REPORT OF SURVEY CONDUCTED AT

UNITED DEFENSE, L.P.
ARMAMENT SYSTEMS DIVISION
ABERDEEN, SD

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Best Manufacturing Practices

1998 Award Winner

INNOVATIONS IN AMERICAN GOVERNMENT

BEST MANUFACTURING PRACTICES CENTER OF EXCELLENCE
College Park, Maryland
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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 United Defense, L.P. Armament Systems Division in Aberdeen, South Dakoth conducted during the week of April 26, 2004. 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.

United Defense, L.P. Armament Systems Division, Aberdeen, South Dakota is a leader in machining, welding, finishing, mechanical and electrical assembly, and product service necessary for the support of the Advanced Gun System for the Navy's future surface combatant, the Mk 45 Mod 4 Naval Gun System and missile launch canisters, and the mechanical components for the Navy's Vertical Launching System, Mk 41. The Aberdeen facility continues to be a leader in the system integration and support of the Vertical Launching System by establishing standards of excellence in complex fabrication. Among the best examples were the facility's technical expertise and implementation of its Material Handling techniques, Powder Coating process, Lean Manufacturing Concepts, Safety Program, and Business Process Model.

The BMP Program is committed to strengthening the U.S. industrial base. Survey findings in reports such as this one on United Defense, L.P. Armament Systems Division Aberdeen 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

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Section 1

Report Summary

Background

In 1994, the Food Machinery Corporation (FMC) and the Harrisburg Steel Company (Harsco) merged their defense units to form United Defense, Limited Partnership (UDLP). FMC began in 1884 with the development of a new type of spray pump used to combat San Jose scale in California's orchards. The demand for the spray pump was so great that the inventor, John Bean, formed the Bean Spray Pump Company. The company was now concentrating its manufacturing efforts on agricultural equipment. The late 1920s brought about a change for Bean Spray Pump Company when it merged with makers of food processing equipment and cannery machinery for vegetables, and created a larger company with a new name — FMC. As World War II began, FMC entered the defense business, manufacturing amphibious tractors and tanks for the U.S. Military.

Harsco began in 1742 and established itself as an internationally recognized leader in the production of America's first seamless gas cylinder. Later, the company began producing a range of specialty steel products, and expanded into new products and markets as a diversified industrial organization. During World War II, Bowen McLaughlin York, a division of Harsco, began building tanks. For the next 50 years, FMC and Harsco achieved recognition for producing quality combat vehicles and Navy guns.

In 1985, UDLP opened a 160,000 square foot facility in Aberdeen, South Dakota to build missile canisters for the U.S. Navy. Meeting the mission requirements for the U.S. and its allies security needs, the Armament Systems Division (ASD) supports weapon technology and platform developments. As a provider of weapon and munition handling technologies, the facility applies advanced engineering technology and expertise for the development of key Department of Defense systems such as missile launch canisters and mechanical components for the Navy's Vertical Launching System (VLS), Mk 41, a worldwide standard shipborne missile launching system. The VLS Mk 41 is a canister launching system which provides a rapid-fire launch capability against hostile threats. The missile launcher consists of a single, eight-cell missile module capable of launching Seasparrow missiles used against hostile aircraft, missiles, and surface units. The U.S. Navy currently deploys the Mk 41 VLS on Aegis-equipped Ticonderoga-class cruisers and Spruance and Arleigh Burke class destroyers.

UDLP ASD Aberdeen has been recognized for its innovative technology, affordability, and excellence by its customers and peers on local and national levels. Among its honors are the South Dakota Governor's Workplace, Health, and Safety "Award of Honor for 2002." This is the Governor's highest award of this type, and the Aberdeen facility also won the award in 1999, 2000, and 2001. In 1995, the facility swept the South Dakota Business Excellence Award by receiving first place in all three categories – Plant and Environmental Safety, Quality, and Manufacturing. UDLP ASD Aberdeen received the prestigious Abbey Award in 1995 and again in 2002 from the local Chamber of Commerce for World Class Excellence in Manufacturing. Within the United Defense Armament Systems Division, the Aberdeen facility was recognized for its outstanding safety accomplishments by receiving the Chairman's Award for Safety Achievement in 1997, 2002, and 2003. UDLP ASD Aberdeen continues to be a forerunner in the manufacture of components for multiple missile launchers and canisters, is ISO-9001 Certified and received the ISO-14000 Declaration of Conformance. The facility's implementation of Lean Manufacturing concepts showed an impressive flow of work throughout the factory floor, with very little wasted movement and well organized work cells. The facility's team empowerment concept was demonstrated by the employees' process ownership in how they managed their own work and made continuous improvements. UDLP ASD Aberdeen's technical expertise and implementation of its Material Handling techniques, Powder Coating process, Safety Program, and Business Process Model provide outstanding products to the U.S. Military. The BMP survey team congratulates the UDLP ASD Aberdeen facility and considers the practices in this report to be among the best in industry and government.

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Section 2

Best Practices

Production

Material Handling Techniques

United Defense, L.P. Armament Systems Division Aberdeen has been proactive in developing and implementing material handling solutions that provide operators with the ability to easily perform their tasks in a safe manner. Repetitive motion injuries have also been significantly reduced by changing the fixtures and tools used.

United Defense, L.P. Armament Systems Division (UDLP ASD) Aberdeen manufactures large, heavy parts and assemblies. Employee rotation necessitates creative material handling methods, and the team environment encourages innovative techniques. The teams identify opportunities for improvement, especially as new team members become part of the team. Typically, a low cost approach will be prototyped to prove out the concept. A final solution is then designed and implemented.

The following examples demonstrate UDLP ASD Aberdeen's wide-range ability in solving material handling problems:

- Weld fixtures have been designed that will raise, lower, and rotate to position the large assemblies in the optimum position for welding (Figure 2-1). This reduces operator strain, twisting, and reaching, and positions the weld area in the optimum position to accomplish a quality weld. Pallet positioning fixtures have been developed that allow the operator to easily access the parts required for an assembly.
- Canister roll-over carts have been developed that are mounted on air pallets to rotate the canisters for processing and to easily move the canisters between stations. Similar techniques have also been implemented in the electrical cable fabrication area to provide the operator easy access to the cable layout board.
- The connector stress relief molding rack has adjustable height, and the operator's chair is also adjustable. Many assemblies also require repetitive motion by the operator to complete the assembly.
- One particular cable has 135 contacts that must be stripped and then have contacts crimped on each wire. In the past, this was accomplished using a hand stripper and a hand crimper. An automatic wire stripper and contact crimper were installed to eliminate the repetitive hand motions.
- Adjustable height, foot-controlled heat guns have been designed and installed.
- Pneumatic band clamp installation tools were purchased to eliminate manual installation.
- Electric scissors were purchased to remove mold flashing from the rubber strain relief on the connectors of cables.

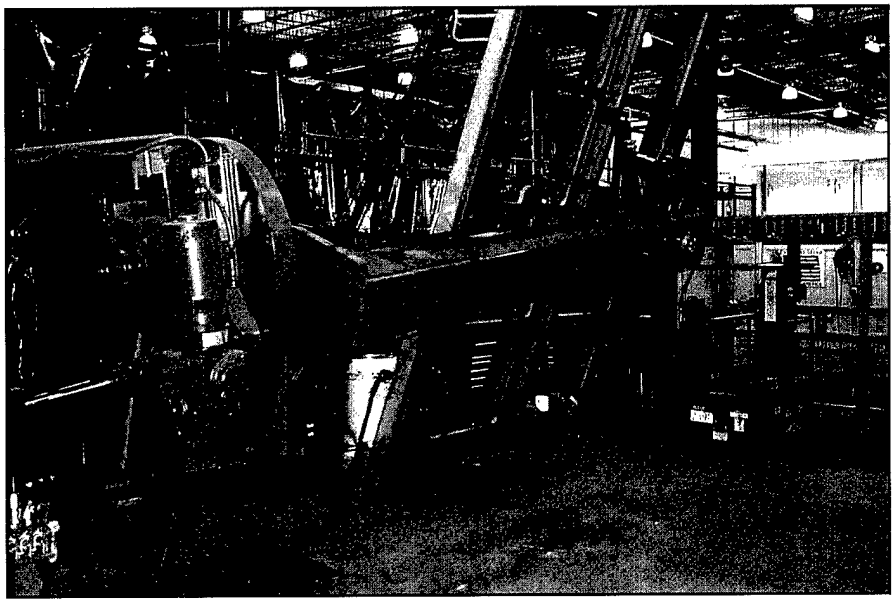

Figure 2-1. Deck Weld Fixture

- An operations engineer designed a multiple layer wire twister for assembling custom multi-wire cable assemblies.

