerance has implemented numerous other initiatives to assist employees and family members including:

- Fully paid, yearly physical examinations for every employee and family member
- Company paid flu shots for all employees and their spouse or significant other
- Employee safety meetings to discuss workplace and home safety
- CPR training and re-certification on an ongoing basis, along with basic first aid training

In Tolerance also encourages community involvement by their employees. As an incentive to get and keep employees active in service organizations and programs (e.g., Rotary, Lions, Sertoma, United Way), In Tolerance pays monthly dues for those employees involved in such organizations and activities. Other employee benefits include personal use of machining equipment, company tools, and company vehicles after normal working hours; regularly planned family social events; and the Leisure Credit System. This is a unique benefit which allows hourly employees to earn additional paid time off from work over and above normal vacation time. This time off can be used for any personal reason (e.g., doctor or dental appointment, late for work), and the employee can request and receive full hourly pay for any unused Leisure Credit hours remaining at the end of the year.

In Tolerance's employee health and fitness program and quality-of-life initiatives are numerous. Several employees have quit smoking, more employees are involved in their community activities, employee morale and retention are high (employees average more than 16 years of service), absenteeism due to illness and lost time due to workplace accidents are low. In Tolerance's investments in its employees' overall health has greatly benefited the company, the employee, their families, and the community.

## On-Line Part Status

*In Tolerance implemented an innovative web-based On-Line Part Status system designed solely for its customers to track the progress of their parts from the time the order is placed to delivery, thus improving customer satisfaction and dramatically reducing telephone inquiries and follow-ups.*

In Tolerance's On-Line Part Status system is a web-based tracking system designed solely for its customers to track the progress of their parts from the time the order is placed to delivery. With more than 400 open orders at any time and dozens of customers, responding to inquiries is a required part of doing business. Although In Tolerance had an on-time delivery record of 99%, customers consistently inquired on the status of their orders by calling during the week and even on weekends. Four people responded immediately to every phone call by accessing information directly from the company's Automated Quotation and Inventory Scheduling System (AQUISS) plant manager database. It was considered an important part of excellent customer service and proved to be well worth the effort.

However, In Tolerance is always looking for innovative ways to improve its customer service and processes. The company decided to give its customers the ability to review their own parts status information, which is compiled in Microsoft Access from the AQUISS plant manager database and can be accessed via the Internet. In 2001, In Tolerance implemented the On-Line Part Status system which allows the customer to log-on to In Tolerance's Website (www.in-tolerance.com), then click on the Customer Log-in icon. The customer then enters a name and password, which is assigned by In Tolerance. Queries can be performed by part number or purchase order number. The customer can then check on the status of the order and also query inventory quantities of other parts. The compiled data is located on In Tolerance's host server where information is updated every four hours, seven days a week.

The On-Line Part Status system is easy to use and secure, and customers can access information at any time. Telephone inquiries are still accepted but have been reduced dramatically resulting in a 20- hour per week savings; weekend calls have been completely eliminated. Companies outside of the Iowa area have shown interest in the On-Line Part Status system, which is resulting in new business.

## Superior Customer Service

*In Tolerance goes to great extent to provide excellent customer service. Along with handling inquiries, providing quick responses, and conducting customer feedback surveys, In Tolerance also understands the special requirements and desires of its customers and ensures those needs are noted and fulfilled as part of the order.*

In Tolerance goes to great extent to provide superior customer service. Along with handling inquiries, providing quick responses, and conducting customer feedback surveys, In Tolerance also understands the special requirements and desires of its customers and ensures those needs are noted and fulfilled as part of the order. Parts are machined to customers' prints and specifications, and customers are asked about their additional requirements. These requirements are documented and updated when new needs are discovered.

It is important to In Tolerance to not only bring in new work, but to also provide excellent service to its current customers. In Tolerance's customer services are a shared responsibility among the Vice President, General Manager, Shop Manager, Quality Assurance Manager, and Sales Manager. Each person answers telephone inquiries and has detailed knowledge on how to access the correct data to respond immediately. Inquiries include specific lead-times and scheduling, pricing, and quick pricing on items of different quantities. In Tolerance is also proactive in handling unforeseen issues which might negatively impact schedules by informing customers in advance. A unique aspect of In Tolerance's customer service is keeping a list of the special needs of each customer. When a purchase order is received, In Tolerance meets with the key people to review any special requirements, and notes them on the route sheets, which ensures they are fulfilled during production. All orders (300 to 400 orders) are reviewed twice a week to verify that all requirements are being met, including the special needs of the customers.

Since customer service adds additional cost to the product, it must show value. In Tolerance receives many testimonials that support its superior customer service, and the company conducts annual surveys to capture feedback from its customers. Feedback is reviewed and used to improve the customer service process. By "going the extra mile," few surprises enter the business of delivering parts in compliance with the customers' needs and specifications. As a result, In Tolerance boasts a 99.9% across-the-board compliance.

