REPORT OF SURVEY CONDUCTED AT

ROCK ISLAND ARSENAL
ROCK ISLAND, IL

APRIL 1997

Best Manufacturing Practices

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Foreword

This report was produced by the 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 Rock Island Arsenal, Rock Island, Illinois conducted during the week of April 7, 1997. Teams of BMP experts work hand-in-hand on-site with the activity 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 government, industry, 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, BMPnet, 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.

Rock Island Arsenal is noted for its expertise in the manufacture of weapons and weapon components. Product items range from artillary gun mounts and recoil mechanisms to aircraft weapons sub-systems. Rock Island Arsenal has been evaluated and selected as a regional center under regionalization initiatives as part of the Army's effort to consolidate services. The Arsenal's manufacturing facility, information technology infrastructure, expertise, and capabilities are world-class and unparalleled within Government.

The Best Manufacturing Practices program is committed to strengthening the U.S. industrial base. Survey findings in reports such as this one on Rock Island Arsenal expand BMP's contribution toward its goal of a stronger, more competitive, globally-minded, and environmentally-conscious America.

I encourage your participation and use of this unique resource.

Ernie Renner
Director, Best Manufacturing Practices

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Section 1

Report Summary

Background

Located on a 946-acre island in the upper Mississippi River, Rock Island Arsenal (RIA) is one of the largest employers in the area with an estimated economic impact of $1,000,000 daily. As the largest government-owned weapons manufacturing arsenal in the western world, the Arsenal provides manufacturing, logistics, and base support services for the Armed Forces.

Noted for its expertise in the manufacture of weapons and weapon components, every phase of development and production is available from prototype to full-scale production of major items, spare parts, and repair items. Product items range from artillery gun mounts and recoil mechanisms to aircraft weapons sub-systems. Some of the Arsenal's most successful manufactured products include the M198 and M119 Towed Howitzers, and the M1A1 Gun Mount.

RIA's capabilities include tool, die, and gage manufacturing; precision investment castings; foundry; heat treating; prototype; gear manufacturing; forgings; spring manufacture; machining; platte and sheet metal; blasting; rubber and plastic molding; welding; and surface finishing.

RIA's laboratory, testing, and inspection capabilities include chemical analysis; a weapons testing complex; coordinate measuring machines; test and measurement equipment calibration; and testing in the areas of vibration, oil and lubrication, radiological, mechanical/metallurgical, nondestructive, environmental chamber, and rubber, plastic, and fibrous materials.

The Arsenal's logistics mission includes the primary tool set mission for federal agencies, the application of chemical-protective coatings to combat vehicles, and the construction of storage units for the Army's War Reserve Ships. The tool set mission can be customized, with a lifetime warranty. Sets range in size from carrying case to fully equipped and mobile shelters. Noted products include the New Aircraft Tool System which saved the Department of Defense over $10 million, and the Contact Maintenance Truck Humvee. Capabilities include turn-key operations; prototype; engineering/design; fabrication; assembly/disassembly; laser etching; indoor/outdoor storage; demil; equipment/component acquisition; and fielding support.

The Arsenal has been evaluated and selected as a regional center under regionalization initiatives as part of the Army's effort to consolidate services. Basic services offered include information technology, public works, law enforcement, equal opportunity, community/family activity support, supply, personnel administration, and fire protection which are provided to over 30 tenants on the island. As home to a Post Exchange, Commissary, and Health Clinic, the Arsenal is a regional service center for active and reserve military and 15,000 military retirees who live within 125 miles of the Arsenal. The Arsenal's grounds and facilities include 2.1 million square feet of manufacturing space; 3.8 million square feet of storage space; and 2 million square feet of administration space.

RIA has evolved over the years into a center of technical excellence for weaponry, tool sets, and base support services supported by a highly educated and motivated workforce of 1,900 civil servants who are represented by five local unions, nine military personnel, and 500 contract personnel. Its annual budget is $185 million.

RIA's efforts are guided by a planned and documented management and quality system. Self-directed work teams, customer/supplier partnerships, and customer feedback are used throughout the Arsenal. Whether the mission is manufacturing, logistics, or base operations, key customer requirements are measured, monitored, and improved based on cost, quality, and timeliness. In recent years, the Arsenal has been recognized as a Center of Excellence for Quality, an ISO-9002 registered facility, a National Partnership facility, a Contractor Performance Certification Program certified facility, and a Presidential Quality Award finalist.

The Arsenal's 117 self-directed work teams share the responsibility and authority to plan, implement, and control work processes, resulting in a streamlined organization from six layers of management down to two. RIA's Labor-Management Council is recognized as one of only five National Labor Partnership winners in 1997. The council has been the primary driver for such improvements as the alternative work schedule, self-directed work

teams, and the 360 degree appraisal system. Recent examples of RIA's partnering with customers include M1A1 Tank Co-Production Program with Egypt; Tank, Automotive, and Armament Command to design and build 5-ton truck armor kits; and General Services Administration customized tool kits. The Arsenal's Community Team, through the Manufacturing Technology Consortium, strengthens the overall community services and practices in education, employment capabilities, manufacturing, and tourism.

The Arsenal has been transitioning from a traditional manufacturing facility to a flexible facility looking to the future. Results of its manufacturing efforts include the reduction in the manufacturing rejection rate of 66% from 1992 to 1996; simulation facility testing reduced the cost of live-firing of howitzers by 33%; volume of hazardous waste has been reduced by 85% and disposal costs reduced by 75%; process cycle time for Computer Numerically Controlled program changes have been reduced by 90%; and $10.9 million in value engineering savings in 5 1/2 years has been achieved. Logistics results show an 84% cost reduction through redesign of the tool procurement process; and a government supply center, "Uncle Sam's Emporium," with competitive prices, a World Wide Web catalog, free deliveries, and credit card purchasing. Base operations relationship has resulted in a reduction of 30.2% in the internal operating budget; $2.2 million in depreciation expense; and 24.8% per capita tenant costs. A Paperless Equal Employment Opportunity complaint system reduced processing costs by 70%. Local community and state government partnering developed the Iowa Communications Network, saving an estimated $200,000 to $600,000 per user.

Streamlining and modernization must continue to take place in all areas of the Arsenal if it is to survive into the 21st century. Decreasing military budgets, increasing technological demands, and legal and regulatory changes involving topics such as privatization and tightened environmental controls present daunting challenges. RIA is fully capable of meeting these challenges and becoming the Department of Defense's provider of choice for military products and services. RIA's manufacturing facility, information technology infrastructure, expertise, and capabilities are world-class and unparalleled within Government. The BMP survey team considers the following practices to be among the best in industry and government.

Best Practices

The following best practices were documented at Rock Island Arsenal:

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Laser Cell/Waterjet/Fabrivision 13

RIA uses machining technology and software to produce, inspect, and reverse engineer flat stock parts. Numerical Control nesting software and the vision inspection machine work in tandem to produce a drawing which can be digitized to show critical dimensions. The drawing is then overlaid onto a template drawing with out-of-tolerance areas highlighted in color allowing easy identification of problem areas prior to production.

Production Engineering 14

Development of Computer Aided Design/Computer Aided Manufacturing hardware and software requirements, use of a master model concept, tool path verification/simulation software, and rapid prototyping technique/machine (Laminated Object Manufacturing), enabled RIA to reduce costs in the entire design, manufacturing, and quality product life cycle.

Teaming with Suppliers 14

Joint concurrent planning and development RIA-supplier acquisition teams meet, discuss, and develop base operations services contract requirements for non-routine project purchases. Planning teams, contractor defined capabilities, and pre- and post-bid conferences are used; 60% of all non-routine or non-standard contracts are now handled in this manner.

Automated Travel 15

RIA has implemented a new software system to provide automatic calculation of benefits and entitlements that employees are to receive from Permanent Change of Station or forward deployment. The new software greatly simplifies the work and provides the entitlements to employees more quickly.

Laying Away In Place 15

RIA has changed its method of storing unused specialized fabrication equipment to Laying Away In Place, or completely shutting down equipment with proper documentation in its current location. By locking out equipment, costs for removal, reinstallation, setup, and calibration are saved, while normal preventive maintenance required for stored equipment is facilitated.

Item	Page

Preventive/Predictive Machine Maintenance 15

RIA established a new program using a preventive and predictive maintenance system which combines computer scheduling, vibration analysis, infratography, thermography, and tribology (oil analysis). Machinery vibration frequency analysis allows for detection and correction prior to a machinery failure. Analysis of grease levels, oil contaminants, bearing lubrication, and heat buildup help identify areas which could lead to failure.

Vibration Analysis 16

RIA uses vibration analysis in heating, ventilating, and air conditioning building operation, chiller operation, and preventive maintenance. Vibration monitors on equipment record the vibration signatures for new or repaired equipment. The signatures are compared using Entek IRD International software to predict when a failure may occur.

Contact Maintenance Truck Humvee 18

The Contact Maintenance Truck Humvee provides a heavy duty maintenance ground vehicle for performing field repairs. With a larger shell design, greater equipment carrying capacity is available. Innovative improvements include a tool box locking system, roll-up door locking system, hardware, door seals, air compressor, toolbox, and tool preservation, as well as a number of process improvements

Customized Tool Kits 18

Customers are able to select non-standard tooling by tooling manufacturers for customized tool kits. Tools are etched with the tool owner's name for easy identification. Foam inserts are used to help customers quickly identify when tools are missing. Computer Aided Design/Computer Aided Manufacturing is used in designing tool lay-out, a water jet is used for foam cutting, and a laser etcher is used for tool etching.

Fielding Activities 19

For new fielded items such as tool kits and shelters, RIA's Logistics team representative accompanies the item for the hand-off to the soldier. Fielding activities extend to include feedback, review of the item during hand-off, and immediate resolution of issues. RIA has improved the quality of tools, lowered production costs of new tool kits, and better matched products to the tasks of the soldier.

operators monitor processes. RIA's capability database tracks 1,246 active characteristics.

Youth Services 32

The Youth Services operation is an aggressive and well managed program with a bright, high tech learning area with modern computers. Services include a summer Day Camp, activities for dependent children, After School Programs, School Out Activities, a Teen Club, and special programs. Selected as an Army School Age and Teen Pilot Program, RIA's Youth Services uses customer surveys, meetings, feedback, and the Parental Advisory Council to stay in touch with the community.

Information

The following information items were documented at Rock Island Arsenal:

Finite Element Analysis and Dynamic Analysis 33

RIA's extensive finite element structural analysis and dynamic analysis capabilities are used as tools for estimation of functional capabilities; repairability and producibility studies; failure analyses; change and waiver/deviation proposals; and product improvement proposals for RIA produced goods. RIA uses these capabilities to help local engineering and manufacturing companies through the Center for Manufacturing Regional Economic Development.

Independent Radiological Test Lab 34

RIA maintains an independent radiation test laboratory which performs radioisotope analysis of field samples submitted from U. S. Army activities throughout the world. It also supports RIA's Radiation Protection Program in performing similar analyses.

Austempered Ductile Iron Minifactory 34

The Arsenal has developed a unique, versatile Austempered Ductile Iron Minifactory with in-house expertise, production, and test capabilities. RIA's Minifactory has the capability to import or develop 3D Computer Aided Design/ Computer Aided Manufacturing part models; design, make, and verify 3D casting models; make rapid prototype or conventional patterns; and mold and cast, heat treat, machine, and test Austempered Ductile Iron.

Basic Control Language 34

Basic Control Language, an ASCII data exchange specification for computer numerical control manufacturing, provides a standardized part-oriented format. This allows different machines to operate from the same input data, as well as a machine-independent input data format for native Basic Control Language numerical controls and postprocessors for conventional numerical controls.

Distributed Numerical Control System 34

This RIA-developed electronic management and distribution system automatically downloads part manufacturing programs to Computer Numerical Control machines on the shop floor from a master repository. This guarantees that the machine operator is using the latest revision of the control software and allows an operator to download new versions directly at the point of operation.

Electronic Data Interchange 35

RIA uses industry standards (file transfer protocol, e-mail attachments, and translating neutral files) to electronically transfer Computer Aided Design files. By using these neutral files, RIA can support customers without formal drawings through the translation of customer specification data into Computer Aided Design/Computer Aided Manufacturing.

Manufacturing Planning System 35

RIA uses Computer Aided Process Planning to improve its manufacturing planning system. Computer Aided Process Planning, an automated paperless historical library system of plans, revisions, operations, and text, provides real-time shop floor graphics and other data, reducing configuration problems encountered by traditional/manual means.

Manufacturing Resource Planning System 36

Information on design engineering, manufacturing engineering, and product costing is part of the Manufacturing Resource Planning System technical data management module. The Manufacturing Resource Planning System is used to generate real-time manufacturing planning data to control and monitor inventory and resources; perform make-or-buy decisions; capacity planning; manufacturing costing; and master scheduling.

body conditioning/building equipment. Fitness services lead off with a personal health appraisal using a Microfit diagnostic program to identify overall health and assist in creating customer-specific exercise programs.

HEARTS Course 45

HEARTS, an adventure-based training course, inspires personal growth by placing participants in situations that encourage new behavior as a team. RIA implemented this special training to facilitate the development of self-directed work teams. The three-phase course combines classroom and outdoor activities that focus on developing human relationships within a group.

Industry Standardization 45

RIA is implementing the Blueprint for Change, a Department of Defense initiative to roll back the use of military standards in procurement by replacing them with performance specifications.

Interlocking Performance Standards 46

Linking strategic plans to officer evaluation reports, senior system civilian evaluation reports, and base system civilian evaluation reports are being tested by RIA. Major categories of performance elements are cost savings, improved customer relations, assurance of adequate internal controls, improvement of resource management systems, and human resource management.

Lead-based Paint Program 46

RIA responded to new lead-based paint laws by implementing an assessment approach using a risk rating system which evaluates the potential for lead exposure based on dust samples, soil samples, and deteriorated paint samples. RIA's Lead-based Paint Program is supported by a process action team. An aggressive blood level screening program is in place. Information on lead-based paint hazards is also distributed to all tenants.

Manufacturing Technology Consortium 46

The Manufacturing Technology Consortium is a regional technology transfer initiative involving local producers and universities. Support to area manufacturers has been provided by renting RIA facilities to develop parts and plans, and providing emergency, temporary production support to a number of community businesses.

Math and Science Are Great Program 47

The Math and Science Are Great Program is an educational awareness, recognition, and mentoring program aimed at students in the seventh and eighth grades to increase their level of interest in math and science. RIA employees mentor, bring students to the worksite, visit schools, and provide one-on-one counseling. Initiated by RIA for local students, the program was the catalyst for Army arsenals and depots to adopt similar programs.

Outdoor Recreation 47

The Arsenal provides outdoor recreation activities for active and retired military personnel and their families, civilian arsenal employees, and other individuals employed by the government. This includes renting outdoor recreational equipment and storing recreational vehicles.

Strategic Business Planning 48

RIA's Strategic Business Planning process incorporates unions as active members and includes benchmarking, internal (Analysis of Strengths, Weaknesses, Opportunities, Threats) and external (Five Year Defense Plan) environmental assessments, customer and market analysis, and linkage to higher Headquarter's Strategic Business Planning. The Strategic Business Planning process establishes major goals, objectives, strategies, and measures. Short, mid, and long-term tactics for each objective are developed separately based on the plan.

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Section 2

Best Practices

Design

Direct Digital Control Capabilities

Prior to 1993, all environmental cooling systems at the Rock Island Arsenal were operated by pneumatic controls. Although the system had been in operation for many years, it had been plagued by poor reliability and inaccurate manual adjustment leading to significant fluctuations in office temperature, particularly during outside climatic changes. The system was maintained by outside contractors who did not communicate well with the Arsenal engineering department or personnel working in the affected offices. Equipment performance profiles were not developed which led to incorrect problem diagnosis.

When a new large computing center was installed in one of the buildings to support several installations within the Industrial Operations Command (IOC), it was apparent that the old control system could not meet the environmental needs of the new computer complex. This fact, coupled with the Army's base realignment efforts which reduced support staff and mandated tighter cost control, created a need for change.

The Arsenal engineering department adapted a Direct Digital Control design to the cooling system to meet the new requirements. The basis of the design was a commercially available digital control system. However, that system did not provide precision control response or detailed equipment performance profiles and was not user-friendly to the groups that used or supported it.