The material handling fixtures developed and implemented at UDLP ASD Aberdeen allow employees of different stature and strength to perform the necessary operations on large, heavy assemblies safely, more quickly, and with better quality. The ergonomic solutions that replaced manual processes have made the operations easier to perform. From 2001 to 2003, cumulative trauma disorders have decreased 75%.

Powder Coating

United Defense, L.P. Armament Systems Division Aberdeen has realized cost savings, increased efficiency and safety, and reduced negative environmental impacts by implementing a Powder Coating process in lieu of liquid painting.

Since 1985, United Defense, L.P. Armament Systems Division (UDLP ASD) Aberdeen has been using two-part epoxy liquid paint for finishing. The process time for most large sized products was three days, mostly spent waiting for the paint to dry. UDLP ASD Aberdeen was also exceeding 10 tons of air emissions annually from the use of solvents involved in the process (within the facility's permitted allowance, but not acceptable to its internal standard).

UDLP ASD Aberdeen now uses a Powder Coating process for finishing some of its products. The products move through a light curtain, which relays the dimensions of the product to the powder guns. Parts as large as 42" and 98" and 8,000 pounds can be handled using this system. Figure 2-2 shows a missile canister being loaded into the powder coating chamber. The powder guns are automated and apply powder coating to the product. Additionally, an automated lance has been installed to enable the inside of the missile canisters to be powder coated. A manually operated hand gun is available for touch-up use as needed.

UDLP ASD Aberdeen has realized many benefits from the use of the Powder Coating process versus liquid paint:

- The operator is removed from this part of the process, increasing overall worker safety
- Air emissions have been reduced from 10 tons of volatile organic compound (VOC) emissions to less than 0.5 ton
- Total time for actual powder coating is approximately 12 minutes (versus four hours)

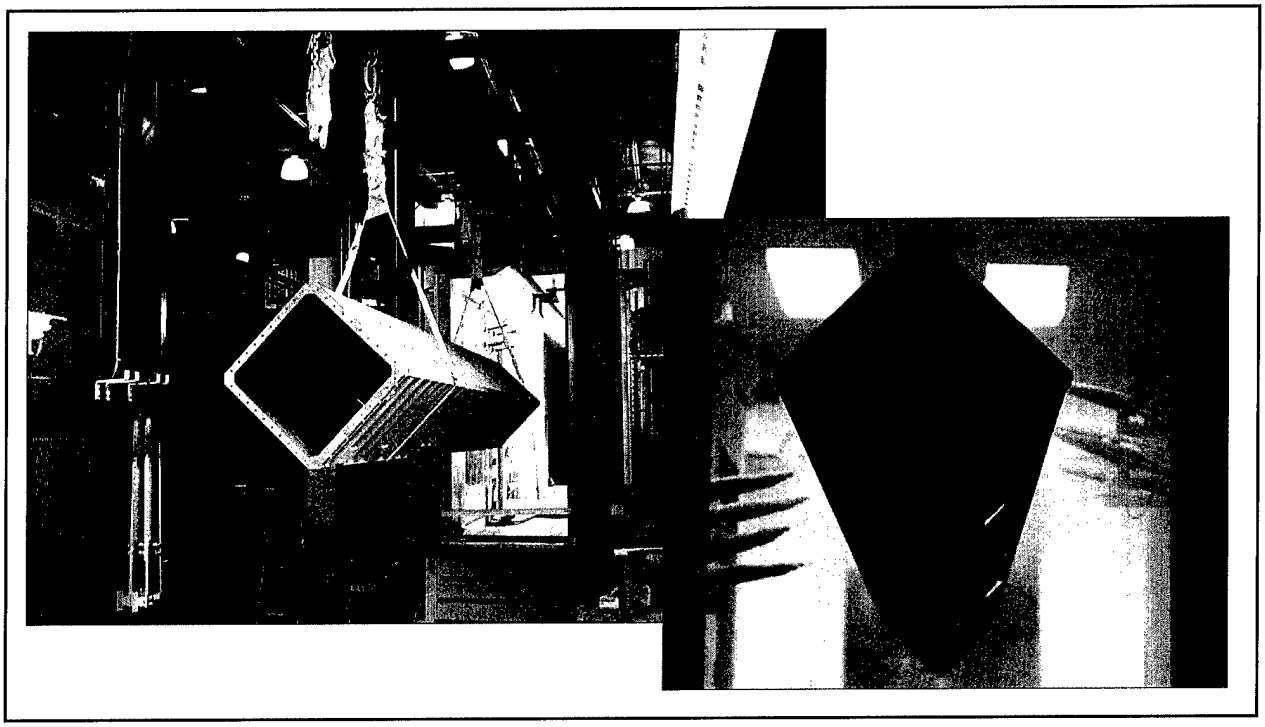

Figure 2-2. Missile Canister Loading Into Powder Coating Chamber

- Overall time for finishing is four hours (versus three days)
- Reclamation system is available
- Powder paint material costs $140 per 1,000 sq. ft. with a coverage efficiency of 70% (with reclamation, it has an efficiency of approximately 90%); liquid paint material costs $660 per 1,000 sq. ft. with a coverage efficiency of approximately 10% to 30%.

Overall, the Powder Coating process saved UDLP ASD Aberdeen approximately $1,150 per 1,000 square feet and is a more efficient process, reducing manual operator involvement through automation and reducing emissions and costs.

Facilities

Parts Preparation

United Defense, L.P. Armament Systems Division Aberdeen developed innovative and effective equipment and processes for preparing individual machined piece parts and complete assemblies for final finishing and painting. These processes and equipment enabled the facility to reduce product throughput time, while increasing the safety of its workforce.

Machined products and items being returned from field service must be cleaned and neutralized to be free of oil, contaminants, and foreign residue prior to subsequent processing. Before the mid 1990s, machined parts were traditionally cleaned in a vapor degreaser containing 1-1-1 trichloroethylene to remove grease, oils, and contaminants. With trichloroethylene being phased out of manufacturing processes due to the environmental hazards created by its use, manufacturing companies had to find alternative cleaning methods. One of the most commonly used methods today is a wash using a caustic wash solution with a final rinse with reverse osmosis treated water. The wash water used in this process is normally heated to an elevated temperature to assist in the cleaning process.

United Defense, L.P. Armament Services Division (UDLP ASD) Aberdeen was faced with a peculiar process requirement. Many of its new manufacture and repair products are missile canisters, which are generally up to 24' long and approximately 24" square. Manually scrubbing these assemblies using the caustic wash solution and brushes was not a long term option as the assemblies had to be cleaned inside and outside of the canisters — a time consuming process. Additionally, there were no commercially available parts washers on the market that could handle the size of the parts and clean both the inside and outside of the canisters.