# Section 3

# *Information*

## *Management*

### Machine Shop Estimating

*Users of Machine Shop Estimating software must have basic machining knowledge. The software promotes accuracy and consistency while reducing the time required to complete a cost estimate. Utilization of CAD files to describe the product greatly improves customer responsiveness and further reduces manufacturing costs through automatic generation of the cost estimate and CNC files.*

In the past, In Tolerance manually prepared manufacturing cost estimates using paper forms and calculators. Although the estimates were prepared by a knowledgeable person with a good understanding of the machine shop, the procedure required several hours or days and was subject to variances due to items such as machine selection and tool choice. After a lengthy search for a better way to provide estimates, In Tolerance chose Machine Shop Estimating (MSE) in early 2003.

MSE is a Microsoft Windows-based software package that creates cost estimates that can be tailored to the individual production facility. The cost estimate is more likely to be accurate since it is built using the actual capabilities of the shop floor equipment. The machines in the shop are characterized by parameters (e.g., capacity, speed, horsepower, feed rates, load/unload times). Customizing the software to accurately represent the shop floor is not a trivial task; however, the up-front effort results in improved accuracy and consistency for the subsequent cost estimates.

The appropriate machines, or work centers, are chosen from a table of those listed on the screen to construct a job routing. MSE calculates the tool path from the part geometry and the tool description. Unique costs for processes such as heat treat, inspection, or plating can be entered as desired. MSE contains a library of more than 1,000 materials with their associated speeds and feeds. These are used to calculate machine times, but like all parameters, may be overridden if necessary.

A material cost library contains the costs for many different materials as well as associated information such as minimums and shipping charges. An on-screen link to a Website is also available where real-time pricing can be obtained. MSE offers labor detail down to what is essentially a method-time-measurement standard (e.g., reach, grasp, insert, turn), and labor rates are entered as desired. An efficiency factor can be applied to account for real-world inefficiencies such as rest periods, part complexity, and learning curves.

The MSE software is relatively new at In Tolerance, and is being used in parallel with manual cost estimating until the customization process is complete, at which time the software will accurately reflect the machine capabilities and other variables that make the shop unique. In its present use, MSE performs in a similar manner to the manual process, but with improved speed and consistency. Substantially greater gains will be realized in the future, when a solids model file will be used to describe the machined part. MSE can then read the CAD file, and using automatic feature recognition, generate shop floor routings, tool paths, cost estimates, and CNC files.

In Tolerance has already begun to realize the benefits of using MSE, and those benefits will expand with the use of CAD files to describe the parts. Reduced time to prepare a cost estimate is one major benefit, and accuracy has been improved due to a reduction in the variables and human involvement. In Tolerance prides itself in customer responsiveness. Estimates that used to take hours or days can now be completed in a fraction of the time, and same-day quotes will become practical. Since the machine capabilities and rules are defined, the estimates will provide realistic shop floor routings with consistent results from one job to the next.

# Appendix A

## *Table of Acronyms*

| ACRONYM | DEFINITION |
|---|---|
| AQUISS | Automated Quotation and Inventory Scheduling System |
| CMM | Coordinate Measuring Machine |
| MSE | Machine Shop Estimating |