The Arsenal engineers adopted a proactive attitude when they expanded the design to provide user-friendly displays and closer monitoring of chillers and air handling units. Many existing sensors were relocated, and new sensors were added to strategic locations. Software was written to accommodate the expansion, and equations were developed to combine multiple inputs and provide more timely control response based on a combination of data points. Detailed system configurations were displayed graphically (Figure 2-1) to show operating parameters at key locations allowing engineer, contractor, and user personnel to observe exactly how the system was performing. Displays at user locations provide the exact temperature of each

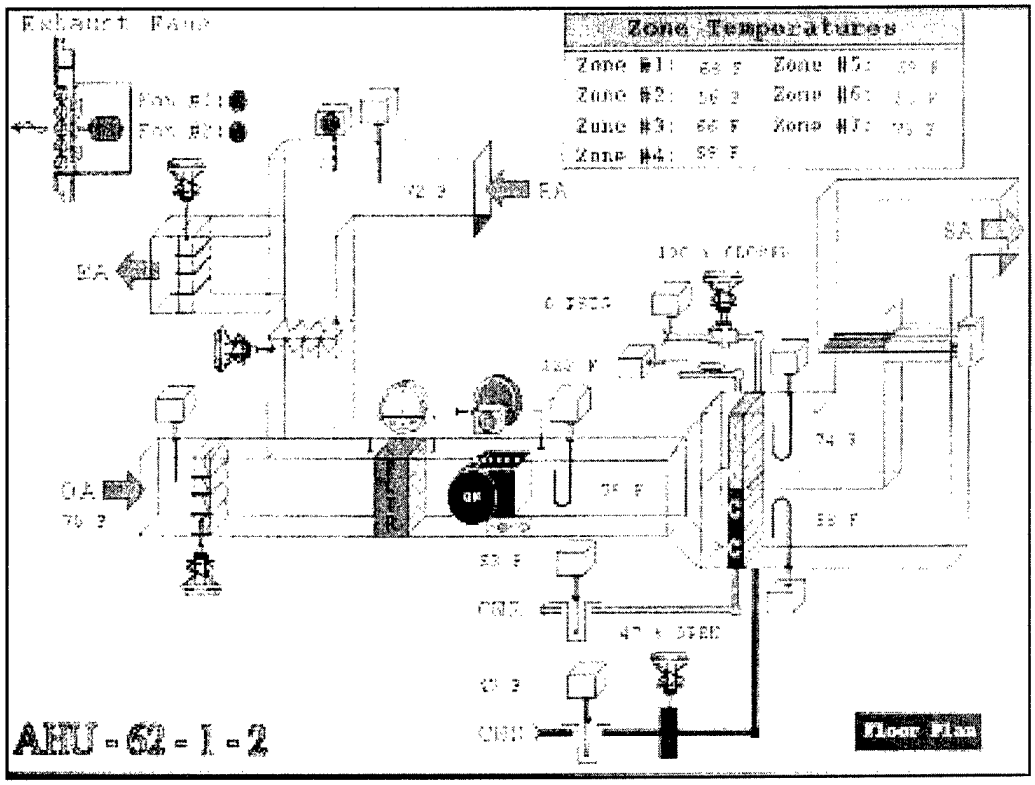


Figure 2-1. Chiller Schematic

work area. Operating parameters and system equipment status are displayed to maintenance contractors and Arsenal engineers. Modem hardware is included to display the same detailed information to off-site locations. The detail provided in this design modification provides a level of control and status information not found in any Original Equipment Manufacturer designs.

This system has benefitted the Arsenal by providing 24-hour monitoring, automatic notification of failure, and cost control by optimizing start/stop times and sequencing chiller utilization.

Lightweight Howitzer New Product Development

Using Integrated Product/Process Development for a Lightweight Howitzer Technology Demonstrator, RIA developed a fully operational prototype in fifteen months. RIA prides itself on making use of innovative technologies to satisfy challenging technological problems. Military users said they wanted more for less and faster, and RIA was one of the first government agencies to step up to the task. The technology demonstrator illustrates the commitment and showcases the capabilities of the Arsenal to design and develop using state-of-the-art techniques.

New weapons systems typically take eight to ten years from the requirements phase to first production release. The user would establish a material needs statement which documented the mission requirements. These were based on experience with currently fielded systems as well as projecting the need for future mission capabilities. Designers would take the requirements and begin the process of developing concepts to meet these needs, fabricate a prototype to evaluate the concepts, make design changes to address any shortcomings, re-evaluate the changes on the prototype, and fabricate a second or third generation prototype before finally releasing it for production. Today, military users expect a quicker turnaround time and lower cost. This has demanded a new approach for doing business. Eliminating the traditional iterative approach to design and test requires using Integrated Product Teams, or concurrent engineering.

RIA used Integrated Product Teams, or concurrent engineering, in 1994 when a conceptual model for a lightweight 155mm towed howitzer was developed to address the needs of the user as specified in the Joint Operations Requirement Document. These requirements defined such things as weight, envelope, traverse and elevation requirements, emplacement and displacement times, and rates of fire. The concept conceived by the Arsenal focused on the technology of soft recoil to reduce weight, improve durability, and reduce cost. This concept was briefed to users at Fort Sill, engineers at the Armament Research Development and Engineering Command (ARDEC) and the newly-formed LW155 PM office. The potential benefits from this approach showed enough promise that ARDEC provided limited funding for RIA to design and fabricate a technology demonstrator which would incorporate the soft recoil features. With this limited funding in hand, the Arsenal set out to develop a fully operational howitzer in less than eighteen months.

Because of the restricted budget and compressed schedule, the Arsenal immediately formed an Integrated Product and Process Team consisting of solids modelers, structural and dynamic modelers, process planners, quality specialists, contract specialists, and metallurgists. These team members worked as a unit to develop the design. State of the art CAD solids modeling was used exclusively in the creation of the components and structures. Each component was evaluated by means of finite element analysis to ensure that structural soundness and minimal weight had been maintained. The operational performance of the weapon was simulated through computer modeling to ensure acceptable performance. Before each part was released for fabrication, an extensive producibility assessment was made and designs were changed as needed to ensure the lowest cost solutions were being used. These concurrent engineering activities verified design integrity with finite element analysis; evaluated operational performance with dynamic modeling; assessed weight and Center of Gravity from solids model derivation; and validated shop floor machining processes all before the first chip was cut. In other words, a virtual prototype had been created from which functional and performance evaluations were made, and procurement and fabrication costs assessed. When the actual prototype was constructed, conventional testing was used to confirm the operational performance and structural integrity predicted by the virtual prototype model.

The concurrent engineering approach used on the technology demonstrator prototype saved more than $1M in design costs and shortened the development cycle by more than half when compared to the historical approach (15 months vs. 36 months), and the weight reduction was 44%. There were addi-

tional benefits that could have been realized if the program continued, including elimination of a second or third prototype, since all structural and performance evaluations were conducted during computer modeling and confirmed during limited testing. The previously acceptable costs normally expended during the Producibility, Engineering, and Planning Phase would be eliminated, since producibility was designed into the first prototype, and the prototype was built using actual production processes that would be employed in production.

Lessons learned from this experience make the Arsenal an experienced government agency in concurrent engineering techniques. People of different disciplines can work together in a team environment and make a significant difference in the outcome of a project. The computer aided tools used in virtual prototyping significantly help in arriving at the best and lowest cost solutions in the shortest time.

Test

Simulation Facility

RIA has successfully used simulation techniques for production testing of large caliber gun mounts and recoil mechanisms. Currently, all large caliber gun mounts and recoil mechanisms manufactured at RIA, with the exception of the M1A1 gun mount, are proof accepted by means of simulation. These simulation methods have proven track records of accomplishing their goals and actually stress the gun mounts to higher levels than live firing.

Approximately 5,000 gun mounts/recoil mechanisms have been acceptance-tested to date. Hydraulic simulation is one of the techniques which is capable of imposing an operational environment that will reproduce critical recoil performance characteristics necessary to assure the structural and manufacturing integrity of a production item. Critical parameters, such as peak operating pressures, maximum velocity of recoiling parts, peak accelerations, and maximum loading on critically stressed or safety related components can be achieved, which represent any level of live-fire loading desired.

Many benefits are realized by the use of Hydraulic Simulation, including a 22% to 33% cost reduction of live fire costs for production acceptance testing; 8% to 30% cost reduction of live fire costs for durability testing; and 10% to 30% cost reduction of live fire costs for R&D testing. Cycle time reductions are realized due to the fact that there are no range or weather delays, and no ammunition or security precautions are required. These and many other benefits arise from utilizing these test methods.

Production

Hazardous Waste Reduction

RIA has an extensive plating facility where chrome plating, cadmium plating, copper plating, phosphate coating, and anodizing are performed. The hazardous waste generated by these processes totals 140,000 pounds per year. This waste is in the form of a muddy sludge which is time consuming to package and costly to dispose.

In 1991, RIA formed a Process Action Team to look at alternate methods to dispose of this waste. The solution was a process dryer which has reduced hazardous waste disposal by 85%. The sludge goes through an existing six filter press and is then automatically loaded into the process dryer. The dryer essentially boils the liquid out of the sludge leaving a fine, dry powder which is deposited into a 55-gallon drum by an auger. The entire process takes about two hours with no operator intervention. The system is a steam powered model which runs off the Island's cheapest energy source. Although the system costs $92,000, the cost reduction from hazardous waste disposal dropped from $70,000 to $17,500 in 1994 alone. The payback period was less than two years. The benefits derived from the system include a reduction in the amount of hazardous waste disposal, a reduction in the costs associated with hazardous waste and its disposal, and less handling of hazardous waste.

Laser Cell/Waterjet/Fabrivision

RIA utilizes a combination of state-of-the-art machining technology and software to produce, inspect, and in some cases, reverse engineer flat sheet metal parts. Using Numerical Control nesting software (Optimation), the programmer and/or operator can automatically nest part programs to a specific sheet size and orient them according to the grain of the material for optimal bending efficiency. This part program is then downloaded to either a laser/punch/milling machine or a waterjet cutting machine. To increase quality control, RIA purchased a vision inspection machine (Fabrivision). With this machine, a flat sheet metal part is placed on a glass table. A series of cameras scan the part and produce

a two-dimensional drawing which can be digitized to show critical dimensions. This drawing can also be overlaid onto a template drawing with any out-of-tolerance areas highlighted in color. This allows the programmer/operator to see at a glance any problem areas that need to be addressed before the part is set into production. This inspection procedure takes approximately 10 minutes on a simple part.

All current part processes in the Laser Cell have been reviewed and 368 of 682 parts have been converted to this new technology. First year direct labor savings totaled over $120,000 in setup hours and standard run hours. RIA also realized a substantial savings by the elimination of several part moves, manufacturing operations, and inspection operations from part processes.

Production Engineering

RIA has progressed from the time-consuming method of production engineering to a streamlined Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) based method of quick turnaround of a quality product. By reducing costs in the areas of drawing interpretation, rapid prototyping, and rework, RIA has realized cycle time reductions and material cost savings, placing them in a very competitive position in the production of machined goods.

A steering committee was formed in the mid 1980s consisting of representatives from the Arsenal Programs, Arsenal Operations, Science and Engineering, and Quality Assurance directorates to develop CAD/CAM hardware and software requirements to bring its products through the entire design, manufacturing, and quality product life cycle. In 1991, Unigraphics was awarded a $3M contract to supply the required hardware and software based on a multi-year specification development and review process.

By utilizing the Unigraphics software suite on an HP-UNIX workstation platform and a master model concept, RIA has cut the development costs 53% in the Engineering Drawing Interpretation area alone. By using a tool path verification/simulation software which verifies the tool location possibilities, RIA has not only dramatically reduced costly time consuming tool path verification processes but also model redevelopment, which would be required if the tool path was found to be impossible due to tool/machining limitations. If a complex tool path is not simulated, major damage can occur resulting in safety hazards, loss of production time, loss of product, and costly tool/machine damage.

In September 1996, RIA implemented a rapid prototyping technique/machine called Laminated Object Manufacturing where cross sections of paper are automatically laminated and laser formed. A case study demonstrated an 80% cost savings over the old pattern development methods, and reduced the development cycle from 15 work days to 2.5 days, saving the customer $11,501 for model development.

Teaming with Suppliers

In the last five years, RIA's Contracting Office has developed an Acquisition Planning concept for the initial planning and development of procurement contracts for base operations services for non-routine project purchases. This concept is based on concurrent planning and development of acquisition contracts by Arsenal customers, prime and subcontractors, and personnel from the contracting office. By early 1997, approximately 60% of all non-routine or non-standard contracts were handled in this manner.

The contract development process is based on establishing planning teams that include all interested parties who work together to configure the final contract. Government personnel explain project requirements and constraints, and contractors define capabilities that can meet these requirements while considering the constraints. This interaction occurs during a pre-bid conference and at follow-up meetings which are held as necessary to ensure that all organizations have a good understanding of requirements, contractor capability, and associated expectations prior to the bidding process.

After contract award, the selected vendor continues to participate in the Arsenal team effort to monitor performance. Weekly or biweekly meetings are held to resolve potential problems and solicit feedback from support organizations. The key element of this team approach is the involvement of Contracting Office personnel who provide timely resolution to contract issues including the initiation of contract modifications by mutual agreement.

The benefits achieved by this contracting approach include minimized inspection, testing, and acceptance costs; projects completed ahead of schedule; and projects completed below awarded contract price and government estimate. Clearly, this pro-

curement approach enhances the ability of the Contracting Office to properly monitor contracts, and also facilitates the successful participation of all agencies involved.

Facilities

Automated Travel

RIA's personnel office is required to produce Permanent Change of Station (PCS) orders on a routine basis and at times, produces many orders simultaneously. This is a long, manual process which requires research of voluminous Joint Travel Regulations.

In an atmosphere of downsizing, the personnel office turned to automation to better serve its customers and accomplish its mission. Using in-house expertise, it utilized off-the-shelf software and created a user-friendly program and database. This program produces in 30 minutes what normally took an average of three days. The entire PCS order is printed out with all cost estimates accurately produced. The Automated Travel System is a very simple but effective solution to the problem of personnel reductions and could be used by all Government installations.

Laying Away In Place

The readiness of RIA capabilities competes with current workload on specialized fabrication equipment. RIA has found significant cost avoidance by changing the method of storing unused equipment. The old method of "hard" layaway of equipment was handled by removing the equipment from the floor and storing it in another building wrapped in protective covering. The supporting electrical, steam, and fluid supply lines also needed to be removed.

The current method of Laying Away In Place (LIP) is to completely shut down this equipment in its current location with proper documentation. This practice of locking out the equipment not only saves thousands of dollars in removal costs, but eliminates the reinstallation, setup, and calibration costs. Necessary normal preventive maintenance required for stored equipment can be easily performed. The LIP process has been used on several pieces of equipment for the past five years. For a given piece of equipment, the cost to LIP is approximately one-third the cost of "hard" layaway. In addition, the level of readiness is greatly enhanced.

Preventive/Predictive Machine Maintenance

Preventive maintenance (PM) at RIA involved an annual shutdown of the foundry for two weeks. The philosophy was "if it ain't broke don't fix it." Scheduling was done manually which resulted in a very costly PM program that did not prevent failures. Once a machine did fail, the work either was at a standstill or had to be moved. Either avenue was a cost to the installation and the customer.

Realizing this, management set about changing this process in 1985. A new program was established that incorporated predictive maintenance. The new program utilized the Arsenal's computer system to do scheduling. This included Occupational Safety and Health Administration (OSHA) inspections, quality inspections, and visual inspections. However, its cornerstone of success is the use of vibration analysis, infratography, and tribology (oil analysis).

All machines have vibrations. RIA's personnel have found that all machinery troubles generate distinct vibration frequencies and, with proper analysis, problems can be detected and corrected prior to a failure occurring. Through the use of transducers mounted on the machinery, data is collected and fed to a computer. The computer then generates a graph (Figure 2-2) which, with proper analysis, helps determine which part is defective. The computer also produces trend data (Figure 2-3) which is used to predict the need for shutdown for repairs. The installation also uses vibration analysis to determine the proper levels of bearing lubrication. It has been noted that many bearing failures were due to over greasing. Through the analysis, RIA has been able to determine the proper grease levels for its machinery. Analysis of the oil contaminants is also used to help determine which parts are wearing faster and to project when failure will occur.

Thermography, or infrared imaging, is the other technique that is used to predict failure. By using an infrared camera, hot spots can be identified on the machinery indicating areas of heat buildup which could lead to failure.

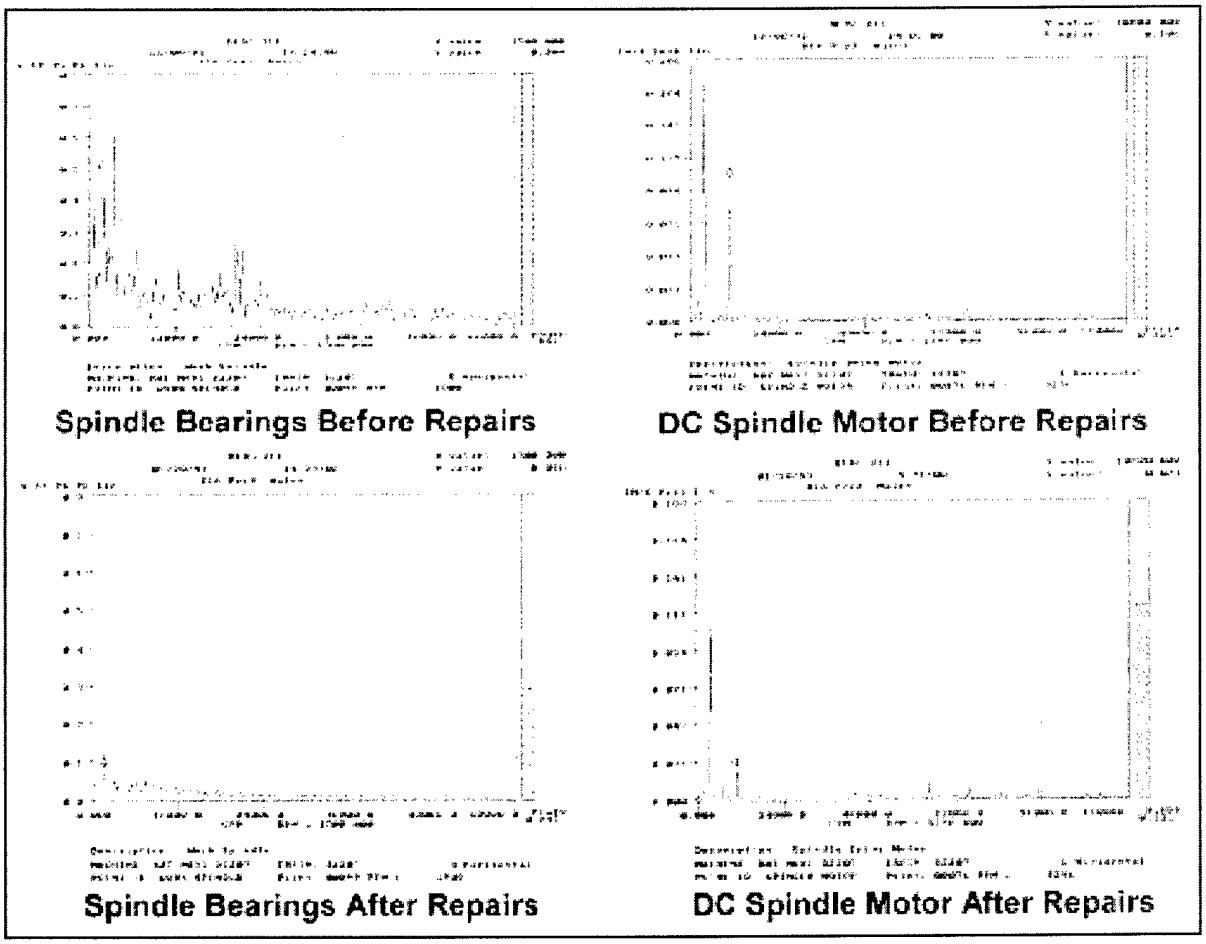


Figure 2-2. 211 Maxi-Bar

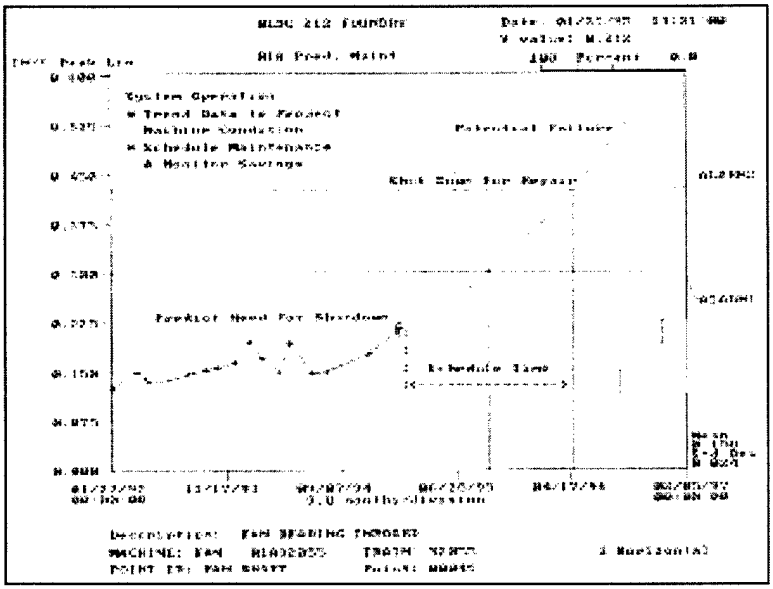


Figure 2-3. Analyze/Trend Data

The results of the Preventive/Predictive Maintenance program are dramatically obvious. The reduction in lost production time, from 180 hours using conventional troubleshooting to 29 hours using vibration analysis, is well documented. RIA has taken an expensive, antiquated process and developed a high tech, low cost solution to lowering costs and being more productive.