To mitigate the problem, UDLP ASD Aberdeen personnel designed and built a parts washer that met the facility's needs. The wash cabinet is located in a vertical position to allow an immediate deluge of the wash water in a drain off. A boom and winch system is used to orient the canister from a horizontal position to a vertical position. The load boom is designed to double as a boom, and an internal wash lance with spray nozzles is strategically located along the length of the boom. The cabinet has high pressure nozzles strategically located within it which effectively washes the outside of the canister (Figure 2-3). Utilization of this wash cabinet to clean missile canisters has enabled UDLP

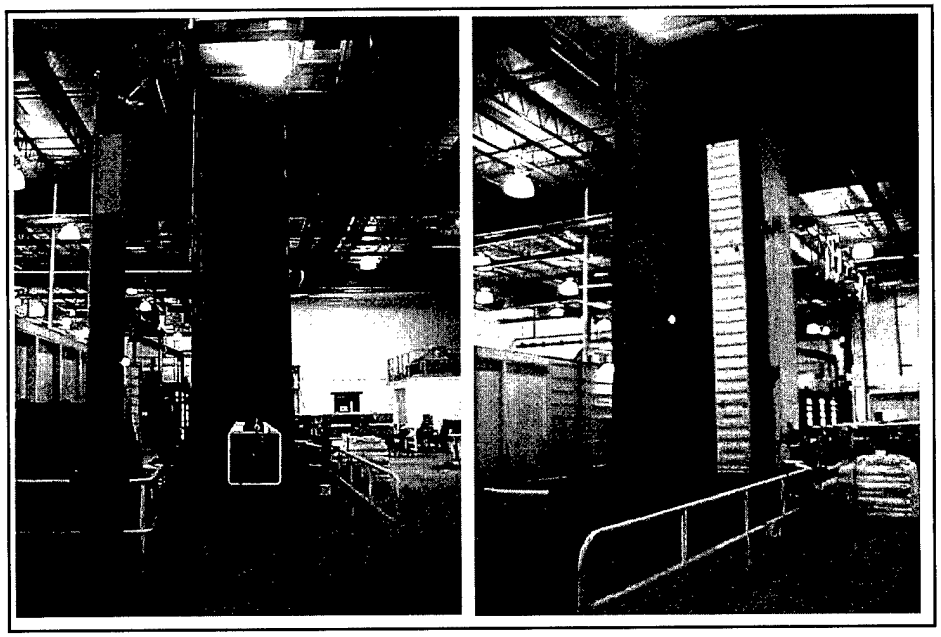

Figure 2-3. Loaded Wash Cabinet

ASD Aberdeen personnel to reduce cleaning time by a factor of ten to one over manual scrubbing. In addition, the use of the cabinet enabled the process to produce consistent and predictable results.

Another method of preparing large missile canisters for finish paint is to grit blast previously painted canisters that are being refurbished or re-manufactured. Traditionally, this was accomplished by placing the unit in a large blasting room where the operator was in full suit personal protective equipment with breathing air. The operator manipulated large, heavy blasting hoses with nozzles to direct the blast pattern against the work surface. Because it was operator dependent, this yielded variations in process results. As operators performed this task, they suffered fatigue which resulted in lost productivity and uncontrolled processes. In addition, the safety of the operator was and is always a concern.

As a process improvement effort and, in an effort to remove operators from the harsh environment, Aberdeen personnel developed an automated blast process to pre-blast painted canisters. The facility purchased a commercial blast cabinet of sufficient size to meet its needs. The internal components of the cabinet were then modified to allow a canister to be crane-loaded into a work fixture. The fixture and canister are then placed into the blast cabinet. The system uses an internal lance blasting arrangement to blast the inside of the canisters and an external blast ring, which supports four rotary blast heads. The blast ring traverses the length of the canister while spinning the blast heads for a spread blast pattern. The system is automated, reducing the need for operator intervention.

The "Auto Blaster" demonstrated a 95% clean up of canisters with no operator interface, eliminating operator safety concerns and ergonomic problems, produced controllable results of the finished product, and reduced operator touch time for canister blasting by approximately 80%.

Management

Assessment Center

United Defense, L.P. Armament Systems Division Aberdeen implemented an assessment process to select those qualified individuals that would best function and contribute within their manufacturing environment. The assessment process determines significant behavioral factors that include group skills, communication skills, personal characteristics, problem solving skills, results orientation, and leadership skills. The process has contributed to a low turnover rate for new hires and very few employees being released after being hired.

At United Defense, L.P. Armament Systems Division (UDLP ASD) Aberdeen, individual employee authority and responsibility are strongly endorsed and encouraged within the facility. Individuals are assigned to autonomous functional teams and provided the opportunity to train and qualify in a variety of roles within those teams. One such role is to conduct exercises that provide an opportunity to evaluate behavioral factors of candidate employees. Selected behavioral factors have been determined to be integral to achieving a high performance work team system. While a successful work history is also valued, behavioral factors are determined to be more essential than technical skills.

Trained and qualified employees participate as assessors with groups of candidates. Together with an independent facilitator, they conduct a series of exercises that enable candidates to participate in and demonstrate their individual attributes. The exercises present a variety of dynamic situations that challenge the six behavioral factors. The employee assessors observe and document their observations of the individual candidate's behaviors, with appropriate anonymity and objective considerations assured at all times. When the group of assessors achieves a consensus on the candidates, recommended candidates are identified to management for subsequent verification actions prior to employment. Candidates are subsequently provided an opportunity to take a plant tour prior to accepting the offer so they can fully appreciate the requirements of the system.

As a result of this significant care and consideration, UDLP ASD Aberdeen has identified and selected those candidates with the necessary skills for success. Both management and workers feel a greater commitment to those hired, while the candidate is exposed to the plant activities and culture. All involved consider the process eminently fair, and turnover for new hires has been low. The Assessment Center is regarded as the first step in a continuous improvement process for all employees. It introduces the candidate to those skills valued by management and workers alike, and it provides assessors the opportunity to gain better understanding of those behavioral skills as they help train others in their use.

Business Process Model

United Defense, L.P. Armament Systems Division Aberdeen helped develop a Business Process Model that enables the Armament Systems Division facilities to standardize key processes across all programs and sites and further eliminate duplication of efforts and redundant resources among different sites within the company.

United Defense, L.P. Armament Systems Division (UDLP ASD) has four manufacturing sites and seven engineering/services facilities located throughout the United States. Until recently, the ASDs operated with independent programmatic and site sensitive business plans. Each site operated as an independent business unit with different goals, objectives, policies and procedures, which resulted in duplication of efforts, inconsistent processes, redundant resources and systems, and general inefficiencies. Overall, a lack of continuity in business processes existed across all programs and sites.

In mid-2002, UDLP ASD Aberdeen contributed to the development of a Business Process Model that would allow the entire organization to standardize administrative policies, procedures, and plans across programs and sites, create enhanced internal process documentation, and implement a formal change control program for all business processes. This Business Process Model looks at all key aspects of a business and documents the processes. Key inputs and outputs of a process are mapped and, wherever possible, metrics are obtained. Subject matter experts (SMEs) and process owners throughout the ASDs are used to provide these inputs and define the outputs of the process. A key element of the business (e.g., management of facilities) is matrixed with the development of technology. Drill downs of this element will define all the key processes, and standardized task processes are then developed to manage each key operational process. If necessary, a third or lower level of each element can be developed for a specific site requirement for the task.

By looking at each key business element, flow charting all processes, and analyzing the inputs and outputs of each process, UDLP ASD Aberdeen developed and implemented this dynamic Business Process Model making it responsive to changing products, process improvements and changes, and regulatory requirements. Since its development and implementation, the Business Process Model standardized key administrative and manufacturing processes throughout the entire organization.

Lean Manufacturing

United Defense, L.P. Armament Systems Division Aberdeen realized dramatic improvements to its manufacturing processes and products by reducing inventory by 78%, reducing cycle times, and opening up capacity for new product lines with the implementation of Lean Manufacturing practices.

United Defense, L.P. Armament Systems Division (UDLP ASD) Aberdeen was opened in 1985 as a facility to build missile canisters for the U.S. Navy. The main plant building was organized with an assembly line process set up in a typical "J" configuration to allow for the efficient flow of materials and products throughout the production cycle. Incoming materials and work-in-process were stored on the factory floor, usually at the point of use. With this type of production and product lines, a compelling need to control inventory did not exist as plenty of space was available to store the inventory; thus, the facility could take advantage of large lot buying leverages. As a result, the facility built up a backlog of material inventory worth approximately $45M, one year's worth of goods.

In late 1997 and early 1998, UDLP ASD Aberdeen experienced a sudden increase in workload from increased orders and transition of work from other United Defense plants, requiring the immediate addition of 30,000 square feet of manufacturing space and 40,000 square feet of storage space for the excess inventory. Realizing that the facility could not handle this increased workload in its present plant layout, UDLP ASD Aberdeen personnel began investing in Lean Manufacturing principles. The first problem the facility tackled was waste — waste of machines, materials, information, and workers (scrap, rework, inspection). The goal was to flow the product at the "pull of the customer" while compressing time and movement.