# Appendix B

## *BMP Survey Team*

| Team Member | Activity | Function |
|---|---|---|
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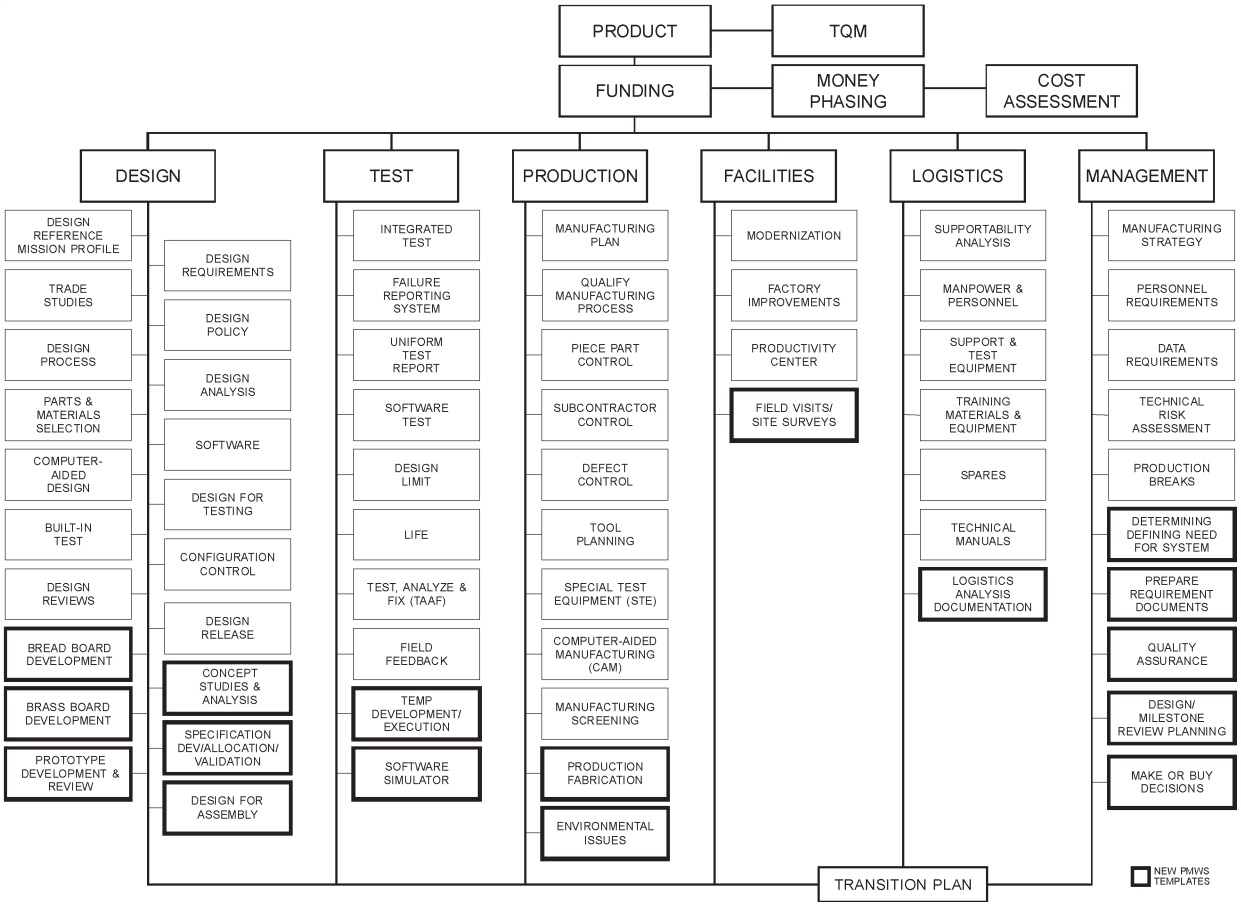
# Appendix C

## *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.

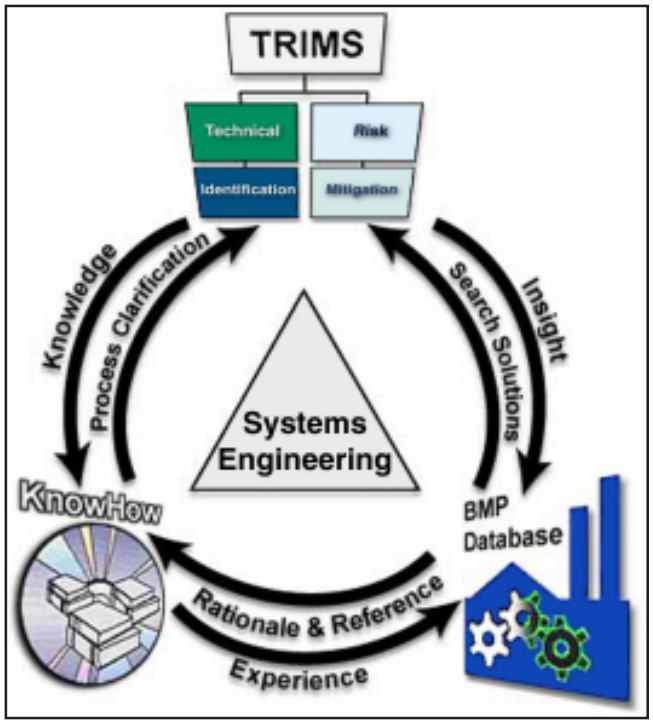
## "CRITICAL PATH TEMPLATES FOR TRANSITION FROM DEVELOPMENT TO PRODUCTION"



# 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) 403-8179, 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:

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# 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.

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### 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.

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### 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.

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### 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:
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Electronics Manufacturing Productivity Facility
One International Plaza, Suite 600
Philadelphia, PA 19113
Phone: (610) 362-1200, ext. 215
FAX: (610) 362-1288
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### 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:
Mr. Richard Henry, P.E.
National Center for Excellence in Metalworking Technology
c/o Concurrent Technologies Corporation
100 CTC Drive
Johnstown, PA 15904-1935
Phone: (814) 269-2532
FAX: (814) 269-2501
E-mail: henry@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
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Indian Head, MD 20640-5035
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DSN: 354-4417
FAX: (301) 744-4187
E-mail: broughja@ih.navy.mil

## 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
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FAX: (504) 280-3898
E-mail: fbordelo@uno.edu

# Appendix G

## *Completed Surveys*

As of this publication, 133 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


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

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| **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 |

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