Vibration Analysis

The previous base operation contract at RIA for all HVAC building operation, chiller operation, and preventive maintenance did not include vibration analysis. Mechanical failures of pumps and chillers were occurring randomly, and always at the

worst possible time when the greatest interruption to operations would occur. The repairs required crisis management and, in some cases, long lead time parts were needed for the repair. Customers were generally without air conditioning during the hottest days, and the service desk would be overwhelmed with calls. The budget could not be maintained due to the unpredictable nature of the failures and the need for fast expensive repairs.

In 1996, RIA began using predictive maintenance techniques with in-house personnel. The first step was to identify which equipment was essential or critical. Vibration monitors are attached to the equipment, and the vibration signature is recorded when the equipment is new or after it has been repaired. The signatures are then recorded monthly and compared to the initial readings using Entek software from IRD International and the experience of the analyst. If the data indicates that a failure will occur, a prediction can be made as to when it will occur. This allows time to order parts, schedule the repair during the least interruptive time to operations, and avoid a failure. The confidence level in the equipment working when it is needed is significantly enhanced.

The application of preventive maintenance through vibration analysis is invaluable, but analysts and the software used can affect the conclusions. The experience of the analyst, the analyst's training, and the proper application of the equipment are critical. Training and faith on the part of the maintenance personnel are also required to accept the results. Many times the vibration analysis will show a problem with an apparent perfectly-functioning unit. Experience at RIA has shown that when the vibration analysis indicated a problem, it really was a problem. One chiller that was working fine and had no indication of a problem was analyzed, and a problem was identified with a bearing on a shaft (Figure 2-4). When the unit was taken down for repair, it was determined that the bearing on the shaft was indeed faulty and would have caused a catastrophic failure if it had been left. A second and third chiller that were apparently working fine were found to exhibit signatures that indicated they would fail. The equipment manufacturer performed a vibration analysis, but concluded from the data that there was no problem. With RIA's persistence, the manufacturer reluctantly agreed to disassemble the equipment. In the second chiller,

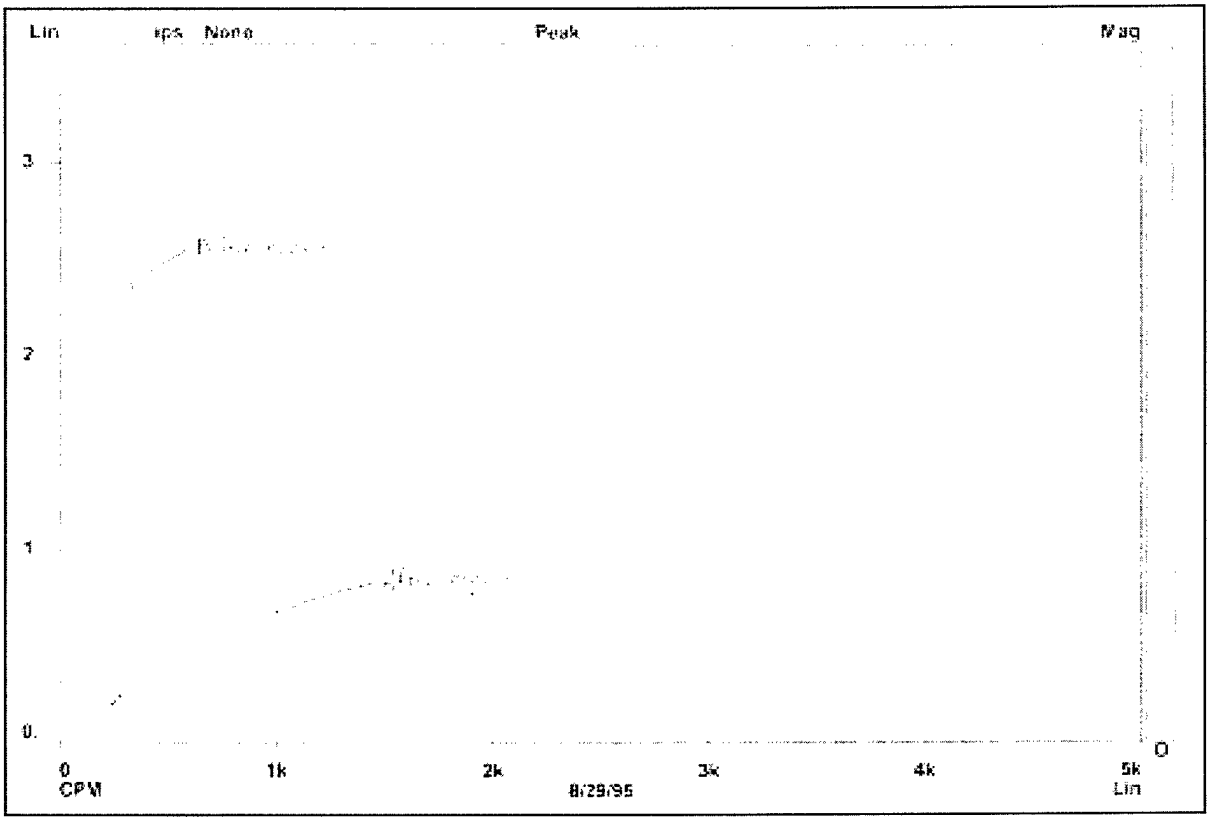


Figure 2-4. Vibration Analysis

the manufacturer found that a Bellville spring holding a bearing in place was improperly assembled. In the third chiller, seven bad bearings were found. The manufacturer then sent his personnel to RIA to learn how the analysis was being performed and to gain from the expertise developed at RIA. The cost for the 150 transducers that have been installed was $21,000. The cost for the monthly data collection and analysis is $800.

Mechanical failures can be virtually eliminated from equipment by using the vibration analysis techniques. Maintenance can be scheduled when it will not disrupt the operations. Repair parts can be ordered in advance of the maintenance action. The state of crisis management is eliminated, and proper budgeting and planning can be performed. Many times the problem can be identified far enough in advance to allow the repair to be performed following the air conditioning season.

Logistics

Contact Maintenance Truck Humvee

The Contact Maintenance Truck Humvee (CMTH) project was initiated to provide a heavy duty maintenance ground vehicle to perform assorted repairs in the field. The vehicle itself is the High Mobility Multipurpose Wheeled Vehicle, referred to as a Humvee. This now famous military vehicle is stronger and durable for rough terrain travel, and provides greater safe clearance over ground obstacles than other trucks. The Humvee's strength allows for larger shell design which in turn, allows for greater equipment carrying capacity. The configuration provides Army field personnel with the necessary tools and other equipment to perform on-the-spot field repairs. A number of innovative improvements have been implemented for this configuration:

- The truck tool box locking system is now more efficient by the elimination of four hardware pieces, and by the use of the new locking system which is uniform to all tool boxes carried by the truck, allowing for significant savings in fabrication and installation times.
- The roll-up door locking system was modified to eliminate right and left handed parts with replacement by a universal part assembly; fabrication and installation time was reduced by 0.8 hours.
- All hardware is now in accordance with the Society of Automotive Engineers' standards vice Government specifications; this allows for hardware interchangeability with less inventory required.
- Door seals, which were separately installed items, were converted to subassemblies; a local supplier now provides these items.
- The overly sophisticated air compressor was replaced with one which requires no holding tank, is lighter, uses less power, and takes up less space; it also requires less wiring and piping so that installation is simpler and less time consuming.
- An off-the-shelf toolbox which required modification and repainting was changed to one which met requirements with a corresponding saving of installation time of four hours per vehicle.
- Tool preservation was reduced to minimal levels eliminating a cleaning requirement prior to shipment and reducing premature tool corrosion.

Process improvements include:

- Shop orders (work instructions) are now issued for the entire CMTH process which provide written detailed instructions and measurable standards for each individual work operation.
- Each work operation is subject to inspection which is documented to ensure proper installation and function.
- Employee empowerment is established through teaming, with each team member responsible for individual quality assurance through the new inspection process.
- Computerized parts listings have been established to identify shortages and to more effectively meet monthly quotas.
- Many parts are now subassembled rather than requiring separate piece part installation.

These improvements have resulted in less operator downtime due to the inventoried parts system and resultant smooth parts flow; improved parts tracking; greater consistency in truck performance due to application of uniform shop orders; and significant reduction in labor hours required.

Customized Tool Kits

RIA's Customized Tool Kit program is designed to provide customers with customized tool kits assembled to meet their specific needs in the shortest possible time. Tool kits are various configurations of tool boxes, cabinets, and shelters containing a spe-

cific set of manually operated and/or automated tools selected to perform maintenance operations by the soldier in the field. Customized tool kits feature laser marked identification of tools, and foam inlays for easy detection of missing tools to minimize foreign object damage.

Prior to 1992, RIA was a traditional tool kit provider. Tool kits were typically made of military standard heavy metal containers and loaded with government issue tools. Tool kits were also accepted by the soldiers in the field in the traditional way, indicating the soldiers accepted whatever was issued to them regardless of deficiencies in meeting their field requirements. Prior to 1989, business was good with orders of 12,000 tool kits per year. However, with the downsizing of military budgets and personnel, tool kit orders drastically declined. Fielding feedback and reviews indicated that a number of improvements were needed in the tool kits issued to the field such as the cost, delivery of appropriate tools, durability of individual tools and tool kits, lost and misplaced tools, and lengthy delivery time for replacement tools. Misplaced tools were often found in the equipment being maintained which led to serious damage of equipment.

In 1992, RIA addressed the tool kit business with a renewed approach that built on the improvements and demands identified by RIA Industrial Operations personnel and field soldiers. Steps were taken to design demonstration tool kits that were less costly by using commercially available off-the-shelf tools; more durable by the replacement of metal tool kit containers with plastic; and easier accountability of tools by using cut out foam inlays. The new design was readily accepted, and a new improved tool kit business was started. The Industrial Operations Directorate established a self-directed work team to develop the capability and capacity to increase the business growth. The team made good use of equipment obtained from surplus accounts, thus reducing the need to procure new equipments, and incorporated innovative processes throughout the operation. Equipments included a laser etcher for marking the individual tools; a water jet cutter for cutting the inlay patterns for each tool; an AutoCAD system for tool layout; and improved warehousing methods. Contracts were established with key tool suppliers that allowed for just-in-time and emergency delivery. The team worked closely with the customers to determine their requirements and provide timely estimates. Final tool kit configuration was generated from AutoCAD and also provided an estimate to the customer at the same time. The tools meet the Society of Automotive Engineers' industrial standards.

An interagency agreement was established with the General Services Administration authorizing RIA as the sole provider of customized tool kits for the Army, thus allowing standardization, consistency, and control throughout the Army. Additionally, major contracts have also been established with the Air Force. Currently, more than 3,000 customized tool kits are delivered to over 100 different customers on an annual basis. A completed tool kit is typically delivered in 90 days after the order is placed, but can be accelerated to 45 days in an emergency. Replacement tools are typically delivered in five days after a request, but a 24-hour emergency delivery is also available. A 1-888-RIA-TOOL hot line has also been established. Today, the business has grown to annual sales of $7 million.

Fielding Activities

When new items such as tool kits and shelters are issued to the field, a Logistics team representative is sent to accompany the item for the hand-off to the soldier. The extension of fielding activities by RIA's Logistic group, including feedback and review of the item during the hand-off and immediate resolution of issues encountered, have proven both effective at resolving problems and making improvements, and improving customer satisfaction with the items delivered.

In the past, when new items such as tool kits and shelters were issued to the field, a Logistics team was sent to the field for the hand-off to the soldier. The team ensured that the items were inventoried; received in tact and in proper working order; provided necessary training to the field soldiers; and helped the soldiers use the items as designed. No long term review of the items by the team or the soldiers was considered. As long as the items functioned as intended, the items were considered sold. Any changes to the item were costly, beyond the scope of the contract, and normally avoided. Often the soldier (customer) had to make the best of what was received or at minimum, wait a long time for changes. The practice in the past has been to complete these tasks with minimal delay and close out the order.

Since 1993, the Logistics team has added additional steps to its fielding activities that include immediate feedback and follow-up for issues identified in the field. The team now reviews the usage of the new items sent to the field. When an item does

not meet the full functionality needed by the field soldier, or when improvements are suggested, the field team representative is present to accept the feedback and review the issue first-hand. Problems and recommendations are brought to the attention of the Logistics engineers and staff for immediate resolution. As a result, the field soldier has a vehicle for resolving real problems found in the field. The fielding activities have also been extended to not only fielding new items, but for items already in the field.

Examples of the successful fielding activities include:

- New Aircraft Tool System fielding: This program replaced the heavy metal tool boxes used in the field with a new tool system (Figure 2-5) for the aviation soldier that featured new plastic tool boxes which are light weight and waterproof; tools placed in foam which enhanced inventory; and prevention of foreign object damage. Not only did the quality of tools improve, but the production cost of the new tool kits dropped from $650 to $91, providing a total program savings of more than $11M for the customer. Another example is a metal aviation footlocker that was replaced with a plastic design which reduced the cost from $5,000 to $943 per copy, providing a total program savings of $7.7M for the total quantity delivered.

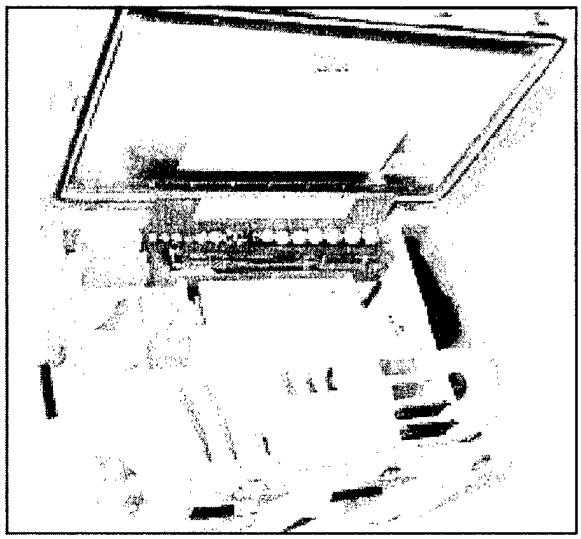


Figure 2-5. Tool System

- Shelters fielding: Shelters (Figure 2-6) are equipped with a variety of equipments, tools, and capabilities necessary for the field soldiers to perform tasks from maintenance of vehicles to the repair of electronic hardware. As a direct result of feedback and review from the field, shelters have been modified to better fit the tasks of the soldier. Changes include everything from installing proper ventilation hoods to adding bookcases in the shelters. Over the past 18 months, Logistics field team representatives have incorporated over 30 changes as a direct result of their presence in the field through the practice of accepting feedback and reviewing the issues identified by the soldiers.

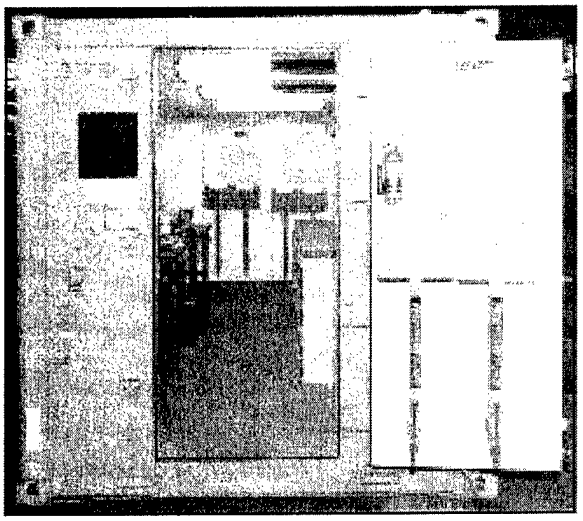


Figure 2-6. Shelter

The extension of fielding activities to include feedback and review has proven both effective at resolving issues in the field and improved customer satisfaction with the items delivered. Additional fielding savings are being explored through this improved collaborative practice with the field soldiers.