In conjunction with waste elimination efforts, UDLP ASD Aberdeen contracted with the Georgia Institute of Technology for Lean Manufacturing training. All employees were trained to ensure their buy-in and support of Lean principles and tools. Plant personnel were given the opportunity to apply the knowledge with hands-on learning on one of the facility's major products. Results of the training and application included travel reduction of equipment, piece parts, or employees from 1.3 miles to approximately 330 feet; cycle time reduction for the product was reduced by 28%; footprint reduction for

the process was reduced by 40%; and the team increased the amount of point of use storage (POUS). Personnel were also trained on how to analyze specific manufacturing flows for two major products and the primary processes required to build these products, as well as ways to change the flow of parts and the way they were stocked. A KanBan system was instituted for large items, assembly quantity kitting was used for medium parts, and POUS was used for small parts.

While the implementation efforts of Lean Manufacturing are ongoing, UDLP ASD Aberdeen has realized significant gains by reducing inventory from the previous $45M to $10M, a 78% reduction; releasing two rented storage buildings; reducing painting time processing from three days to less than four hours; reorganizing several key manufacturing processes; and creating more space to allow the facility to take on a new product line.

Performance Sharing Plan

United Defense, L.P. Armament Systems Division (UDLP ASD) Aberdeen developed an effective Performance Sharing Plan that focuses employees on the profitability of the company and rewards them for achieving performance goals.

United Defense, L.P. Armament Systems Division (UDLP ASD) Aberdeen developed a Performance Sharing Plan (PSP) that focuses on performance targets that the employees can influence. The generic performance targets are safety, quality, schedule, and cost. The PSP's objective is to improve the value of the company through improved earnings. The plan payout to employees is based on Earnings Before Interest and Taxes (EBIT) and the level of achievement of the organization's goals. Production employees have a direct influence on safety, quality, schedule, and cost of the product, and indirect employees increase earnings by accomplishing their work more efficiently and cost effectively. Reductions in the cost of rework and other expenses directly increase EBIT.

UDLP ASD Aberdeen funds an amount equal to 2% of employee earnings when the EBIT goal is achieved; an additional 36 cents for each dollar over the EBIT goal goes into the pool. There is no maximum on the EBIT pool; however, maximum payout is 6% of an employee's earnings. The payout from the EBIT pool is based on a weighted performance factor (Figure 2-4). All full-time and part-time employees who are employed through the end of the performance period are eligible for the payout.

Employees gain increased job satisfaction and motivation through increased involvement and re-

Goals	Max. Goal Wt.	Min. (0%)	Target (50%)	Max. (100%)	Actual Goal Perf.	Actual Perf. Factor	Wt. Perf. Factor
Defects per 1000 hours	30%	6	5	4	4	100%	30%
On-time delivery	30%	90%	95%	100%	95%	50%	15%
Cost performance	20%	102%	100%	95%	101%	25%	5%
Design new product	20%	12/1/02	10/1/02	8/1/02	11/1/02	25%	5%
Performance Factor (Total of weighted performance factors)							**55%**

Figure 2-4. Performance Factor Example

wards. Customer satisfaction is greater because quality products are delivered on schedule and at the lowest achievable cost, and the number of defects per 1,000 hours worked has decreased from 8.0 to 2.8. Employees are informed of their standing against the goals on a monthly basis and are more conscious of safety, quality, schedule, and cost.

Position Rotation

United Defense, L.P. Armament Systems Division Aberdeen established employee Position Rotation as one attribute in its High Performance Work Team System enabling more flexibility to be better positioned to meet the changing customer, supply, and production needs the facility experienced. Position Rotation has been a strong contributor in the efforts to improve team spirit and also helped improve employee morale.

United Defense, L.P. Armament System Division (UDLP ASD) Aberdeen recognized that its particular manufacturing processes required production flexibility. Changing customer requirements, changes in production needs, and the supply of parts drove the need for production flexibility. This need mandated that the facility develop a method to better utilize employee skills and experiences, recognizing that employees with varied backgrounds and experiences (i.e., a multi-skilled workforce) were better able to apply themselves to solve work-related problems. The primary method used was Position Rotation.

Position Rotation is a key part of UDLP ASD Aberdeen's employee training process. It is linked to the employee promotion process and is one of a number of attributes in the facility's High Performance Work Team System. Before an employee is hired, he or she is primarily assessed for possession of strong group skills rather than on technical knowledge. An employee's ability to work in groups and change jobs periodically is vital to the success of Position Rotation. An employee's first assignment is with a team that has an opening rather than in an area where the employee has experience. Employees are assigned a sponsor and trainer and will generally spend from 18 to 24 months in a particular work area. After completing several qualification standards (QSs) and successfully working with the team for six to eight months, the employee receives his/her first raise. After the second raise and for every subsequent raise thereafter, the employee must move to another team for training and qualification. Position Rotation is based on company/team needs as well as employee needs. Eventually, the new employee will be the trainer in a particular work area and will need to have the skills to train others. To enable this process, UDLP ASD Aberdeen utilized the "Train the Trainer" program where employees are taught the necessary skills to be effective teachers.

As with the other attributes in the High Performance Work Team System, Position Rotation contributes to continuous process improvement. The screening process ensures that employees who are hired can derive satisfaction from change and improvement. While this work culture is foreign to some, UDLP ASD Aberdeen has seen strong employee participation in this program. The facility reports high employee morale and lower turnover rate. Position Rotation supports a team spirit, which in turn has helped improve safety, quality, schedule, and cost.

Procurement Credit Card Program

United Defense, L.P. Armament Systems Division Aberdeen established a company Procurement Credit Card program that goes beyond the normal industry process. Shop floor personnel are issued and trained in the use of company credit cards for the purchase of company-related overhead operating supplies.

In 1997, United Defense, L.P. Armament Systems Division (UDLP ASD) Aberdeen initiated a Procurement Credit Card program. The facility analyzed its supply chain management program and realized that a large volume of purchase orders was being issued for low impact/low dollar purchases. In many cases, the purchase order process cost exceeded the dollar value of the purchase order. In addition, the process for purchasing emergency items of low dollar value created delays in production and maintenance activities.

UDLP ASD Aberdeen's Procurement Credit Card program reduces the amount of purchase orders and is more responsive to the facility's needs. In order to be eligible to participate in the program, potential participants must attend a comprehensive training program where they are trained in the program's purposes, purchasing of allowable mate-

rials or supplies, card usage responsibilities, and proper accounting procedures after using the card. The training includes instructions on purchasing items that are specifically prohibited (e.g., personal, leasing, office furniture, travel/seminars/tuition, recognition awards, membership dues, computer related expenses).

Credit cards are issued to one administrative assistant for the routine purchase of office supplies and one maintenance repair operations person for the purchase of machining, welding, painting, electrical, packaging supplies, and building maintenance items. In addition, UDLP ASD Aberdeen issued credit cards to shop technician team members to purchase low cost shop supplies, safety supplies, and general use tooling. The issuance of credit cards to shop floor personnel was an innovative step since management approval is not required prior to initiating a purchase.

The internal monthly statement reconciliation and auditing processes help ensure the integrity of the program and monitor that the $2,500.00 per purchase and $5,000.00 monthly transaction limits per user are enforced. Since implementing the process, UDLP ASD Aberdeen has expanded the use of the credit card and estimates an annual cost avoidance/cost savings of approximately $300K. These savings are based on a calculated purchase order processing cost of $130 and a calculated cost of printing a bi-monthly check of $20 to the credit card company.

Quality System Training Record Database

In 2003, United Defense, L.P. Armament Systems Division Aberdeen implemented a Quality System Training Record Database. This computerized database provides a live, interactive system for documenting and auditing employee qualification standards obtained for each job or skill learned.

Historically, United Defense, L.P. Armament Systems Division (UDLP ASD) Aberdeen maintained individual paper records or binders for all employees on each qualification standard (QS) accomplished for a particular job or skill learned. Individual QS paper records had the potential of being lost or misplaced which, if lost, required the re-creation of the lost record. While a database had been maintained to compile records of accomplishments, each QS required manual entry by staff assistants. Floor personnel did not have access, and no easy method existed to search for employees trained for a particular job. Additionally, without original documentation of QSs, completed training could not be verified.

UDLP ASD Aberdeen rotates each of its 100 employees to a new job within the manufacturing process about every 18 to 24 months to learn a new skill. On average, an employee's QS binder could contain 20 to 40 records. QSs are specifically designed for each job, and identify skill areas and role responsibilities as well as elective and mandatory requirements. Continuing to improve and learn new job skills within the manufacturing process is part of the promotion process for all employees. In 2003, UDLP ASD Aberdeen developed and implemented the Quality System Training Record Database — a more reliable and versatile computerized database to maintain training records and QSs. The new database is a fully computerized, interactive system which allows access of floor personnel. It has eliminated the need for overhead administrative support in keeping and updating QS records, and prevents unqualified trainers from approving others in the training process. It has also eliminated concerns of lost paper records because all training documentation is maintained in the database, and all entries are entered directly by the trainers.

UDLP ASD Aberdeen's Quality System Training Record Database allows for system queries by either employee or skill, helped identify those employees who need skills for rotation to other jobs during heavy workloads, and aids in auditing and required ISO compliance demonstrations.

Safety Program

Employees at United Defense, L.P. Armament Systems Division Aberdeen have been involved in developing and implementing continuous safety improvements. The Safety Program has resulted in a significant reduction in injury rates, despite higher exposure hours.

In the late 1980s, United Defense, L.P. Armament Systems Division (UDLP ASD) Aberdeen focused on producing various missile canisters — a new product line for the facility. At that time, there was little emphasis on safety and, as a result, the recordable injury rate was as high as 25 per 150,000 exposure hours. Between 1987 and 1991, the lost workday injury rate climbed from zero to five per year as the exposure hours increased from 150,000 to 200,000.

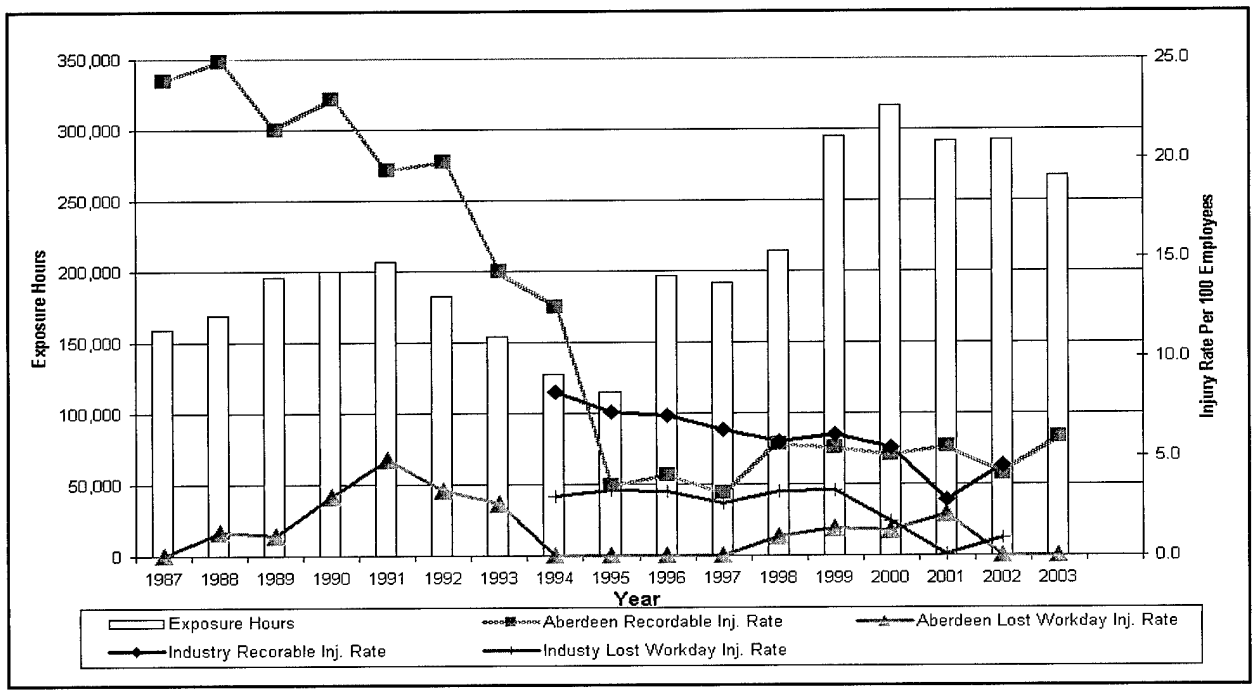

Figure 2-5. Injury Rate History vs. Industry Average

In 1991, UDLP ASD Aberdeen placed a higher emphasis on safety with employee involvement. The new focus became to safely produce a quality product on schedule at the lowest achievable cost, and made employees responsible for their own safety and the safety of their co-workers. This responsibility is designated in the plant's credo, the safety policy, and the performance appraisal process (a yearly evaluation of an employee's performance). Additionally, manufacturing procedures include how to safely produce products. These procedures include operations such as welding, painting, cutting, and heavy material handling. Employees are also involved in developing and implementing improvements in safety by improving fixtures and tools, including enhanced ergonomics, reduced manual handling, reduced manual welding, use of air pallets, and an improved dust collection system. The employees' responsibilities are further enhanced with the utilization of a safety committee, comprised of six shop technicians and several management support staff. The shop technicians (safety representatives) must be experienced in three of the five manufacturing areas and attend OSHA training. The safety representatives conduct three types of safety audits monthly. The rotation of representatives in each work area allows all work areas to be audited once a week. Logs are kept to ensure follow-through on action items. One-on-one feedback is provided to co-workers on the utilization of safe and unsafe practices during weekly team meetings and performance appraisals. Safety is also included as part of the performance sharing plan.

Positive results were realized from the implementation of the Safety Program (Figure 2-5). The lost workday injury rate in 1991 was five for 200,000 exposure hours. By 1994, the lost workday injury rate dropped to zero for 130,000 exposure hours. Since 1991, the lost workday injury rate has been at two or less, despite an increase in exposure hours. Between 1991 and 1995, the recordable injury rate dropped from 20 to four and has remained between four and six, despite increasing exposure hours.

Skill Based Pay

With the inception of operations, United Defense, L.P. Armament Systems Division Aberdeen implemented a Skill Based Pay system. The system has been highly effective at motivating employees, encouraging growth in employee skill sets, and nurturing the team environment.

When the United Defense, L.P. Armament Systems Division (UDLP ASD) Aberdeen opened in 1985,

it was decided that a Skill Based Pay structure would be implemented. When a person is hired, he or she may fill any vacancy and begin at an entry-level pay rate. Training is provided for new hires in technical production, team interpersonal skills, and production process skills. The employee progresses through seven separate pay steps, is assigned to a work station, and must meet the defined qualification requirements for that work station. Every 18 to 24 months, the employee is rotated to another work station to learn new skills. The progression beyond the third step requires participation in collateral duties (e.g., team leader; schedule, parts, supplies, quality, and bulk representatives). The Skill Based Pay system attracts job applicants who want to learn and control their own destiny.

Employees are not in competition with each other for advancement, but their advancement is based on how well they function as part of the team after they meet the detailed qualification requirements for their work station. The Skill Based Pay system encourages employees to constantly strive for continuous improvement in everything they do. Morale is high, turnover is low, and the job rotation also eliminates the potential for any job becoming routine over time. Since implementing the Skill Based Pay system, UDLP ASD Aberdeen has a highly skilled and motivated workforce.

Supplier Management

United Defense, L.P. Armament Systems Division Aberdeen enhanced its Supplier Management system by creating a Supplier Review Board, resulting in greater control over its vendors.

In the past, the three Armament Systems Divisions (ASDs) of United Defense, L.P. (UDLP) independently managed a total of 370 suppliers, and each site had independent supplier quality processes. In 1999, UDLP ASD Aberdeen created a Supplier Review Board (SRB) to help streamline supplier management and supplier quality processes. The SRB's purpose is to determine new suppliers, evaluate performance, and review under performers. The board meets monthly to discuss quality, delivery, and other issues affected by suppliers who do not meet requirements. The results of the monthly evaluations are sent to the respective suppliers quarterly or monthly based on the scale of the supplier's business. The SRB allows for a preliminary procurement review to ensure that supplier capability and procurements by other ASDs are not affected. The review board also schedules on-site assessments of potential new suppliers to ensure they meet quality requirements. Corrective actions resulting from these reviews must be completed prior to the SRB's approval of the supplier. The supplier list is used to monitor performance based on quality and delivery expectations, and also contains commodity codes designating supplier capabilities (e.g., process, material type, size of product, complexity [dimensional], single/sole-sourced).