The Iowa Communications Network

The Iowa Communications Network (ICN) is a fiber optic based digital communication network capable of data transmission speeds of 54 megabit/second. Authorized users of this network are state and local governments, Federal Agencies, schools and universities, libraries, and hospitals. RIA, the regional Army Corps of Engineers, and the National Weather Service have become fully authorized users, as well as the more than 50 armories in the state. The intended use of the ICN is the collaboration between organizations and information sharing.

RIA's intended role in the ICN is to provide technical consulting and engineering services expertise to other members, and to more effectively

manage the expansion of ICN into the eastern Iowa region. This has led to a community partnership, with RIA serving as the chair, consisting of Eastern Iowa Community College; City of Davenport, Iowa with its library association; Scott County, Iowa Courthouse; Federal Court System; General Services Administration; St. Ambrose University; and Utilities and Railroads.

By partnering in the planning and contributory funding of ICN, participating organizations have realized the following benefits: saved from $200K to $600K each in the network funding; accelerated the overall connection schedule; fostered a successful team spirit; and allowed for overall network connectivity for users.

Specific benefits to RIA include serving as a support conduit for reserve components; the ability to provide redundant access to major carriers such as the AT&T Regional Office; the opportunity for collaboration with local universities; and the opportunity to play a major ongoing role in the establishment of a powerful instrument for effective wide area community information sharing.

Self-Service Supply Center, Uncle Sam's Emporium

RIA denotes its Self-Service Supply Center (SSSC) as "Uncle Sam's Emporium" (USE). This supply store was first initiated in 1981, with functional refinements being applied to enhance its usefulness over this period of time, to more effectively serve its 294 customer accounts. Downsizing, creation of the Government Credit Card Program, and recent benchmarking activities with respect to commercial or private sector counterparts such as Office Max and Office Depot created an opportunity for RIA to fill an important need while helping to ensure the continued self-sustaining operation of its SSSC. Two benchmarks — solvency and customer service — were set as determinants; goals to use available technology, have a clear understanding of logistics, and superior customer service were identified. Fundamental to success is the development of technology to provide on-site and regional customers the ability to purchase supplies using an interactive on-line catalog via the World Wide Web and VISA and MasterCard. The target market includes current customers, people currently purchasing using the Government credit card, and people currently making micro-purchases using other methods of payment. The on-line store is being created in five stages, with each stage reliant on customer feedback as a design tool to ensure that the project truly fits customer requirements. The array of offered products is available currently on 3.5" disk with plans for CD-ROM.

Once fully operational, RIA will have the Army's foremost one-stop office supply store providing top quality service, speed, convenience, and quality products at competitive prices. By using RIA's SSSC, or USE, customers avoid lost man-hours created by item identification, cost-comparisons, off-post shopping, preparation of paperwork for VISA, milstrip purchases, reconciliation, and status of supply requests. Customers will have the ability to purchase a variety of items to support their operations with their Government credit card, and they never have to leave their desk. Several innovations and refinements to USE include:

- Individual Item Surcharges
  Customers were assessed a usage fee based on the size of the organization which was added to their apportionment for the year. Customers never knew what to budget for this surcharge. Initially, RIA submitted and received approval for a waiver, 710-2-2, Chapter 13, to deviate from using the Army Master Data File and acquisition cost in pricing. Internally, RIA concluded that the fees associated with SSSC operations could be better budgeted by assessing a surcharge to each item purchased. In May of each fiscal year, RIA's resource management organization accumulates pertinent sales data and calculates a surcharge (percentage) based on overhead rates, sales projections, and labor costs. This surcharge is used for SSSC markup for the coming fiscal year. Now the sale or selling price reflects the only cost incurred by the customer, and customers have a simplified budget process for supplies. Customers also know that when they budget for a certain level of purchase power, no hidden costs will appear later. With the surcharge tied directly to RIA's overhead rate, surcharge fluctuations reflect services based on actual usage of the SSSC, and ensure that RIA remains competitively cost focused.
- Deliveries
  RIA made significant changes to its SSSC delivery process based on customer feedback, a desire to be more competitive with industry, and the desire to enhance its customer service. Previously, the SSSC would provide direct-office delivery only for purchases of three or more boxes of reproduction paper. In late 1996, SSSC began accepting delivery requests for orders of

at least ten items or $50 at no cost to the customer. Customers can submit a request using a customized order form via intra-office mail, FAX, electronic mail, or phone. Staff response (item selection, preparation for delivery, delivery) is accomplished within two days of order receipt, and the current average for delivery is three per day. Customer feedback indicates this to be a powerful and significant time and money saver. This service is free, and has proven so valuable that customers are now using RIA's SSSC USE as a first choice versus commercial business.

- Point of Issue for Common Hardware and Software
  A blanket Mission Need Statement (MNS) has been established for stocking common Automated Data Processing Equipment (ADPE) items. Previously, customers prepared and processed a MNS for ADPE purchases through several approval channels. This process was time consuming and expensive for both purchaser and approving offices, as well as lacking uniformity from MNS to MNS. The equipment used throughout the installation was not compatible with other systems and equipment. To streamline the internal process, a blanket MNS was established in late 1993 to begin stocking common ADPE items in the SSSC. RIA's Information Management Directorate prepares the MNS which authorizes ordering and distribution through the SSSC. The MNS can be updated throughout the year as equipment features or customer requirements change. Preparation and processing time for individual MNS are eliminated, compatible ADPE equipment becomes standard throughout the installation, and order-to-delivery time is reduced from eight months to a matter of hours. Since the inception of this process, approximately 1,000 pieces of ADPE have been issued through the SSSC.
- Automation Technology
  RIA's current customer base is presently limited to 294 individual accounts. Improvements such as use of Government VISA cards allow 80% of micro-purchases to be made quickly. The additional use of the Internet (World Wide Web) provides a means to service customers throughout the world. The target market now not only includes current customers, but those accounts which previously used other self-service stores that closed due to operational inefficiencies. Current plans are to establish a Web-sited on-line self-service store in five basic phases, each with provision for customer feedback. A contract to begin this effort was awarded April 1, 1997.

Tool and Maintenance Management System

RIA developed a Tool and Maintenance Management System (TAMMS) that streamlined and improved the acquisition process of procuring shop floor items. This system drastically reduced inventories and expedited the procurement process.

A graphical, user-friendly interface was developed enabling an employee to search for current inventories by specifying the required item and by entering key words that describe the desired item. If the item is not in stock, the employee can request an item via the system and specify quantities. The supervisor has gained many benefits from this system, which include purchase approval and access to information for use in determining items that are potential excess items. When the Potential Excess Report shows that inventories of a certain item have been high for a long period of time, the supervisor can specify the item and quantity to be excessed. Certain performance indicators, listed in report form, are benefits of this system. The performance indicators include Document Register Report, Document Register Budget, Potential Excess Report, Suggested Stockage Codes, Suggested Reorder List, and Zero On-hand Flasher Report.

RIA's TAMMS system improved the planning process of procurement, increased visibility of the ordering mechanisms, and united the cataloging system to the inventory system. The tracking and monitoring of items have become automated reducing the time lost in hunting for items, and dramatically reducing the required paperwork.

Winning Strategies

In late 1995, the Army's Industrial Operations Command, under base realignment directives, requested proposals for site locations for regional Civilian Personal Operations Centers. This provided an opportunity for RIA to increase the tenant population and distribute overhead costs which were critical to the Arsenal while it operated in a period of reduced manufacturing activities.

A strategic planning exercise was initiated to establish a proposal to locate the Center at the Arsenal. This plan was extremely critical since

locating the Center elsewhere would have resulted in a loss of the local Civilian Personnel Advisory Center and 60 jobs at RIA.

A first step of the planning process was to establish a partnership among the local Army Corps of Engineers at Rock Island and Savanna, Illinois, the Corps Headquarters in Chicago, and the Quad Cities Development Corporation to help leverage consideration for an Arsenal location. This combined group represented 32% of the population to be serviced by the new regional Center. The group also benchmarked successful proposals from an installation in Germany and at Fort Riley, Kansas. This team approach worked to vie against competitors from Fort McCoy, Wisconsin, the Tank Automotive Command in Detroit, and the St. Paul Corps of Engineers office.

The second step of the plan was to host a site visit to demonstrate Arsenal capabilities. A proactive approach was utilized to promote facilities, support units, and quality of life at the Arsenal. Supporting presentations by local mayors and community support organizations enhanced the overall presentation. Post award critiques of the visit indicated that this proactive attitude, the spirit of Arsenal and Community personnel, and its support capabilities were keys in providing a successful proposal.

The importance of establishing a partnership and developing a proactive approach were confirmed when the new regional Center was awarded to RIA and the local Civilian Personnel Advisory Center site was retained. As a result, 120 new positions have been created with an expected growth to 186 in 1999, 25 positions were retained, and overhead cost distribution was increased.

Management

360 Degree Performance Management System

In 1995, RIA instituted the 360 Degree Performance Management System (360 DPMS) as a result of a reinvention process from the Army Management Engineering College. Prior to this, RIA relied exclusively on the Total Army Performance Evaluation System (TAPES). TAPES is a supervisor/employee review process that is based on a unisource evaluation. The shift to 360 DPMS was made to make the evaluation process more accurately reflect the employee's performance by measuring behavioral attributes like team support or workload sharing. Although TAPES is used to comply with administrative requirements, the unique aspect is that the input for it is the 360 DPMS.

The 360 DPMS procedure began with the labor/management partnership selecting and defining the feedback criteria. The categories formulated include technical support; practical support; technical competence; efficient use of time; communication; initiative; flexibility; customer service; working relationships; and process and self improvement.

Next, the employee selects the raters from people who are most familiar with the employee's work. This group can include team members, customers, supervisor, team leader, subordinates, and self. A survey is then conducted from which reports are created and analyzed. The final analysis is a concise report that summarizes the ratings of the different categories, and is used to commend or intervene the employee's behavior.

The benefits of the 360 DPMS are that it is fair, simple, and trustworthy. With so many raters, the employee is evaluated from a multi-dimensional perspective. Being easy to fill out quickly, the survey has a cost savings through reduced labor requirements. An additional benefit is that the number of complaints concerning the evaluation process has decreased because the potential negative feelings of the supervisor having ultimate control is eliminated. By promoting a participatory culture, the employees are motivated because their performance will be noticed by the people with whom they work.

Automated Vacancy Announcements

RIA has implemented an automated vacancy announcement system to eliminate the printing and posting of job vacancies. The previous method used to inform employees of vacancies consisted of posting three to six sheets of paper on 325 bulletin boards. Typically, 400 to 500 vacancies were posted during a year. Problems with the previous method included the long lead time for printing and distribution which added seven to ten days to the process. The cost of printing was escalating at a factor of two times over a two-year period. Many times the announcement would disappear when an employee would take it off the bulletin board to make copies.

The new vacancy announcement system uses CCMAIL to post the vacancy electronically, saving seven to ten days in printing and posting the announcement. There are no printing costs, very little distribution costs, no bulletin board upkeep costs, and it is environmentally sound since no paper is generated. By accessing their CCMAIL, employees

can now get the announcement even if they are on travel. The first world wide web posting for an RIA vacancy was on March 31, 1997.

The new system has been accepted by the union and employees. The only drawback has been in the manufacturing area where employees do not have as much access to computers. The union has set up computers where employees can come into the union office to view vacancy announcements. Plans are also underway to set up computers in common areas such as break rooms in the production areas. The new announcement system saves money and labor, provides more timely and efficient notice to employees of vacancies, and provides faster response for the department with the vacancy. The FY96 cost savings was $2,816.

Base Operations Relationship Management

A reduction in manufacturing activities at RIA has been accompanied by a reduction in overhead cost absorption. Other arsenal organizations have been required to create income that will compensate for this shortfall. The tenant support group within Base Operations has established a mission to aid in the apportionment of indirect costs. This program, Base Operations Relationship Management, is involved in increasing tenant population and providing quality services to match tenant needs as well as other internal cost reduction initiatives.

Over the last four years, the group has contracted with 61 new tenant organizations generating approximately $30M in income with $9M of direct charges. In addition, facilities maintenance costs have been reduced by 28.6%, and the internal operating budget was reduced by 30.2%.

In an effort to increase tenant participation, opportunities for customer involvement have been increased. Quarterly workshops are held for tenants to gain feedback on the quality of services and support provided. Individual tenant meetings are held to discuss special needs and contract issues. Consideration is given to tenant funding constraints during contracting activities. Activity Based Costing methodology has been applied to ensure that tenants pay only for services used. Stabilized pricing policies have been guaranteed to tenants through 1998.

The organization has also laid away over 400,000 square feet of facilities, excessed over 100 production equipment items, and reduced depreciation expense by $2.2M annually. The combined activities of this group have had a distinct positive effect on maintaining Arsenal operations during a period of downsizing and stricter budget control.

Commander's Quality Excellence Award

Originated in 1987 by the Commanding Officer at RIA, the Commander's Quality Excellence Award is given to recognize and reward employee achievements in the area of quality improvement. All RIA employees and offices are eligible for the award. Initially conceived as a group award, the recognition has been expanded to include individual achievement. A nomination questionnaire is submitted to the Award Committee for review. The questionnaire was designed to allow each nominated individual's actions to be compared side-by-side rather than the more interpretive method of using a free-form nomination letter. Unique as a non-monetary award for quality improvement, the Award Committee has chosen 38 groups and eight individuals as recipients.

The Commander's Quality Excellence Award consists of two plaques. One plaque, inscribed with the name of the recipient, is displayed in the entryway of Building 211; a second plaque is displayed in the recipient's work area until the next quarter's recipient is chosen. Additionally, a photo of the Commander and the recipient is taken at the time of the award presentation, a certificate is placed in the recipient's personnel file, an article noting the award appears in the *Target*, and the recipient receives a lapel pin imprinted with "Rock Island Arsenal" and "Commander's Quality Excellence Award."

Besides the obvious benefit of a cost savings in production through the accomplishments of nominees, there is an important additional benefit as nominees are recognized for their contribution. This encourages others to contribute. RIA is aware of group and individual effort and is willing to recognize it.

Community and Special Events

The employees and their families have several opportunities to become involved in family-targeted activities at RIA. The Base has implemented a series of programs that partner with the local community and foster unity among educational, business, and military/non-military organizations. The Base's goal is to involve all employees from the lowest levels to the highest levels, to participate in installation activities to promote the "Total Army

Family." Employees and their families are encouraged to participate in events such as bring your family to work, Easter egg breakfast and hunt, Halloween dinner and party, breakfast with Santa, and town hall meetings.

The local communities are invited to join in the sharing at different events throughout the year, such as the Christmas tree lighting and an Island-wide Armed Forces Day celebration. The Armed Forces Day celebration includes activities from Civil War reenactment to information booths staffed by the Quad City police department who educate the public on subjects such as gangs and the Drug Abuse Resistance Education program.

RIA's Army Community Services group has been working diligently to complement all these family-focused activities and programs, which include the Lending Closet, the Video Lending Library, Relocation Services, the New Parent Program, Family Member Employment Assistance, Consumer Affairs and Financial Assistance Program, scholarship services, resume writing, the Exceptional Family Member Program, the Family Advocacy Program, Information and Referral, and Volunteer Coordination. All these programs have the common mission of strengthening families.

These programs have not gone unnoticed by the employees and their families. The ongoing employee surveys returned to RIA's leadership prove that this teaming has become ingrained in the worker attitude and also promoted productive teaming activities into the workday. RIA received the prestigious Army Communities of Excellence Award twice in the past four years.

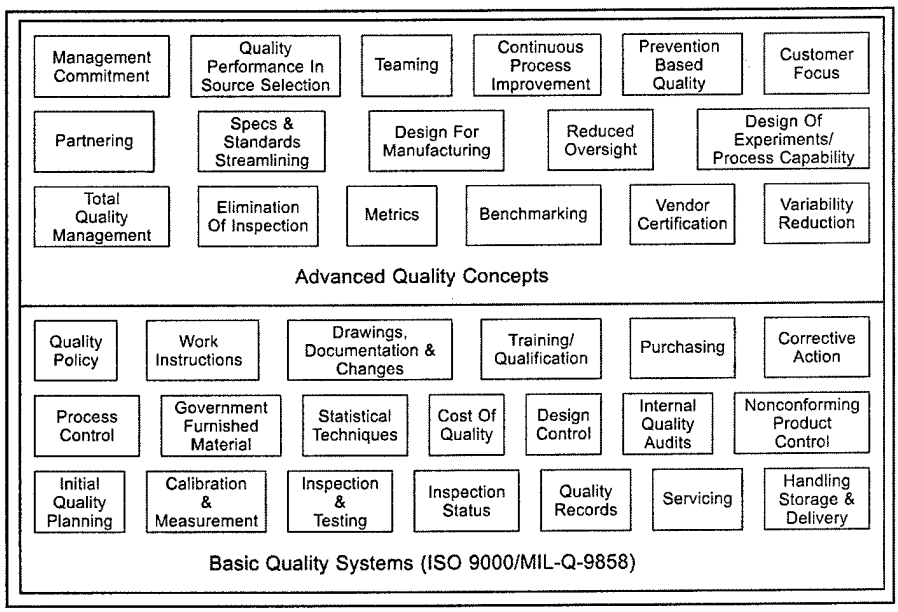


Figure 2-7. AMC Contractor Performance Certification Program

Contractor Performance Certification Program

Previous to 1993, RIA conformed to the MIL-Q-9858A Quality System. Believing itself capable of more, and in response to a demanding environment, RIA wanted to improve its competitive posture by providing a structured approach for self-assessments; a uniform set of assessment criteria and metrics for measuring performance; assurance that the government is receiving cost effective quality; and recognition as a facility that demonstrates high quality and continuous improvement. RIA established a goal to achieve certification under the Contractor Performance Certification Program (CP2) documented in the U.S. Army Materiel Command (AMC) pamphlet, AMC-P 715-16.