With the implementation of the Supplier Management system, the UDLP ASDs reduced their suppliers from 370 to 240, nearly doubled the overall quantity of on-time deliveries since 2002, gained insight into their vendors' quality processes, improved communications with the suppliers, and improved the quality and timeliness of procurements.

Section 3

Information

Production

Laser Welding

United Defense, L.P. Armament Systems Division Aberdeen switched from gas metal arc welding-pulsed to laser welding for its Mk 25 missile canisters, resulting in improved weld quality and cost savings. The use of laser welding also reduced bowing and twisting of the canisters.

Prior to 2002, United Defense, L.P. Armament Systems Division (UDLP ASD) Aberdeen used gas metal arc welding-pulsed (GMAW-P) to weld the Mk 25 missile canisters. This process resulted in distortion, bowing, and twisting due to the high heat input, which caused difficulty in assembling them into a quad pack and did not allow interchangeability of the canisters. To address the distortion issue, UDLP ASD Aberdeen changed to laser welding and adapted an existing robot cell to save time and money. Operators were already familiar with the machinery and programmed and tested the system. A laser seam finding system was also installed, which locates the joints by measuring differences in heights using a laser beam.

Laser welding is low maintenance, has a low cost of operation, and is user friendly. Additionally, it has a high divergence rate, which increases safety. A fill wire feeder was added to the system because of strict undercut requirements. The laser has nine kilojoules of heat input versus 20 to 30 kilojoules from the GMAW-P, which alleviates the distortion difficulties. The system also gives a reduced weld size and reduces the use of filler metal. The filler metal reduction resulted in saving $75,000 in the first year of use. Additional benefits for the Mk 25 canisters include overall increased weld quality and decreased filter wire usage and rework time.

Facilities

Environmental

United Defense, L.P. Armament Systems Division Aberdeen is committed to meeting environmental

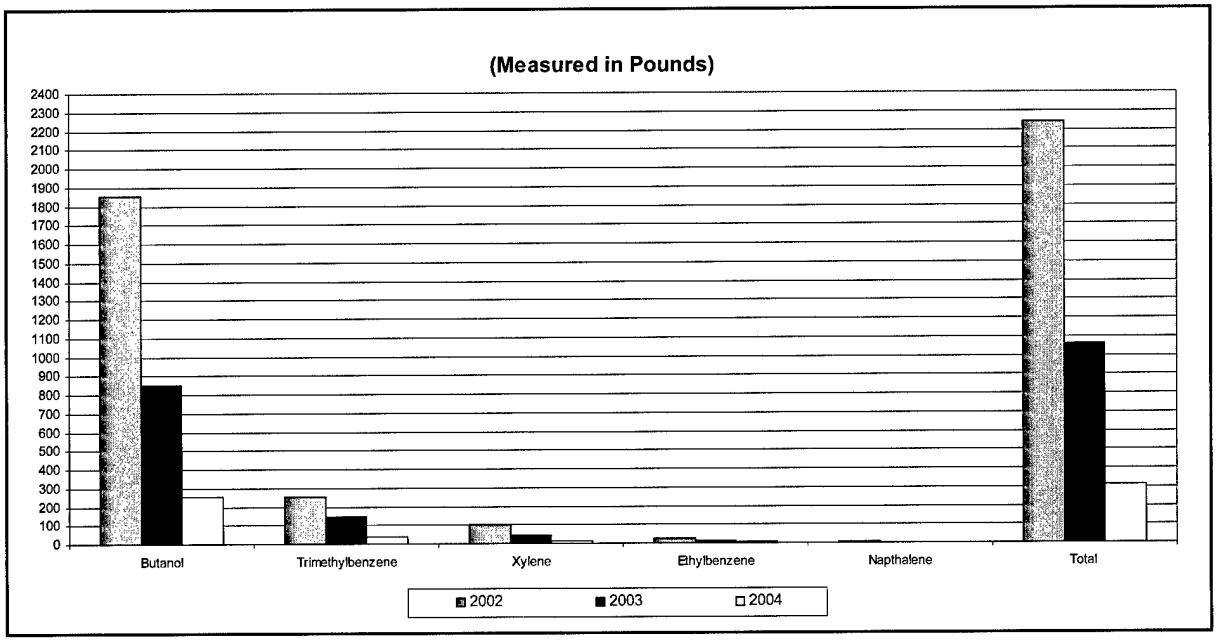

Figure 3-1. Emissions - Based on Forecasts

regulations on an ongoing basis and developed an integrated approach to proactively minimize negative environmental impacts.

Prior to 2001, United Defense, L.P. (UDLP) had its individual facilities, such as the Armament Systems Division (ASD) Aberdeen, perform minimal environmental reporting requirements to the Divisional Environmental Manager. Each facility addressed its own environmental targets and objectives and established separate programs to manage regulatory conformance requirements of local, state, and federal agencies.

UDLP is now addressing environmental issues at the Corporate level. Environmental targets and objectives are integrated throughout the ASDs, and the company is working toward environmental goals as a whole rather than individual facilities. UDLP ASD Aberdeen is ISO 14001 compliant with a defined program and resources. Dynamic targets and objectives are defined, and periodic performance reviews are conducted. Additionally, an integrated internal procedures awareness review has been established. This review requires that all capital appropriations requests be submitted to an environmental review, which identifies environmental impacts caused by the associated projects. This level of commitment in addressing environmental impacts has been incorporated into UDLP ASD Aberdeen's business process model. As a result of the environmental initiative, UDLP ASD Aberdeen has realized an 85.5% reduction of volatile organic compound (VOC) air emissions in the past 24 months, and eliminated one of the few remaining hazardous materials from the plant (Figure 3-1).

UDLP ASD Aberdeen's commitment to meeting environmental regulations and Corporate goals is ongoing. The dynamic targets and objectives for 2004 include the continuing reduction of VOC emissions by completing the implementation of powder paint; reduction of aqueous wash water disposal by 85%, which will yield a savings of approximately $15,000 annually; and improving the internal air quality in one of its manufacturing facilities.

Management

Communication

United Defense, L.P. Armament Systems Division Aberdeen implemented an integrated communications process that addresses the range of employee, functional team, plant, and division needs. This system's integrated capabilities have greatly contributed to communicating and controlling manufacturing issues.

Communication has been widely recognized as a key attribute of the operating culture within United Defense, L.P. Armament Systems Divisions (UDLP ASDs), and even more so within the culture of the Aberdeen facility's workforce. Aberdeen's credo specifically cites its reliance on open, honest communication while emphasizing the need to listen, and implemented a tailored communication process in keeping with its background and current and projected requirements.

With a firm foundation of communication between and among individuals at UDLP ASD Aberdeen, it was an easy adaptation to also encompass facility and ASD requirements. The robust Aberdeen culture expects and requires open, one-on-one communication and feedback to achieve continuous improvement opportunities. As such, a solid basis existed to ensure that two-way communication was also provided for the employee with the facility and the Division. Standard and unique requirements are identified, with essential elements shared with candor and clarity. Such information is provided with the recognition that not only do employees exercise considerable autonomy and self-directed work efforts, but they must be properly informed to make good judgments and decisions.

To ensure a positive flow of information to the employee, a combination of printed and electronic means are employed. The Division-wide newsletter ensures wide distribution of general interest information throughout the larger organization. Intranet sites (both facility and Divisional) complement these newsletters with current events, data, results, planning, and topics of continuing value. In addition to the ad-hoc dialogues that transpire daily, plant-wide meetings are held bi-monthly that encompass the full range of current issues, group communications, training, and employee recognition. Functional teams and their team leaders also hold weekly meetings that focus on the primary issues of safety, quality, schedule, and cost. Consequently, a consistent flow of appropriate information is provided to the employees.

UDLP ASD Aberdeen understands and supports the costs associated with these communication actions to properly enable the autonomous functional teams to make informed decisions. As a result of its culture and enabled workforce, UDLP ASD Aberdeen has realized improved morale and increased worker identification with the facility and company

goals. Equally important, continuing improvements in facility safety, quality, schedule, and cost performance have resulted.

Councils and Networks

United Defense, L.P. Armament Systems Division Aberdeen initialized a Manufacturing Council to address global utilization of Corporate assets and the necessity of core competencies. One of the Council's charter tasks is the implementation of a single business system across the Divisions.