Through CP2, contractors who consistently deliver quality products, apply process controls, and continuously demonstrate aggressive efforts to improve quality are formally recognized. The program incorporates all elements of the ISO-9001 quality system, plus several advanced quality concepts (Figure 2-7). CP2 is based on management's commitment to total quality, compliance to quality system requirements, effectiveness of the Statistical Process Control (SPC) program, and metrics. Other areas of evaluation include continuous improvement, ethics, environmental, and safety. The CP2 effort is a teaming approach between contractor and government.

The Arsenal's high level of quality and commitment to quality were recognized when RIA became the only government-owned, government-operated supplier certified to CP2. Recognition and certification to CP2 allowed RIA to have first article requirements waived in some contracts. Other benefits from the certification include improved controls in

the operations, improved accountability for work functions, improved understanding of the responsibility for quality, and through the new channels of communication, better teamwork yielding enhanced customer focus.

Credit Card Program

The International Merchants Purchase Authorization Card (IMPAC) is a government-wide commercial VISA card used to buy supplies and services costing under the micro-purchase limit of $2,500. During 1993, the National Performance Review established a goal to create a government that works better and costs less. The credit card program was identified as a component of acquisition reform in the National Performance Review. In FY96, the Army executed about 1.7M purchases worth more than $700M. According to a January 7, 1997 U.S. Army Audit Agency report, it was projected that purchasing costs were reduced by $92 when using the credit card compared to traditional purchase order transactions. Work year savings equivalent to $155M were projected for FY96.

RIA began implementing the IMPAC program in 1993 by issuing cards to 25 cardholders and allowing them to make authorized purchases under $2,500. By January 1996, 14% of micro-purchases were made with the credit cards. Later in 1996, the Department of Army set a goal for 80% of Army-wide purchases under $2,500 to be bought with the credit card. At that time, RIA initiated extensive program and process changes which resulted in 96% of micro-purchases being made by credit card in July 1996, and 99% consistently since October 1996. For the first five months of FY97, 5,149 of 5,174 micro-purchases were made with the IMPAC card.

The RIA Contracting Directorate began these changes by setting up a comprehensive training program for credit card holders and their respective approving officials, obtaining waivers for pre-purchase supply and property book screening, issuing an installation-wide credit card program handbook, and establishing a strict screening and justification process for any micro-purchase requests not using the credit card. As a control measure, post purchase review of purchase logs by the Acquisition and Accountability Division as well as the Contracting Directorate were instituted. Emphasis was placed on establishing procedures which maximized the ability to purchase all items with credit cards that were allowed by higher level Army, Department of Defense, and Federal regulations.

Presently RIA manages the credit card program for the Arsenal, major tenants, and other assigned activities. There are now approximately 300 card holders and 200 approving officials representing 116 different offices. The 99% use for micro-purchases is one of the best within the IOC and the Department of Defense. The Army-wide goal was raised to 90% in March 1997.

Benefits to customers in reduced approval processing and ability to purchase items quickly are substantial. Vendors also benefit from receiving timely monthly payments for credit card purchases. Government savings through reduced finance and accounting transaction charges and reduced processing through resource management, contracting, and logistics offices as outlined by the U.S. Army Audit Agency report are being maximized through RIA's aggressive use of the credit card program.

Employee Assistance Program

The Rock Island Arsenal Employee Assistance Program is administered by two personnel. The program provides counseling services with a focus on drug and alcohol abuse. It also provides training to the workforce on drug and alcohol abuse, and has developed a program on Violence in the Workplace. The program's Soaring Eagles program is a well-documented success. This program encourages involvement of Arsenal personnel with the local communities. The Arsenal provides over 70 mentors to children in three local schools who have been identified as being at risk. The students and schools are very happy with the program, and it has provided a positive image for the Arsenal in the community. Although the Soaring Eagles program has participants from other industries, the Arsenal has provided far more mentors than all of the others combined, making RIA the leader within the community.

Help Desk

The Help Desk was established to answer questions and resolve the daily problems that are encountered by users of automated applications throughout the Rock Island Complex. The role of the Help Desk has continually expanded as the number of hardware and software applications, and number of people using these applications, have steadily increased.

Several years ago, RIA established its original Help Desk with two people to help automation users with mainframe problems and lockouts. The time

frame, which was characterized mainly by mainframe terminals, was followed with a proliferation of personal computers (PCs) and Commercial-Off-The-Shelf (COTS) software applications. This led to relocating the Help Desk with the COTS and PC experts, and expanding the number of people handling problem calls. The Help Desk handled the more common calls, with more extensive problems being referred to more technically experienced personnel within the office. With downsizing becoming a reality in the federal sector, more technical training was provided to Help Desk technicians, enabling them to answer more calls on initial contact. The Help Desk people became the first level of contact for all PC and COTS calls, as well as mainframe problems. Any questions which could not be resolved within the Help Desk were routed to the proper place for resolution. By 1994, the annual call volume was approximately 28,000.

With the increase in complexity and number of automation applications by 1995, the Help Desk took on increased levels of responsibility, and became the single point of entry for all sustainment issues. The goal was to make trouble reporting and resolution easier for the customers, and provide improved management visibility to systemic problems and issues. The Help Desk now handles calls on mainframes, mini computers, desktop computing (hardware, software, peripherals), e-mail services, databases, communications network, infrastructure, operating systems, and automation security. Present call volume is 50,000 annually servicing 8,500 Local Area Network (LAN) accounts, 6,000 e-mail accounts for RIA and tenants, and 3,000 remote off-post accounts using the mainframe and UNIX. With this expanded role, the Help Desk is now colocated with the PC/LAN and UNIX teams to enhance internal communications and provide better customer responsiveness.

The Help Desk team now consists of a manager and six people, and provides one-stop access by phone or e-mail for all automation problems. The staff has received both technical and personal relations skills training with the goal of being totally customer focused. Seventy percent of the calls are resolved on the initial customer contact. The customer organizations have established trained Work Group Managers to coordinate local questions before referring problems to the Help Desk. Frequent meetings are held to keep all personnel up-to-date with the latest developments. The Help Desk Expert Automation Tool (HEAT) was implemented to handle call assignments within the entire organization. A new telephone system was installed to even out the Help Desk call volume to each technician and to service customers in the order they called. HEAT also provides management visibility to generic problems and to which customers are having the most problems. This enables proactive support to other areas, preventing the occurrence of problems before they happen. The Help Desk organization also maintains a hardware and software library for lending to customers. This includes pentium multimedia notebooks, network connectivity, and automated remote briefing capabilities.

In establishing the Help Desk in its present form, RIA visited other commercial and government locations to benchmark and develop new ideas for customer service. They also became a member of the Help Desk Institute which provides specific training, networking opportunities, and information on future trends. As a result, RIA's Help Desk has been organized to effectively support a wide variety of customers and their unique needs. It has succeeded in providing one stop for customers to get their automation problems resolved or routed to the appropriate people. It has combined local experience with ideas obtained through benchmarking, and actively stays at the front of new developments and trends in the automation field. This has resulted in good customer service. Future plans include developing the Help Desk into a self-directed team, continued benchmarking, and increasing the focus on services to off-post organizations.

Legal Mechanisms - How To Do Business With Industry

RIA's mission is to support military readiness by manufacturing parts and equipment that directly support the Army and other Department of Defense (DOD) agencies. As defense budgets have declined, demand for military products and services has been scaled back along with the Arsenal's workload. To counter this trend, RIA has looked for alternative ways to utilize its excess industrial capacity to preserve jobs for its employees and maintain critical skills and capabilities that will be required in periods of increased national security needs. Alternatives explored by RIA include foreign military sales, business relationships with industry, and selling manufactured goods and services outside DOD. These types of activities are non-traditional for DOD industrial activities, and require special care to ensure that they do not violate existing laws or policies.

Although volumes of laws and regulations govern DOD procurement and acquisition, very little exists in the way of regulations or case law governing how government industrial facilities can operate in the industrial and commercial realms. RIA has been a leader in developing effective ways to work with industry and the commercial sector that meet existing laws and requirements. Only a handful of statutes address direct sales by federal activities. In 1993, federal law was amended to allow arsenals and depots to sell manufactured goods and services outside DOD. However, there are specific constraints. The work cannot interfere with DOD work or the installation's military mission. Services sold must relate to an article authorized to be sold. The article or service must not be commercially available, and it must be in the public interest to do the work. Purchasers who contract with the Arsenal must agree to hold the U.S. harmless for injury or damage to persons or property. RIA faces many constraints that commercial companies do not. The Arsenal is not allowed to make a profit or lose money on a job, so great care must be taken in costing and pricing. Work must be fully funded by the customer prior to commencing a job so the Arsenal can normally only undertake projects on a cost reimbursable basis rather than the industry norm of firm fixed price.

In spite of the many limitations and challenges, RIA has successfully undertaken many non-traditional projects that have utilized excess capacity and kept employees on the job. These projects have included partnering with industry; subcontracting for defense contractors; working with General Services Administration and commercial tool manufacturers to produce customized tool sets for the Army and Air Force; building and refurbishing specialized vehicles; testing and calibrating equipment for commercial companies; providing technical assistance and consulting services; leasing facilities to industry; and many other applications. The key to success has been the willingness by Legal, Contracts, and the production directorates to apply common sense and creative thinking within the framework of statutory and policy constraints. Cooperation and innovative approaches have provided new business opportunities that are excellent models for redefining the way government industrial facilities do business in today's changing environment.

Paperless EEO Complaint Process

RIA has implemented and demonstrated a new computer system designed to automate the processing of EEO complaints. The system is called the Paperless EEO Complaint System. EEO Complaints include files which are complex and can contain hundreds or thousands of pages. The data is sensitive and must be protected. Case files must be available for review at various levels in an agency, and must be forwarded to the Equal Employment Opportunity Commission for hearings. Many complaints could be in process at any given time.

Prior to this system, EEO complaints were processed using a time consuming and costly paper document system. Documents were created manually, stored in cabinets, and transferred by mail. Postage and copying costs were high, and security was a problem. Under the old paper system, it was relatively common for case file documents to be lost or misfiled.

In order to safeguard and reduce the time and cost of handling EEO case files, RIA purchased a computerized system that electronically creates, maintains, and transfers EEO case files. The system was designed by RBP Associates of Landover, MD. The cost of the system in 1994 was approximately $25,000. The system is compatible with the Army's Equal Employment Opportunity Management and Analysis System that has been used within the Army Materiel Command for the past ten years. The new system runs on a Pentium-based PC with a 4.3 gigabyte hard disk and CD-ROM writer drive. It has a high speed, 40-page per minute scanner, and provides secure transmission over the Internet and encryption on CD-ROM. The system creates CD-ROM disks that can be mailed or transmitted electronically to the Equal Employment Opportunity Commission. RIA's EEO office staff tested all aspects of the software module to control scanning, maintenance, and production of paper copies and CD-ROMs of complaint documents and files. The software module was modified to reflect changes needed to correctly process EEO complaints. Modifications were also made to the hardware. Demonstrations were provided to other Army installations.

The Paperless EEO System eliminates reproduction and misfiled or misplaced documents. It provides increased accessibility, greater security, and reduced overall processing costs. Figure 2-8 shows a cost comparison of processing a typical file by the old paper system and the new paperless system. The new system reduced overall processing costs by nearly 70%. It has been recognized as an important business process improvement by the Army Materiel Command, and is being evaluated for future use by other agencies and Army installations.

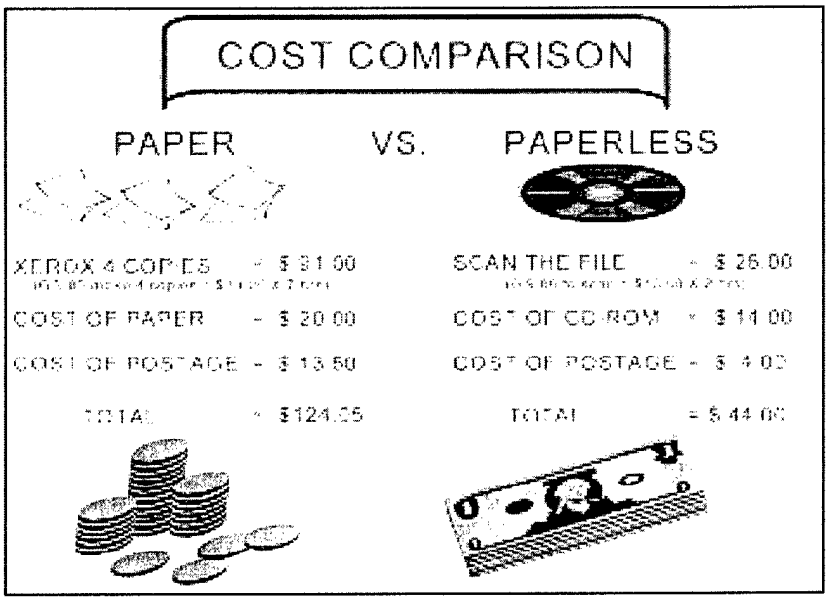


Figure 2-8. Cost Comparison: Paper vs. Paperless

Post Restaurant/Arsenal Club

The Post Restaurant and Arsenal Club Division of the Directorate of Community and Family Affairs at RIA provides food service to the base. Its mission is to provide patrons with good healthy food, and bar, catering, and vending services in a clean environment and at reasonable prices. Services are available to military personnel and their families, civilian Arsenal employees, and other individual community groups.

Its mission is accomplished by providing vending services, a retail store, snackmobile service, three cafeteria annexes, and by maintaining the largest restaurant owned by the Army. By Army mandate, these operations must be financially self supporting. Supplying food and refreshments for special and command functions such as holiday events and Armed Forces Day, using volunteers from the Arsenal, have helped meet this mandate. Revenue has also been increased by supporting community organizations such as the Boy Scouts and Red Cross while they are using base facilities.

Customer surveys show that the use of these services has a positive effect on job performance by improving productivity, attitude, and communication. The availability of this service has increased the Arsenal's ability to recruit skilled employees and provided satisfaction with the military way of life which positively affects soldier retention.

Recycling/Demilling Ton Containers and Process Equipment

RIA has employed its sophisticated equipment and manpower to solve the Rocky Mountain Arsenal (RMA) problem of disposal of ton containers (TCs). The treaty obligations between the U.S. and former Soviet Union require demilitarizing (demil) of containers that may have held one or more types of chemical agents. RMA requested that RIA demil over 4,000 decontaminated chemical agent containers, commonly called TCs, and about 1,800 tons of process equipment by melting them in the RIA foundry. RMA chemically and thermally decontaminated approximately 25% of the containers to the 5X condition per Army Regulation 385-61, which renders them safe for human contact without any personal protective equipment. The remaining containers and equipment were chemically decontaminated to 3X condition, which can be handled but cannot be heated in an open furnace. RIA obtained a new air emission permit from the Illinois Environmental Protection Agency (IEPA). All of the 5X containers were melted into ingots two months ahead of schedule and sold for recycling by the Defense Reutilization Marketing Office during 1994.

To recycle the 3X TCs and process equipment, RIA designed and modified its existing furnaces in the heat treating shop by upgrading the facility with construction of an afterburner and stack monitoring equipment. RIA has applied and received a construction permit for modification of the furnaces and air emission permits for heat treating and melting the containers and process equipment. Environmental Assessment and Finding of No Significant Impact were also submitted to the IEPA. No adverse comments were received from the public after public notification. Thirteen containers (26 half TCs) or 30,000 pounds of process equipment at a time are being heat treated at 1,250°F for 90 minutes to convert 3X to 5X condition. The material will be processed by August 1997. RIA is capable of recycling/demilling about 3,000 TCs or 2,400 tons of

equipment per year on a single shift per day basis. Capacity can be tripled without major upgrade of equipment.

The success of the operation has generated interest for disposal of other equipment such as bomb shells and artillery projectiles. RIA has negotiated and signed a Memorandum of Agreement with Aberdeen Proving Grounds in Edgewood, Maryland to recycle/demil 1,700 3X TCs. RIA is seeking to recycle/demil for at least three other military and commercial clients. Liability, accountability, cost, and the ownership by the government are the main reasons RIA has been selected to recycle and/or demil the chemical agent ton containers, artillery projectiles, bomb shells, and process equipment. RIA has found potential buyers for the ingots produced from the containers. One of the buyers is a local farm implements manufacturer who needs the type of high grade steel from which the TCs were made. Such a recycling project would indeed "turn swords into plowshares."

Self-Directed Work Teams

Self-directed work teams (SDWTs) were introduced at RIA about two years ago with the intent of streamlining the organization and eliminating several layers from the structure. SDWTs are groups of employees sharing responsibility and authority to plan, implement, and control the accomplishment of particular units of production or service. A Teaming Design Group was established in January 1995. The Design Group benchmarked SDWTs in other organizations and submitted a design plan that was accepted in May 1995. Planning and implementation were done in partnership with the unions. A Teaming Support Group (TSG) was established and chartered to provide the professional support services essential to the success of SDWTs. TSG began training and chartering teams in August 1995.