United Defense, L.P. Armament Systems Division (UDLP ASD) Aberdeen recognized that manufacturing sites were under utilized across the Corporation and core competencies were being replicated. Programs were making autonomous make/buy decisions while sites had autonomous purchasing organization(s). UDLP ASD Aberdeen determined that the implementation of a single business system across the ASDs was needed.

To assist in the implementation of a single business system, UDLP chartered the following leadership teams:

- Manufacturing Council: UDLP Plant Managers
- Quality Partnership Council: UDLP Quality Managers
- Material Acquisition Network: UDLP Procurement Managers
- Integrated Business System (IBS) Process Teams: ASDs' multi-site, multi-functional subject matter experts (SMEs)

The Manufacturing Council's mission includes operating as a clearinghouse to support program management for major purchasing and new program decisions. Council members provide leadership to the UDLP material acquisition and component manufacturing strategies, jointly address specific workload troughs and under utilized, specialized capabilities, and make UDLP's major capital equipment acquisition decision recommendations. The Council functions as an informal source of mentoring and manufacturing initiatives across the ASDs, supports and coordinates key manufacturing initiatives for consistency, and addresses UDLP's common manufacturing, marketing, and performance issues. The Council members also offer sharing and coaching support in leading change and joint development of solutions to common manufacturing related problems.

UDLP ASD Aberdeen developed and implemented common quality requirements and revised its make/buy policy to consider in-house fabrication as an alternative. The clearinghouse process identifies strategic parts, and sources them in appropriate UDLP-wide sourcing agreements (e.g., flat rolled products, hardware, fasteners and computers). UDLP ASD Aberdeen realized a 7% decrease in hardware costs for its products. Business processes were standardized for its Procurement Standard Practices and Material Management and Accounting System, and improvement in its IBS process continues.

360 Feedback Program

United Defense, L.P. Armament Systems Division Aberdeen recognized the benefits of an employee feedback system and established the 360 Feedback program. The facility recognized that feedback of employee performance skills from peers, customers, and managers helps employees identify strengths and areas for development that eventually benefit both the employee and the Company.

In 1985, United Defense, L.P. Armament Systems Division (UDLP ASD) Aberdeen established an employee feedback process that is also used as part of the annual appraisal process. UDLP ASD Aberdeen recognized that feedback from peers, customers, and managers help employees identify strengths and areas for development. The benefits of such a process led the facility to implement the 360 Feedback program for staff management positions in 2002.

The 360 Feedback program is used as a baseline to assess a number of performance skills including technical, interpersonal, effectiveness, customer satisfaction, teamwork, professional knowledge, and innovation. The major goal was to identify strengths and areas that could be enhanced. It is used for developmental purposes with summary results provided to the employee. For the shop technician, the 360 Feedback program is recognized as an opportunity to understand and improve.

Establishment of the 360 Feedback program has proven beneficial for both the employee and the Company as it facilitates personal growth, career development, and aids in composing meaningful development plans. It helps employees in giving and receiving feedback, provides performance feedback from various sources in a non-threatening environment, improves morale, and helps identify and facilitate development of high potential employees.

Point of Use Storage

United Defense, L.P. Armament Systems Division Aberdeen uses Point of Use Storage which places components adjacent to work stations. This reduces the time employees must travel to other locations in the plant to retrieve parts and materials.

Since its inception, United Defense, L.P. Armament Systems Division (UDLP ASD) Aberdeen has used Point of Use Storage (POUS) which places components adjacent to work stations. POUS stores needed kits and other parts at the work location where assembly takes place. This reduces the amount of time employees must travel to other locations in the plant to retrieve parts and materials. The facility also employs a backflush methodology to relieve inventory, and a cycle count system to audit inventory accuracy. Once the assembly is complete, the bill of material items are backflushed and relieved from inventory.

UDLP ASD Aberdeen maintains inventory accuracy by annually stratifying inventory based on turnover value into A, B, or C classifications. The inventory is cycle counted quarterly, bi-annually, and annually for A, B, and C classifications respectively. Each team is comprised of a parts representative who performs the counts as required. Parts representatives also meet monthly with the inventory planner to review metrics and identify issues, resolutions, and process improvements. Each team is responsible for maintaining scrap logs that are submitted to the inventory planner.

UDLP ASD Aberdeen controls inventory by using three systems — POUS, backflushing, and auditing inventory accuracy — enabling the facility to achieve an accurate, reliable inventory system and yielding an inventory accuracy greater than 95%. Since April 2001, UDLP ASD Aberdeen has maintained 100% on-time delivery, and accuracy for 2004 to date is 98.5%.

Quality Management System

United Defense, L.P. Armament Systems Division Aberdeen implemented a computerized system to manage its quality assurance requirements in the manufacturing environment. The process, common throughout the Armament Systems Divisions, uses a commercially available software tool. The integrated capabilities of the system have greatly contributed to communicating and controlling manufacturing quality issues.

In 1999, United Defense, L.P. Armament Systems Division (UDLP ASD) Aberdeen implemented a computerized, commercially available Quality Management System, AutoQualityâ, a suite of integrated applications to improve data collection, meet the facility's quality assurance requirements in the manufacturing environment, and improve quality management within the Aberdeen facility and throughout the ASDs. Primary applications have included features such as receiving inspection, supplier rating, nonconformance, in-process inspection and test, gage and tool, and statistical process control. Reported principal features and benefits include consistent integration in prevention, detection, correction, and management roles for product manufacturing. Since the data structure is available and common throughout the ASDs, communications have improved, both within and among the separate facilities, while eliminating the need for duplication of data for the multiple, integrated quality assurance roles.

Specific benefits achieved include rapid retrieval of historical information, flexibility in searching and reporting quality data, comprehensive and timely supplier quality communications, ability to attach relevant documentation, ability to easily modify requirements, auto-notification by e-mail of required quality actions, calculation and generation of quality metrics, and continuous improvement of workforce and supplier quality.

While overall manufacturing and product quality have steadily improved since the introduction of the Quality Management System, UDLP ASD Aberdeen continues to enhance its use and proficiency with this tool. Consistent communication has enabled greater efficiency in both prevention and correction efforts as seen between facilities and among different products. The readily available quality data has resulted in quicker and more comprehensive problem recognition while also contributing to significantly more expeditious resolutions.

Team Responsibilities

United Defense, L.P. Armament Systems Division Aberdeen implemented a number of autonomous teams within its manufacturing environment. These teams, unique to Aberdeen, are predicated on the

basis that greater involvement equals greater commitment. A strong sense of identity has been formed that equates success of the individual with that of the team and the Company.

United Defense, L.P. Armament Systems Division (UDLP ASD) Aberdeen implemented an innovative process to establish autonomous teams within its manufacturing environment to exercise increased and self-directed involvement. Employees are assigned to one of a variety of functional teams (e.g., welding, finishing, painting, cabling). During their time on that team, employees will rotate through a number of varied role responsibilities (e.g., parts, supplies, quality, leader). As a result of the training and experience in these varied roles, each employee is challenged to grow, both technically and personally, while making positive contributions to the plant's manufacturing objectives. Employees become increasingly aware of their own potential to influence the safety, quality, schedule, and cost of UDLP ASD Aberdeen's manufacturing environment. UDLP ASD Aberdeen recognizes that employees possess a considerable range of skills and abilities, and the facility has removed one supervisory level to challenge and harness its employees' potential.

While traditional management identifies "what" results are expected, it remains the responsibility of the teams to determine the "how" mechanisms to achieve those results. Considerable emphasis is given to providing open, honest feedback to other team members to help them continuously improve their performance. This includes mentoring employees on their communication abilities. As a result of enlarging the traditional workforce responsibility and authority, improvements have been achieved in morale, turnover, and performance, and employees have taken a similar approach to more active roles outside the Company as citizens within their local communities.

Tooling and Supply Management

United Defense, L.P. Armament Systems Division Aberdeen improved its Tooling and Supply Management by implementing a procurement system that uses one major supplier for most of its maintenance, repair, and operations supplies.