The TSG is involved in all aspects of the team development process. Organizational assessments are conducted with senior management personnel to develop expectation baselines for teams including goals, objectives, and values. TSG personnel attend team meetings and review team meeting minutes. Regular meetings are conducted with team delegates of chartered teams to share successes, lessons learned, and problems. Monthly facilitator meetings are conducted. TSG provides formal training courses including executive workshops, team-building skills, coach and facilitator training, consensus and conflict resolution, dynamics of change, and HEARTS training. Informal training is given as needed. Classes are usually one or two hours in length. Topics include performance appraisals, discipline, problem solving, leave issues, safety, regulatory guidance, customer service, and computer skills.

To date, 158 SDWTs have been identified; 117 teams are formed and in various stages of teaming; and 43 teams have been chartered. Figure 2-9 shows how SDWTs have streamlined the Arsenal's organizational structure. Teams are now in the process of developing metrics for team effectiveness. Metrics are being aligned with RIA's key business and process metrics of cost, quality, and timeliness.

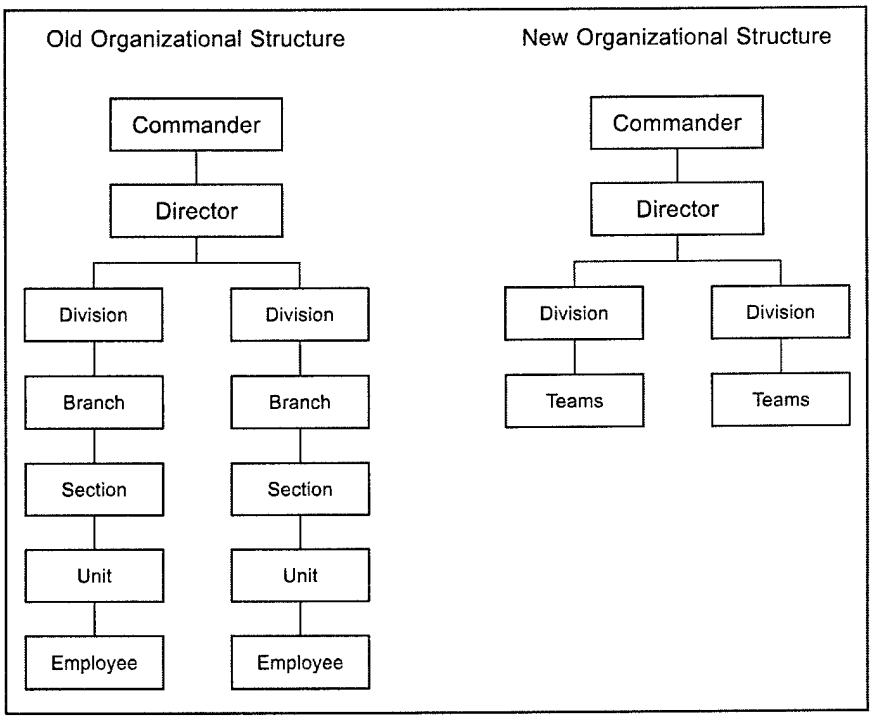


Figure 2-9. Self-Directed Work Teams

Long-term plans call for development of metrics to measure customer satisfaction. Continuous improvement strategies incorporate additional benchmarking, training, and introduction of 360-degree performance appraisal. RIA has been one of the leaders in the Army Industrial Operations Command for SDWT implementation. Key elements for successful teams at RIA are emphasis on communication and training, recognition of success and achievement, and clearly defined goals by top level management.

Show-Me-the-Ropes Mentoring Program

RIA's Show-Me-the-Ropes mentoring program was developed as an objective of the Affirmative Employment Program Plan. The program was instituted in 1992 to provide an opportunity for women and minorities to improve job skills, increase productivity/potential for higher level jobs, support the upward mobility of the participants through career development information, and improve morale.

The five members of the Mentoring Steering Committee program coordinate the selection and pairing of an employee with a skilled mentor for a six-month commitment of weekly, hour-long, formal meetings. During this period, the mentee is guided in setting goals; expanding knowledge of different careers; learning how the system works to select qualified candidates for various jobs; and building a network of contacts with the insight into what one can do to help oneself advance. A second six-month period is set aside on an as-needed basis for requested training. Additionally, an evaluation form is e-mailed to participants to complete and e-mail back. This has increased the response rate and response time for gathering the reactions and impact of the program.

The mentoring program has been useful not only for government installations in the current climate of downsizing and budget constraints, but also has positive implications for any organization wishing to eliminate under representation of minorities and enabling employees to help each other. In fact, other installations have shown interest in the program because of its benefits in providing the employees a sense of responsibility for their development. The program offers no guarantee of selection or promotion for participants; however if selected, participants are coached on ways to not just survive but to achieve their career goals. Participants specifically like the ability to build a personal network of contacts because they are usually able to find someone that not only helps them professionally but also personally. Participants also report that having a wider pool of talent to draw from allows them to discover alternate ways of accomplishing a goal that would not have been possible without the network.

Mentees report such benefits as help in defining and setting realistic goals and action steps; perspective on organizational structure, priorities, politics, and culture; connection with a person concerned with their development; feedback on effective behavior on the job; and information on how the system works and how to work within the system. Mentors include such benefits as the satisfaction in helping others; development of communication skills; the opportunity to gain insight about people in different organizational units and across cultures; and the opportunity to gain perspectives on their own career goals.

Statistical Process Control

Prior to 1982, RIA's manufacturing operation relied on a detection/segregation type quality program. Although this method of establishing process dimensions to limit variation was used by industry for many years, it was expensive and ineffective due to high nonconforming material rates and untimely corrective actions. Parts were produced, defective parts were identified and dispositioned, etc., and throughout this cycle, the movement and/or storage of parts were required.

The adoption and expansion of statistical process control in RIA's manufacturing operation were administered by its Quality Assurance organization during the 1980s. Implementation and development of the program included the training of employees, automation of data collection, and acquisition of statistical analysis software. These steps were significant improvements and initiated RIA's transformation to a prevention type quality program.

As a result of RIA's participation in a customer established certification program, two significant developments occurred in 1992 and 1993. In 1992, SPC training was expanded to include statistical techniques as a tool for reducing variation in administrative processes. This detailed, application-specific training helped win support as others saw the value of the program. Another enhancement occurred in 1993 when the ownership of SPC applications in the manufacturing operation shifted to Planning/Production. With this development, manufacturing replaced Quality Assurance as the organi-

zation responsible for identifying SPC applications, and an enhanced level of process owner buy-in was established. The current structure is as follows:

- SPC Coordinators provide technical support, administer training, and interface with management.
- Process Planners identify SPC applications and submit requests for reduced inspection.
- SPC Leaders provide floor-level technical support, analyze process capabilities, and calculate control limits.
- Quality Engineers review process capability analyses and provide technical support to Planning/Production.
- Facilitators set-up/download automated data collectors and facilitate SPC applications at the Cost Center level.
- Machine Operators monitor processes using SPC techniques, maintain process stability, and document process improvements.
- Quality Information Technician maintains the capability database, distributes customized reports, and summarizes data for management review.

As of March 1, 1997, 1,246 active characteristics were identified for SPC at RIA. Since 1993, the benefits obtained from the improved system include a 21% reduction in the overall manufacturing defect rate; and for two specific production items, 73% and 79% reductions in variation. In addition, a benefit was realized when the SPC team applied the principles to its own task and reduced the SPC data cycle time by 70%.

Youth Services

The Youth Services operation is an aggressive and well managed program. A former bar area has been turned it into a bright, high-tech learning area. Through the use of both Appropriated Funds and Non-Appropriated Funds, RIA procured modern computers for students to use for homework. RIA built a beautiful summer Day Camp area which is used 10 weeks each summer for the children, and can also be used for picnics by employees. RIA conducts many activities for the employees' dependent children and provides access information for activities and organizations within the community. Also offered are After School Programs, School Out Activities, Teen Club, and special programs. The Arsenal's program has been selected as an Army School Age and Teen Pilot Program.

The Youth Services uses customer surveys, meetings, feedback forms, and the Parental Advisory Council to stay in touch with the community's needs and to continually improve its processes. RIA runs a very good program that should be held as a model within the IOC.

Section 3

Information

Design

Finite Element Analysis and Dynamic Analysis

RIA has state-of-the-art capabilities in finite element structural analysis and dynamic analysis. This capability is used to evaluate functional capability, repairability, producibility, failure analysis, Request For Waiver/Request For Deviation/Engineering Change Proposal (RFW/RFD/ECP) submittals, and product improvement proposals (PIPs) for components and systems acquired or produced at RIA. This capability is also used to support local engineering and manufacturing companies through a program called Center for Manufacturing Regional Economic Development.

The old method of determining structural integrity was to build prototypes and run them though operational testing, and then perform failure analysis for determining areas that required redesign. This was costly and time consuming. The new process can model the initial design in the computer without building an initial prototype. Figure 3-1 is a dynamic analysis model of the latch box design for the prototype 155mm light weight howitzer using MECHANICAL motion modules. These models can be simulated with various loading conditions and boundary conditions. If any design deficiencies are found, the models can be modified to correct the deficiencies. This computer analysis process can be repeated until an optimized design is obtained without any prototype being manufactured. After a design has met all functional requirements, a prototype can be manufactured for full-scale live testing and comparison with computer analysis results. This new process has both tangible and intangible benefits that include minimized prototype manufacturing costs; reduction or elimination of time delays due to prototype redesign; and achievement of an optimized design. For current product engineering support, this new technique is an invaluable asset in determining functional capability, repairability, producibility, failure analysis, RFW/RFD/ECP submittals, and PIPs.

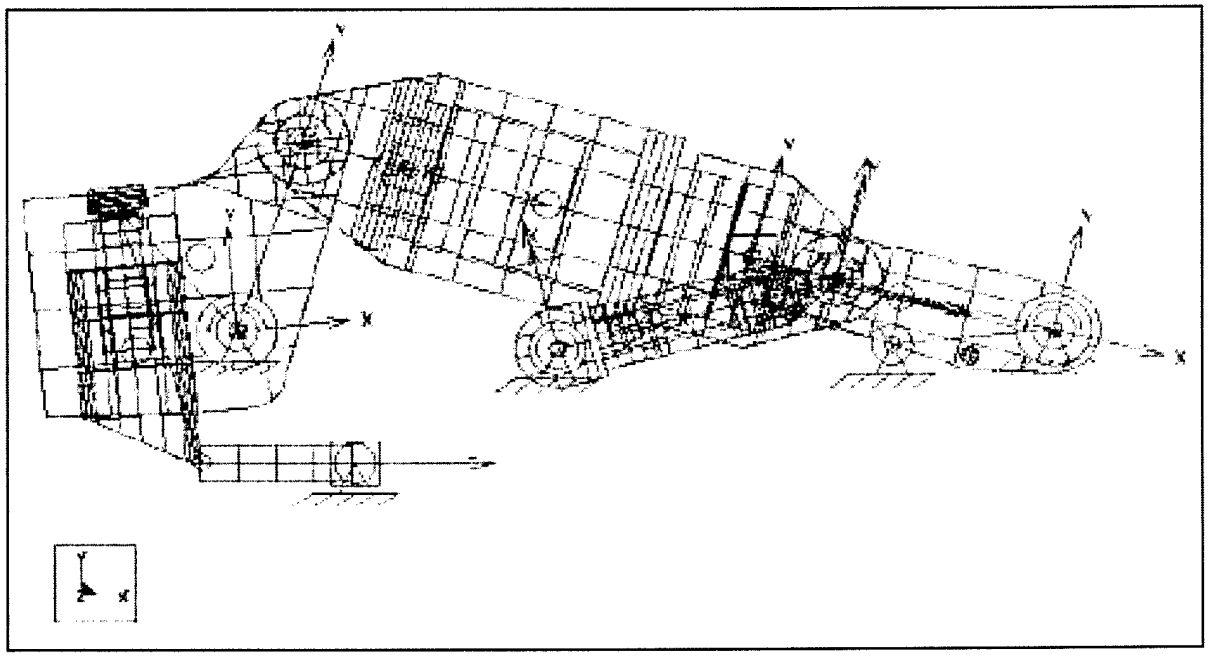


Figure 3-1. Dynamic Model for Latch Box Design

Test

Independent Radiological Test Lab

Since 1993, RIA's Material Laboratory Division has been licensed and certified by the Nuclear Regulatory Commission to provide the U.S. Army Armament Chemical Acquisition and Logistics Activity with radiation wipe test analysis. RIA has provided leak test analysis of radioactive commodities to more than 3,000 DOD customers located throughout the world.

With two low background alpha/beta flow proportional counters for counting alpha/beta radioisotopes, and two liquid scintillation counters for analyzing low energy alpha/beta emitters, RIA has developed an accountable process to sample, analyze, and report quantitative results with a quick turnaround time of less than or equal to 10 days. RIA's reports also provide customers with information and directions on corrective actions that need to be taken when radioactive levels exceed acceptable levels. RIA's Material Laboratory Division has demonstrated that it is capable of providing customers with quality radioactive analysis in an efficient and cost-effective manner.

Production

Austempered Ductile Iron Minifactory

RIA has developed a unique, versatile Austempered Ductile Iron Minifactory with in-house expertise and production and test capabilities. The minifactory arose from a congressionally-mandated program to explore uses for American ductile iron and austempered ductile iron in defense-related applications.

Austempered Ductile Iron (ADI) is basically the same composition as ductile iron, but is heat treated to give it higher strength. Some of the advantages of ADI include competitive strength-to-weight ratios, suitability for thinner walled and complex castings, low machining costs, and better machinability. RIA's minifactory has the capability to import or develop 3D CAD/CAM part models, design and make the 3D casting model, verify the casting model using casting fill and solidification simulation, make rapid prototype or conventional patterns, mold and cast, heat treat, machine, test, evaluate, and report as required. In-house forging, plating, and welding services are also available to support the minifactory.

Basic Control Language

Programs for driving Numerically Controlled machines have historically been created by either a high level programming language such as Automatic Program Tool or a CAD/CAM system. The output data (CLdata) has always been produced in a proprietary format that depends upon both the programming system and the computer platform on which the part program is produced. A shop that utilizes several types of CAD/CAM systems and/or several different types of machine controls requires a separate postprocessor for each unique situation.

RIA was burdened with this particular scenario since it had approximately 120 Computer Numerically Controlled (CNC) machines which required 70 separate postprocessors to support them. In the mid 1980s, RIA discovered that North American Rockwell had contracted with Vega, Inc. to develop and install Computer Numerical Controls which would accept CLdata as a direct input without postprocessing. The outcome was a new standard for CLdata, titled RS494, the first Basic Control Language (BCL) for CLdata. Using this newly found information, RIA joined the newly formed BCL Users Group. Since RIA was intending to purchase 70 new CNC machines, it was decided to specify BCL as the NC input format for these purchases. RIA also purchased converter software for existing equipment. Converter software translates the proprietary CLdata into BCL Standard CLdata. Some of the benefits derived from BCL include one postprocessor for all machine tools; no alternate program re-proofing or re-programming; and reduced training requirements. Currently, RIA has 46 BCL compatible machines, and supports an additional 36 non-BCL machines by way of a BCL input generalized postprocessor.

By adopting standard CLdata, RIA can capture manufacturing lessons learned and pass the information via electronic data exchange to other DOD facilities to improve response time during emergency mobilization events.

Distributed Numerical Control System

RIA developed a Distributed Numerical Control (DNC) system which eliminated the previous method of part programs being driven from paper/mylar type, mag cartridge, or floppy disk depending on the capability of each particular CNC machine controller. Part program distribution is now done elec-

tronically from one master repository. This new technique guarantees that the machine operator is using the latest revision of the control software, and allows the operator to download new versions directly at the point of operation instead of time consuming trips to tape libraries where the operator may not get the latest released version of the controlling software. Configuration Management control has been made easy by having only one repository for the latest controlled version.

DNC was the first Client-Server application installed at RIA. It uses industry standards for communication Transfer Communication Protocol/ Internet Protocol, Network (Ethernet), and database management (Statistical Query Language compliant). A total of 168 machines with more than 20 different types of machine controllers are now connected to RIA's DNC system. The turnaround time for program changes was reduced 90% resulting in a cost savings of $200K annually; $5K was saved annually on distribution medium; and shop floor libraries were eliminated.

Through DNC, a direct communication link was established between the programmer and the shop floor using DNC notification capabilities which increased the feedback response for efficient transfer of information. The DNC workstation is also used to access work instructions and labor reporting systems.

Program Change Order (PCO) management was the next step RIA took in improving the manufacturing process. PCO is a six state process which manages program changes and revisions in a streamlined method eliminating redundant steps in the overall change process. The six states are as follows:

- 1st Issue — Indicates part program is new and not previously used for production.
- Proving — Formerly a 1st Issue part program that has been edited at least one time.
- Hold — Indicates this program was formerly a Production program and has been edited; this program can only be downloaded immediately after the edit was made; afterwards, it can only be downloaded by a programmer, foreman, or leader.
- Allow — Indicates a programmer or foreman has authorized use of a program in a Hold status for production.
- Reject — Edits made to a Production part program that have been rejected by the programmer.
- Production — A part program which was in a 1st Issue status and has been run successfully with no further changes required.

RIA stands with industry leaders in the area of NC machine control. The Arsenal's DNC system provides a structured methodology ensuring that part program integrity is maintained at all times.

Electronic Data Interchange

RIA is on the highway of electronic data interchange for communicating and rapidly responding to customer requirements. This is performed by using file transfer protocol (ftp)/internet, e-mail attachments, and translating neutral files such as Initial Graphics Exchange Specifications, Data Exchange Format, and STandard for the Exchange of Product model data Application Protocol 203 to and from proprietary CAD/CAM files.

With the use of neutral files, RIA is capable of supporting customers, and has been able to manufacture quality products and models without formal drawings by establishing best practices with the customer and translating specification data into CAD/CAM. This proven practice embraces teaming concepts and reduces lead time, as evidenced by comments on customer surveys.

Manufacturing Planning System

RIA is using Computer Aided Process Planning (CAPP) to improve its manufacturing planning system. CAPP is an automated paperless system that provides real time data and reduces the configuration problems encountered by traditional or manual means.

CAPP provides shop floor graphics and other value-added data needed to perform an operation, along with information for determining process variations and capability. This user-friendly system provides a standard library of plans, operations, and text which allow the user to build partial or full process plans by inputting minimal information. CAPP also maintains a historical record of all process revisions which include previous routings, drawing revisions, and a comment sheet which contains information on any changes made to a process. CAPP yields reductions in planning cycle time; defines and controls process requirements; and enhances communication between the planning and production/shop personnel.

Manufacturing Resource Planning System

RIA is deploying a Manufacturing Resource Planning System (MRP II) to control, schedule, and monitor inventory and resources. MRP II contains information on design engineering, manufacturing engineering, and product costing as part of its technical data management module. RIA uses MRP II to generate real time manufacturing planning data on inventory control, make or buy decisions, capacity planning, manufacturing costing, and master scheduling.

This on-line system is used by RIA management, planning, and manufacturing personnel as a front end to a Distributed Shop Floor Control system used for job assignments, dispatching materials, reporting labor, and order/operation maintenance. MRP II provides RIA with the information needed to be proactive in allocating the inventory and resources required to cost effectively meet customer schedules and associated demands.

Rapid Prototyping

RIA has deployed rapid prototyping and casting practices using CAD and modeling techniques, casting simulation and rapid prototyping technologies for design, value engineering, technical assistance, production planning, and pattern and mold making. The rapid prototyping and casting practices reduce manufacturing times, costs, and associated risks of both prototype and small production runs. Through teaming with subject matter experts, RIA is able to develop, visualize, and analyze proposed product designs prior to product fabrication, and make or buy full-scale physical prototypes of various materials it uses directly or indirectly for investment and sand casting molds. This practice has allowed RIA to validate product baseline drawings, identify and correct drawing errors, design castings and tooling, manufacture patterns and molds, and avoid costly manufacturing start-up costs.

RIA has demonstrated that the use of CAD and simulation of proposed product lines are proactive tools for determining risks associated with manufacturing processes. These tools have proven to be a cost effective means to streamline manufacturing processes, detect processing problems before they occur, and enhance productive communication among the engineers, production personnel, and customers. RIA has also demonstrated that prototype and small lot investment and sand castings can be shipped in about two months.

Weld Cell

The fabrication of weapons systems components manufactured at RIA require several different processes. All parts are tack welded in dedicated fixtures, preheated in ovens, placed into finish weld fixtures, and then finish-welded by semiautomatic or manual means. Upon completion, they are sent to the inspection department for visual and magnetic particle inspection of all welds. The weldments are then sent back to the weld shop for repair of any discontinuities. All welding, moving, fixturing, defixturing, and repair are very labor intensive and time consuming.

RIA has developed a flexible welding system (FWS) which enhances the efficiency of these operations and in turn improves productivity. The FWS consists of a Laser Guided Vehicle (LGV), a flow-through automatic preheat oven, two 6-axis articulated robots, and four 12,000 pound capacity positioners. Once the tacked weldments are loaded into a fixture, the FWS takes over the entire process. The operator does not touch the parts until the LGV delivers the finished product to the inspection/repair station. At that time, the operator performs visual and magnetic particle inspection and repairs any discontinuities. The benefits obtained include consistent, spatter free welds; a 75% reduction in post weld clean up; corner wrapping of welds which reduces starts and stops by 75%; and simultaneous welding, material handling, and inspection operation on multiple parts in a designated 7,000 square foot area.

Facilities

Advancing Application Development's Process Maturity

The three Applications Development Divisions within the Information Technology Directorate used software Engineering Institute's Capability Maturity Model to assess their process maturity. It was discovered that their organizations were at Level 1, on a scale of one to five, the ad hoc or chaotic stage, and that they had no metrics in place. The use function points were tried, but nothing productive was accomplished. The Work Reporting and Control System collected data on projects; however this data was found to be meaningless since there were no means to measure the size or complexity of their projects.

The Divisions developed two sets of metrics to measure their process maturity. The first set was for application development, and was used to measure the readiness of the Software Engineers to perform their mission. The areas measured were education, skills, investment in hardware, type of equipment, new development projects, and resource allocation. The Divisions found they were weak in types of equipment and education. The second set of metrics measured efficiency. The areas measured were customer satisfaction, disruptions, administrative performance, personnel management, and productivity. Disruptions and administrative performance were found to be weak areas.

The Divisions' goal is to improve to a Level 3 on the Capability Maturity Model scale in two years. The metrics now being measured should help them attain their goal. All of the information and results are provided to the entire workforce which have helped ensure the credibility of the metrics and employee buy-in.

Child Development Services

The Child Development Services office of Rock Island Arsenal has expanded over the past 10 years from a babysitting service manned by volunteers to a program manned by 39 personnel who provide care for 104 children. The program provides full-time, part-time, and hourly services to military and civilian employees of the Arsenal and has been accredited by the National Academy for Education of Young Children. All personnel are trained above and beyond the requirements. The program has received commendable ratings from numerous inspections. The staff is dedicated and has done its utmost to create a positive and happy atmosphere for the children's development. The staff uses various methods of feedback and implements valid suggestions.

Contracting Methods

In 1988, RIA was directed to conduct an A76 review of its Public Works' blue collar areas. This review resulted in a single contract being let for installation logistics and facilities support services for five years. Numerous coordination problems led the installation to let two contracts at the end of the five-year period — one for facilities support services and the other for logistics support. Numerous problems were still encountered with the facilities support services, most of which were internal to the contractor. The contractor often did not supply the proper skills for different jobs, and coordination was lacking. A significant amount of time was lost resolving problems, and customer satisfaction was very low.

The Installation decided not to let a single contract for facilities support services, and is in the process of letting multiple best value, flexible workload contracts. Those contracts that have been let have already shown a marked improvement in performance and customer satisfaction. Many services are also purchased using government credit cards which have sped up the process enormously (at times as quickly as same-day service) and will probably result in cost savings. The Directorate of Public Works' members have also found that many coordination problems are now easily resolved by dealing directly with the functional experts. This has streamlined the support service processes and should also result in cost savings or avoidance.

Not enough data has been collected as yet, nor are there substantiated cost savings. However, the potential is there, and Public Works' personnel seem to be on the right track to realizing cost savings and process improvement.

Environmental Management

Prior to 1991, RIA had several violations of various Environmental Protection Agency standards. This resulted in findings by Army, state, and federal environmental auditors. Since 1991, several steps have been taken to improve its environmental program by implementing Army guidance to bring RIA in line with Department of the Army requirements. Through Command emphasis and a solid training program, RIA has increased employee awareness and provided the employees with a detailed guide on waste disposal. The guide is a collaborative effort of five RIA offices. The Commander conducts a Quarterly Environmental Control meeting including all of the directors and division chiefs. Unannounced audits by the Quality Systems Directorate are conducted. RIA has formed process action teams to address several environmental issues, such as modernization of the potable water plant, hazardous material acquisition, and asbestos abatement. The installation has teamed with the IEPA as "Partners in Pollution Prevention," which has given RIA additional avenues to assist in solving environmental issues. The installation also utilizes cross-func-

tional teams to approach environmental problems, giving RIA access to technical expertise not normally available.

Through these efforts, the installation has been able to meet the requirements of 23 different environmental acts, regulations, etc. RIA has zero findings since 1991 and has eliminated vapor degreasers, polychlorinated biphenyl lead based paints, and high volatile organic compound paints. All underground storage tanks have been replaced, and a good recycling program has been established. A very efficient chrome recovery system has been installed, the quality of the potable water has been improved, and most of the waste that had been classified as hazardous has been handled in a manner which allows it to be classified as nonhazardous waste. All of these are good initiatives with positive results. They are all regulatory or cost driven and are in use across the Department of the Army as well as other federal agencies. The turnaround in environmental management since 1991 is to be commended.

Partnering in HVAC Contracts

Prior to 1997, RIA had subcontracted all technical support services for HVAC building operation, chiller operation, and system preventive maintenance under one general contract to a single supplier. This single contract configuration, covering the three distinct service requirements, did not provide timely solutions to excessive downtime and emergency needs because the contractor's personnel were not aware of contract specifications regarding areas of responsibility, resulting in the wrong resources being applied to a particular problem; a lack of coordination and cooperation existed between the contractor and RIA engineering and inspection group; there was a lack of supplies and support for repair personnel; and non-technical RIA contract personnel incorrectly interpreted technical requirements of the contract and misguided the contractor's efforts.

In 1997, it was decided that a team approach or contractor/Arsenal partnership be developed to focus on reducing contract misinterpretation and enhancing system performance. Individual contracts were established with more than one service organization to support each of the three maintenance requirements. This was done to minimize confusion between the contractors and Arsenal personnel, and to maintain maximum equipment availability. In addition, the contracts stipulate that Contract Responsibility Training will be provided to all personnel, and that all personnel will meet weekly to discuss problems and coordinate work assignments. Contractors are also required to provide mobile vans containing specified tools and supplies to ensure that repairs can be effected quickly.

This partnership between contract employees and government personnel, including training and interactive discussions, will provide closer cooperation and an effective deployment of resources. Less time will be spent on contract issues and crisis management, and more time will be spent on problem diagnostics and repair activities. Measurable benefits are expected to be achieved as this program matures.

Logistics

Automated Material Safety Data Sheets

More than 6,400 different Material Safety Data Sheets (MSDSs) are available on-line through a PC connected to RIA's LAN. Users can query the database by local MSDS number, product name, manufacturer name, national stock number, cost center (user), or hazardous ingredient. The computer-based system is accessible Island-wide, and extensive copies of MSDSs are no longer manually prepared or distributed.

The RIA Safety Office manages local program implementation of the federally mandated Hazard Communication Standard, 29 CFR 1910.1200. Per the Hazard Communication Standard, customers are not to use materials until MSDSs are available. One of the primary and most significant tasks associated with Hazard Communication Standard is the procurement, distribution, and management of MSDSs. The Safety Office is the central repository for MSDSs.

Prior to the updated, automated MSDS system, more than 6,400 documents consisting of 35,000 pages were filed in more than 100 three-ringed binders. The data sheets are required and received for each hazardous material purchased and used by RIA. The data sheets are analyzed by the RIA Safety Office and Industrial Hygiene Office for content and applicability at RIA. Site-specific data was then entered into an antiquated Intel computer system. Index cards were prepared manually to cross reference each MSDS. Hundreds of copies of MSDSs were made daily and distributed to users, and 15 reports were printed and distributed quarterly to central locations. The entire MSDS process was extremely time and resource consuming. The volumes of materials were becoming restrictively cumbersome to manage. Audits conducted by the Quality

Systems auditors showed a weakness in compliance with the local Hazard Communication requirements.

The process has now been replaced with a state-of-the-art automated on-line MSDS system. Project implementation, with the assistance of information technology, began one year ago by scanning over 6,400 MSDSs into a portable document file (PDF) format using Adobe Acrobat 3.0 software. As this occurred, the information previously stored on the Intel computer was downloaded, manipulated, and converted to PC application. To access the new system, users need a PC connected to the RIA LAN, Internet Explorer World Wide Web Browser, and the Adobe Acrobat PDF Reader software. Users can browse query results to find the specific MSDS they are interested in, and view or print a hard copy. Users can also generate their own reports and print a hard copy.

The Automated MSDS system significantly improves data entry, access by all individuals to current MSDS information, and compliance with Hazard Communication program requirements. Updates can be accomplished quickly, making more time available for safety personnel to devote their time to other safety issues. Further enhancements will make the system completely paperless.

Customer Survey Feedback Form

RIA's Directorate of Industrial Operations delivers basic items of issue (BII) and tool sets which logistically support the Army soldiers and fielded equipment. Since the early 1980s, a customer feedback form has been sent out with all tool sets and BII deliveries. This form asks for suggestions, complaints, and favorable comments which can be used to improve the logistics materials provided by RIA. The forms were returned to the Quality Assurance organization which addressed problems needing correction. Positive feedback or comments on what was working well did not generally flow back through the Industrial Operations Directorate.

RIA is in the process of expanding and improving this customer feedback mechanism. The form used for BII and tool sets is in the final stages of revision, and will be returned directly to the Industrial Operations Directorate. This will provide more complete feedback to those most closely involved with the product and will also enable a deeper look into trends or generic problem areas rather than only addressing each individual response. A new feedback format has been established for customized tool kits. This format asks for similar information, but establishes additional response methods through use of data fax and electronic mail. It also commits to a five to seven day response to feedback received. This is a new program, and telephone follow-up calls to the initial questionnaire are planned to determine if it is well received. The program also provides the basis for creating a master file to enable a generic look at products and processes as well as at each individual response.

Customer feedback mechanisms are essential for identifying problems, letting customers know an organization stands behind its products, and creating customer satisfaction. RIA has developed an effective mechanism for obtaining feedback and is continuously looking for ways to make this feedback process more effective.

Implementation of the Standard Industrial Funds System

The Standard Industrial Funds System (SIFS) was mandated for use by RIA as part of a change in the Department of the Army's policy requiring uniformity in Army installation accounting and budgeting systems. Direction to migrate to this system occurred during a period in which simultaneous implementation of several other accounting systems were already underway, creating difficulties in achieving a smooth transition. RIA was confronting the need to transition to the following automated systems concurrently—Time and Attendance Reporting; Civilian Pay; Defense Property Accountability System; and SIFS.

The difficulties in implementing SIFS were compounded by a short notification time of six months; poor SIFS user manuals and associated documentation; inadequate training in the use of SIFS and limited knowledge of the system; and the realization that SIFS was intended for Depot application vice an installation with a large array of unique and disparate missions.

Once the system was established, the initial exercise of SIFS indicated a serious operating loss due to element operating losses in the areas of labor variances, order losses, and clearing account losses. Although gains in applied overhead and inventory were also indicated by this initial system use, the overall result indicated unacceptable SIFS function for RIA. The then current SIFS configuration did not allow for an accurate portrayal of how the installation was conducting its business. The need for change was driven by several possible consequences — workload reductions underway which

invariably forced operating cost increases to the point of installation closure; privatization pressures; and indicated operating losses which, unless reconciled, represented a sizeable percentage of the operating budget (a 24% increase in product cost).

In response to the imperative to correct the inadequacies in the way SIFS functioned for RIA, a corrective action task force of 84 employees within RIA and other installations was organized into teams with the mandate to address 273 individual tasks for analyzing SIFS function and correcting the way data inputs were used to depict financial posture. Over 14,000 hours were spent in these efforts, with concurrent close monitoring of task accomplishment, recasting of remaining tasks as required, and reconciliation of the resultant multiple forecasts of net operating results.

The result of the efforts to more accurately and effectively use SIFS are indicated by a FY98 reduction in direct labor costs of $9.87 per hour, 46 system change requests to more effectively adapt SIFS to the RIA environment, and a corresponding thorough streamlining of financial asset accounting procedures. The system is currently functioning satisfactorily for RIA.

Multimedia Network

Between 1978 and 1988, RIA utilized 22 buildings' minicomputers and remote dial-in capabilities as the LAN and Wide Area Network. This network provided multiple services to RIA tenant organizations and Armament Munitions and Chemical Command (AMCCOM) subordinate organizations worldwide. Phased funding was provided for the minicomputer network based on the business requirements of the customers using this service. However, the minicomputer network did not address the need to allow a single terminal device to access all minicomputer and mainframe computer resources.

In the late 1980s, the Arsenal migrated to a single local area network (UniLAN) capable of accessing all computer resources and providing a broadband for audio-video applications. Funding was provided by the Defense Ammunition System Project to meet the Arsenal's business requirements. By using existing cabling to the minicomputer rooms in the 22 buildings, transition to the UniLAN was simplified and accelerated. The UniLAN provided data services to 12,000 host computers/terminal devices, Desktop Video services across AMCCOM sites, and Closed Circuit Television. However, the power of the PC changed the computer environment to a network centric environment, requiring very significant changes to the network services.

The Personal Computer Local Area Network (PC-LAN) Project began in 1991 and addressed the customers' growing network needs. The goals of the project were to provide a client/server environment for sharing software, data, and printing capability; provide the necessary networks to deliver required information to individual desktops; and ensure a flexible architecture taking RIA into the 21st Century. The 1992 to1996 PC-LAN Project phases consisted of:

- Phase 1 — An Island network backbone: The dual fiber optic network backbone was implemented in 1992, providing a redundant 100 Mb/sec service between Island buildings.
- Phase 2 — Network services: Installation of new building cabling and network hubs allowed transmission speed to desktops to increase to 10 Mb/sec from the previous 9600 baud using the Fiber Data Distributed Interface and Ethernet connectivity to the desktop; new class-5 wire was required in all of the Island buildings.
- Phase 3 — Fileserver services: Local services were provided to 100 to 250 customers for shared software, data, and printing services. The combined network and software provided improved computer access, client/server data access services, and access to all DOD and Private Sector information.
- Phase 4 — Software standards and Windows migration: Implementation of server software reduced software licences, improved installation software standardization, and allowed for a complete migration to a Windows Graphical User Interface (GUI).
- Phase 5 — Applications Development: With the client/server and GUI environment, new applications were re-engineered to provide improved applications services.
- Phase 6 — Elimination of obsolete systems: The original minicomputer LAN, the UniLAN, and DOS software were eliminated allowing support services to be concentrated on the PC-LAN environment.

RIA continues to evolve the network to meet the needs of its many Army and DOD tenant organizations. The RIA Multimedia Network was key in attracting new tenant organizations such as the Civilian Personnel Regional Operations Center, and the Defense Finance and Accounting Service to Rock Island. RIA customer appetite for network

services continued to grow, and resulted in the following FY96 and FY97 network projects: modernization of mobile data access capabilities; upgrading of audio conferencing systems; installation of an upgraded Integrated Services Digital Network providing Desktop Video capable of communicating worldwide; and migration to an Asynchronous Transfer Media Campus Network providing 155 Mb/sec services for increasing multimedia applications.