Previously, United Defense, L.P. Armament Systems Division (UDLP ASD) Aberdeen used an ad-hoc, back-door purchasing program from various suppliers for its Tooling and Supply Management. This process resulted in a lack of standardization, disruption of production flow and utilization, return and warrantee issues, and minimal after sale support. To improve its Tooling and Supply Management, UDLP ASD Aberdeen instituted a maintenance, repair, and operations (MRO) procurement system which identified overhead cost items and pre-designated 32 storage cells for those items. A KanBan card system and bar code scanners are used to order supplies. The scanning system allows any given item to be ordered no more than once in a day. If that same item is scanned the following day, the item is flagged for management's review. UDLP ASD Aberdeen is also moving away from multiple suppliers to one major supplier for MRO supplies. This supplier ships daily, with orders presorted by storage cell. By developing a relationship with one supplier, UDLP ASD Aberdeen improved order accuracy, warranty, and technical support, decreased delivery times, and increased fill rate to 87%.

UDLP ASD Aberdeen's Tooling and Supply Management system enabled the facility to reduce its inventory for MRO supplies to two-week levels, thus reducing the need to stockpile and use space. It has also reduced processing time in purchasing, receiving, and accounting; increased accuracy of orders; reduced obsolescence; and encouraged standardization.

Appendix A

Table of Acronyms

ACRONYM	DEFINITION
ASD	Armament Systems Division
EBIT	Earnings Before Interest and Taxes
FMC	Food Machinery Corporation
GMAW-P	Gas Metal Arc Welding-Pulsed
Harsco	Harrisburg Steel Company
IBS	Integrated Business System
MRO	Maintenance, Repair, and Operations
POUS	Point of Use Storage
PSP	Performance Sharing Plan
QS	Qualification Standard
SME	Subject Matter Expert
SRB	Supplier Review Board
UDLP	United Defense, Limited Partnership
VOC	Volatile Organic Compound

Appendix B

BMP Survey Team

Team Member	Activity	Function
Larry Halbig 317-891-9901	**BMP Field Office-Indianapolis** Indianapolis, IN	**Team Chairman**
Victor Norris 301-405-9990	**BMP Center of Excellence** College Park, MD	**Technical Writer**
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Peter Bissegger 909-273-5766	**Naval Surface Warfare Center – Corona** Corona, CA	
Paul Silver 909-273-5494	**Naval Surface Warfare Center - Corona** Corona, CA	
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Larry Robertson 812-854-5336	**Naval Surface Warfare Center - Crane** Crane, IN	**Team Leader**
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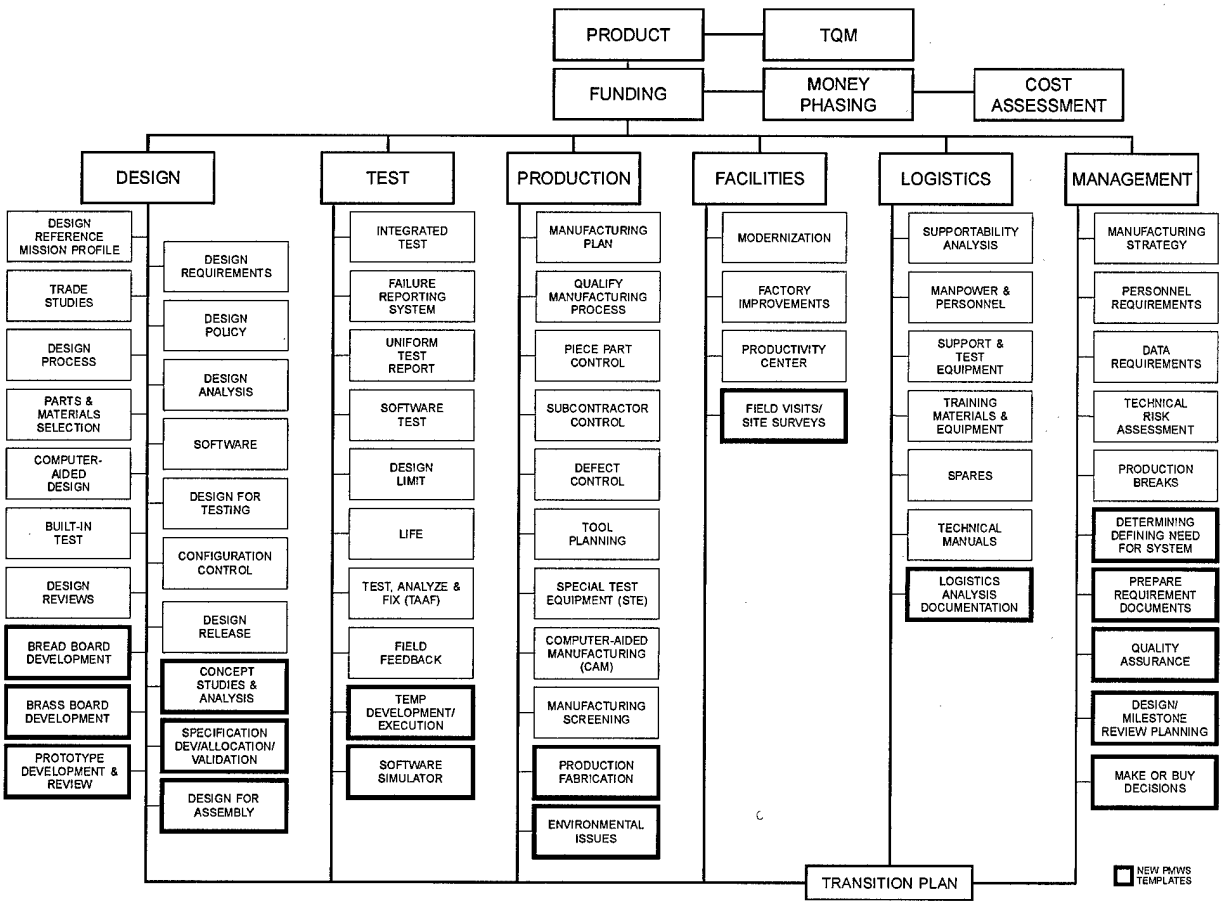
Appendix C

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.

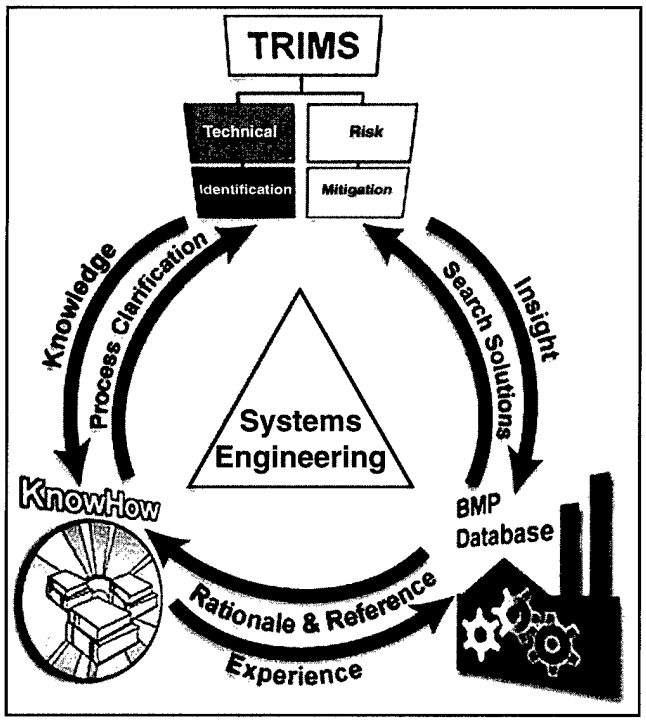
"CRITICAL PATH TEMPLATES FOR TRANSITION FROM DEVELOPMENT TO PRODUCTION"



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.

Point of Contact:
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4321 Hartwick Road
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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.

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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:
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Applied Research and Development Institute
Composites Manufacturing Technology Center
934-D Old Clemson Highway
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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:
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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:
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West Hills Industrial Park
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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:
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National Center for Excellence in Metalworking Technology
c/o Concurrent Technologies Corporation
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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
Building D326, Room 227
Indian Head, MD 20640-5035
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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:
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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:
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Research and Technology Park
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Appendix G

Completed Surveys

As of this publication, 138 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 (now Lockheed Martin Aeronautics Company) (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 In Tolerance - Cedar Rapids, IA ABC Virtual Communications, Inc. - West Des Moines, 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
2004	United Defense, L.P. Armament Systems Division - Aberdeen, SD