The evolving RIA multimedia network enables organizations to improve their business processes. Processes such as the customer-developed Soldier Support Network, on-line job announcements, and worldwide desktop video conferencing are a few examples of how the customers have used technology to improve their business. RIA's teaming and a modular funding/implementation approach have promoted standard, evolving multimedia network services for all local and remote RIA customers.

Management

Advanced Acquisition Planning

RIA's contracting organization services the manufacturing facility, supporting offices, and major tenants in providing construction, materials, and services through contracts and purchase orders with private industry. Originally there was no formally established approach to advanced planning for major procurement actions. Organizations generating requirements would submit purchase requests with scopes of work when the need was recognized. This resulted in no up-front involvement from the contracting office and little planning for the long lead times characterized by major procurement actions. It also resulted in periods where backlogs developed, such as during the last quarter or month of the fiscal year when expiring funds were required to be obligated.

Acquisition planning began informally with the recognized need to keep track of milestones and balance the procurement workload throughout the fiscal year for better utilization of contracting resources. For FY95, Headquarters IOC directed implementation of a formal Advanced Acquisition Plan (AAP) to provide more visibility to major procurement milestones, provide a reporting mechanism for competition and socio-economic programs, and avoid having significant actions backlogged at the end of the fiscal year. RIA is in the third year AAP, which now uses Dbase 5 software for tracking and visibility. All actions over $100K are individually tracked. There are 202 projects in the FY97 AAP.

Customers are now required to identify their projects in advance of the fiscal year. The contracting office then participates in developing the scopes of work as necessary, and coordinates the required time frames through to contract award. This preplanned effort results in distinct advantages over the previous informal planning. Customers are required to identify their projects earlier, allowing for more realistic acquisition lead times. The contracting office gets involved much earlier in the process by assisting in the development of scopes of work and eliminating the wasted time and resources spent when inadequate packages are returned for rework. By identifying all known projects before the fiscal year starts, the contracting office is able to establish project milestones and spread the contract awards evenly throughout the year rather than having them grouped at the end of the year. Lastly, the AAP, through tracking and monthly reports, provides continuous visibility to contracting goals and accomplishments.

The AAP better enables the contracting office to meet customer needs, establishes a steady workflow which optimizes the limited contracting resources, provides documented and realistic up-front planning, avoids unbalanced year-end spending, and enhances interdisciplinary coordination. The AAP, as implemented by RIA, is an effective tool for managing major procurement actions and planning for sufficient lead times to meet customer requirements.

Army Ideas For Excellence Program

The Army Ideas For Excellence Program (AIEP) at RIA is intended to encourage employees to improve present policies and practices and to enhance morale by giving employees and active duty personnel an opportunity to improve operations at RIA. AIEP is a suggestion program which has been in operation since 1945. Military personnel have been eligible to submit and receive recognition for suggestions since 1965. Employees are encouraged to submit suggestions by filling out a suggestion form. Suggestions are evaluated expeditiously by Arsenal personnel selected for their knowledge and expertise in the area addressed by the suggestion. Approved suggestions yield cash awards to the suggestor from $50 to as much as $35,000. Awards are based on the tangible and intangible first-year

savings or benefits documented by the evaluator. When an idea is adopted for which the evaluator recommends an award under $50, the suggestor receives a non-monetary award of similar value chosen from a selection of attractive items. Non-monetary awards were instituted because the cost of processing monetary awards for less than $50 by the Defense Finance Center was often more than the award itself. The RIA program has a full-time manager who has extensive experience in employee suggestion programs, and facilitates an active program with excellent participation and recognition for employees.

In 1996, the program received suggestions from about 15% of the total employee population, and nearly 50% of those suggestions were adopted. Overall, the AIEP saves the Arsenal money and increases morale and goodwill. Employee ideas are not wasted, and participating employees feel directly involved with the Arsenal. The program helps make the Arsenal competitive in an ever-changing workplace.

Automated Nonconforming Material Record System

The Automated Nonconforming Material Record (NMR) System is a computerized tracking system for recording, monitoring, and processing defects and corrective actions in manufactured products. RIA has used a paper system for reporting, evaluating, and dispositioning minor nonconformances in manufactured products. The NMR was routed sequentially through several factory and office areas until disposition and corrective actions were fully documented. Analysis showed that on average, a NMR document was touched by 38 people and took 25 days to process. Problems with lost forms and unreadable entries were also encountered. It was difficult to get defect and rejection histories from existing databases to use in analyzing a nonconformance.

Around October 1996, an automated processing system was implemented to improve the NMR system and to provide paperless processing. A cross-functional team approach was utilized in developing this system which now uses automated signatures, parallel routing, and e-mail notification of required actions. Delrina Forms Flow software was used in conjunction with an ORACLE database.

A nonconforming condition is now entered into the automated form at the time of identification. Part and system codes are entered at that time which automatically create the specific routing and signatures required. An e-mail message is then sent identifying this record as needing action. A tracking system identifies where the NMR is in the process and how long it takes at each location. On initial implementation, average processing times were reduced from 25 to 14 days. Screens are available to check on previous NMR condition histories, and these can be sorted by part number, date, cost center, or characteristic. The system also shows all open NMR actions at any given point in time, and can identify those actions requiring high priority disposition.

This automated system has been in use for about 11 months, and the improvements are starting to be realized. Average processing time has been reduced by 44% due to parallel processing and by eliminating the need to move paper from office to office. A tracking mechanism shows where all open items stand, and the problem of lost documents has been eliminated. Data has been entered into the system for six months to begin developing part and nonconformance histories. This will provide ready access to necessary information for all those involved in the dispositioning process, and will improve analysis capabilities. RIA's cross-functional approach has successfully developed an automated tool to more efficiently process nonconforming material dispositions.

Business Development

RIA has begun taking a structured approach toward business development to achieve its goals of becoming the principal center for artillery manufacturing, and the best value center for defense-related industrial expertise and technical services. In the past, Army policies prevented the Arsenal from marketing and competing for work. Business development focused on inside sales and workload dictated by DOD. Recent changes in the laws, regulations, and policies governing defense procurement now allow limited opportunities for RIA to compete for work and market its capabilities. RIA is proactively developing new business opportunities in both the public and private market sectors. The Arsenal is actively selling goods and services, and engaging in marketing activities such as trade shows.

New marketing initiatives include the establishment of a dedicated sales office. Future Business Status Reviews were initiated in October 1996 to address the potential workload of RIA's three mission areas — manufacturing, logistics, and base operations. Participants are major Arsenal directorates, union representatives, and specific program managers. The reviews provide a structured forum for discussing known potential workload,

changes in status, and evaluation of planned workload in relation to actual workload. Another initiative is the Customer Focus Meetings. These meetings provide regular monthly opportunities for RIA management and program managers to meet with major customers to discuss current initiatives, partnerships, issues, and future acquisition strategies. The meetings provide better communication with customers, a greater understanding of customer needs, and opportunities to develop new business. These new initiatives are helping increase the Arsenal's business base and strengthen its position in a declining defense market.

Commodity Based Contracting Teams

RIA's Directorate of Contracting consists of Production Support, Special Acquisition, and Installation Sustainment and Policy Divisions. Previously, no formal organizational structure existed within these divisions. Each contract specialist was assigned to a contracting officer. However, there was no requirement to process contracts and other purchase documents through a specific contracting officer. All workload was assigned and monitored by the division chiefs.

In 1993, this relationship was restructured to improve responsiveness to customers and enable better acquisition planning. Teams of three to four specialists under a team leader with a contracting officer's warrant were established and assigned a commodity specialty. This formalized commodity-based team concept cemented the relationship between contract specialists and the commodity contracting officer. The team leader translates customer requirements into an acquisition strategy and plan, and monitors milestone progress within the team's assigned commodity area. Presently, 12 teams operate at RIA. However, flexibility has been maintained to allow assigning workload outside a team's commodity area if required to balance resources. In 1995, the commodity-based team structure contributed to the ability to implement a formal AAP process with each team leader responsible for the AAP projects within their commodity area.

Community Recreation - Auto Craft Shop

The Directorate of Community and Family Affairs at RIA has maintained a Community Recreation Division for several years. This Division consists of many units providing assistance and support for recreation activities to active and retired military personnel, civilian Arsenal employees, and other individuals employed by the government.

One of the units is the Auto Craft Shop which provides facilities, tools, and instruction to assist with personal vehicle repair. Three full-time employees are responsible for scheduling the facility, showing individuals how to diagnose and fix problems, and administering the business. In the last 12 years, the shop has grown from a double-service bay to the current nine-bay facility. Available capabilities include a complete engine rebuild room, state-of-the-art alignment equipment, and a complete tool set that can support every type of automotive repair need. Costs are maintained at a level that provides reasonable savings for base personnel.

In addition, Auto Craft Shop personnel provide auto repair training sessions to base personnel. Most notable of the classes includes a maintenance class for women, computer diagnostic techniques, air conditioning system maintenance, and winterizing methods. The Arsenal provides this service in the belief that soldiers' perceptions of available support systems influence their emotional well being.

Continuous Improvement in Safety Performance

Due to a unique way of analyzing the incident rate of accidents at RIA's operations, the safety department recognized that the injuries, although declining significantly, were not decreasing at a rate that paralleled the reduction of hours of exposure. The total incident rate had flat lined, the first-aid incident rate was decreasing, but the OSHA recordable incident rate was increasing slightly. By profiling a three-year window, the department identified a decrease of hours of exposure of 32%, while the incident rate had only decreased by 26%.

In early Spring 1997, the Safety department implemented the Continuous Improvement in Safety Performance (CISP) program. CISP is a structured and disciplined approach for setting performance goals, identifying major problem areas, setting action plans to achieve the goals set, and accounting for the results of the program to ensure continuous improvements. CISP refocuses on accountability, accident prevention, safety awareness, employee involvement, and goals and objectives. The CISP program has created focused charting to not only identify incidents, but to break these incidents into analysis by job classification, anatomical location, injury type, and specific events.

By further breaking out these results, identification of a specific job's rate of strain/sprain, laceration, or contusion can assist in the review of practices associated with specific tasks. An action plan will be used to educate and improve processes to accomplish annual goals of the program.

Early results from these processes have identified changes in ergonomic needs such as full hand triggers for sprayers instead of the two fingered triggered sprayers previously used; lighter weight supply hoses on hand tools; and pull down levers on equipment to replace push out or up levers. Expectations of the CISP program include continuous improvement in safety performance; compensation cost avoidance; the ability to be benchmarked against world-class industries; and enhancements to employee moral, overall efficiencies, improved productivity, and the ability to maintain RIA's safe worker reputation.

Crisis Management - Security Programs

RIA's Law Enforcement and Security Directorate consists of 54 personnel. This is augmented by 35 members of the workforce organized as an auxiliary Police Force. These personnel receive the same training and certification as the permanent force. The Directorate went through a process of successfully defending the number of police officers versus guards which had been dictated by higher headquarters. By retaining a higher number of police officers, RIA has realized a higher morale among the security force, a better image with the Arsenal workforce and the neighboring communities, and a greater flexibility in hiring capabilities.

The Directorate has changed its training methods for law enforcement officers. Previously, the officers received training from military sources only; currently, they receive training with local agencies from the State of Illinois which is more pertinent to their locality. Another improvement is in Security Awareness training for Arsenal employees. RIA has gone from using one person full time who provided training in increments, to using a computer-based training program that individual employees use at their own pace, job site, and at their convenience. These changes have saved the installation $140,000 per year in overhead expenses. The Directorate also participated in the IOC-directed Safety/Security Standdown Day which was directed across the command in response to an increase in explosive-related accidents. Each installation was directed to suspend operations for a day and conduct safety training, and it was decided to include security training as well. The Arsenal's Law Enforcement and Security Directorate participated. The Directorate used feedback as much as practical to make improvements, as well as various media (closed circuit TV, electronic bulletin board, CC mail, billboard, meetings) to continue the awareness generated by the Standdown Day.

Earned Value Management System

RIA is implementing an Earned Value Management System (EVMS) across all operations and product lines to realize the benefits associated with early awareness of cost and schedule variances. Certification by the AMC to DODI 5000.2 Cost/Schedule Control System Criteria is expected in June 1997 for its project management process for the XM-35 program.

The initiative for this effort was a realization that the increased expense of a more detailed cost accounting system would provide the return on investment and the tighter controls demanded by today's competitive environment. Most programs under the previous system were over cost and behind schedule in spite of controls. The M1A2 program is using the new system and is on target for schedule and cost because technical risks surface earlier under this system. Monthly program reviews are in effect, and progress of all aspects of program planning and execution are tracked. EVMS is a forcing function for timely detection and resolution of cost and schedule variances. EVMS is less costly to implement than the previous system — $200K versus an estimated $1M for a major acquisition program.

Microframe Software is used for RIA's EVMS, and training has been conducted for program managers, control managers, and system users. Monthly reporting packages and in-depth software training are also provided. The key to timely resolution of variances lies in the team concept, where Project Work Teams consisting of process planners, material planners, and fund comptrollers work together on situations that are made visible by the EVMS. By designing the EVMS to meet DODI 5000.2, a capability exists that may mean the difference in competitive awards of work packages.

Fitness Center

RIA has implemented an in-depth health and fitness program for its employees to maintain healthy bodies. Over the past nine years, this program expanded from a small facility with limited services to the reuse of an excess larger base facility with indoor running track, aerobic/martial arts room, batting/golf cages, basketball courts, and body conditioning/building equipment. An introduction to fitness at this facility leads off with a personal health appraisal via an interesting piece of diagnostic equipment marketed by Microfit costing approximately $14,000. In less than an hour, this equipment identifies overall health of the employee, and assists the trainers in creating targeted exercise programs for the customer. Retesting every three months provides health improvement information and helps achieve the fitness center's number one priority — safe and great health service.

The Microfit equipment was extremely helpful in a fitness center pilot test program running from April to October 1997 when IOC personnel were encouraged to dedicate up to three hours per week to working out at the center. Although the three hours away from the office seemed inconvenient at first, this pilot test program was designed to analyze the health benefits of exercise and how good health affects the number of lost work days due to sickness.

In addition to the normal fitness support and training at the center, RIA employees are offered blood profile testing annually. The blood profile program has been so well received by employees that a three-month waiting list is standard. The fitness center is open 16 hours a day, seven days a week to accommodate the family life of all employees.

HEARTS Course

HEARTS is an adventure-based training course that was created by RIA to help personnel develop teaming skills. The HEARTS strategy encourages personal growth by removing participants from their normal settings and placing them in situations that encourage new team behavior. During HEARTS training, participants gain opportunities to strengthen individual pride and courage, and experience great team accomplishments. Participants prove to themselves and to each other that they are capable of doing far more than they ever thought possible. Team building was determined to be a critical need to facilitate the culture change resulting from reorganization caused by Base Realignment and Closure actions. Development of a High Performance Teamwork concept and introduction of core values developed by the Command's Labor Management Partnership led directly to HEARTS training.

HEARTS consists of classroom and outdoor activities that focus on developing human relationships within a group. It gives new meaning to the importance of working as a team, with the outdoor events a metaphor for the obstacles and challenges found in the workplace. HEARTS is an acronym representing the command's core values—Honesty, Ethics, Accountability, Respect, Trust, and Support. HEARTS is a three-phase process with Phase I focusing on personal breakthrough and growth. Phase II focuses on high performance teamwork and organizational problem solving, while the goal for Phase III is to make continuous improvement a way of life. Pre- and post-HEARTS surveys have been conducted, and the numbers reflect a personal belief by most participants that something happened over the course of training that increased their appreciation of the value of this kind of training. Overall, a dramatic change has occurred for the better in the relationship between supervisors and their teams.

Industry Standardization

The Secretary of Defense Initiative to roll back the use of military standards in procurement, called the Blueprint for Change Initiative, has been incorporated in IOC policy and will impact RIA's competition for work and procurement from its suppliers. Before the initiative, RIA manufactured parts to meet detailed drawings supplied by customers. Military standards and specifications formed the basis for managing many systems. RIA followed the Defense Federal Acquisition Regulations to develop contracts with its suppliers. The Secretary of Defense Initiative requires the use of performance specifications, cancellation of military-unique documents, and use of commercial buying practices.

RIA is now in the process of learning how to respond to new situations created by its customers responding to the new direction. RIA is still largely guided by higher Headquarters' direction, but its greatest challenge is procurement to new government rules while competing for new work with private contractors.

Interlocking Performance Standards

Performance Reviews for government personnel traditionally have not been linked to top management objectives. RIA is employing a new approach, presently restricted to the Resource Management Directorate, of linking strategic plans, officer evaluation reports, senior system civilian evaluation reports, and base system civilian evaluation reports. Recent reorganization has eliminated branch, section, and unit level supervisors and replaced them with team leaders. As a result, a high degree of management participation exists. RIA is unique in its strong community feeling, and its insular approach stems in part from having low turnover. People are individually productive but somewhat reluctant to change. There was skepticism for merit pool payouts of performance awards which formed the initiative for interlocking the Directorate's performance objectives.

The attributes of the old system were independent performance standards, usually written by the last supervisor, with 30 of 31 (97%) employees rated exceptional. The new approach takes advantage of positive forces in the workforce — well-trained, motivated, teamed, and individually productive. The major categories of performance elements are cost savings, improved customer relations, assurance of adequate internal controls, improved resource management systems, and human resource management. An open book approach exists, and midpoint results are shared with division chiefs and evaluated by the group. The distribution of ratings is now 70% exceptional, 20% highly satisfactory, and 10% satisfactory. Additionally, more cross training is performed to facilitate meeting higher standards and improved personal productivity.

Lead-based Paint Program

In August 1992, RIA began working on a Lead-based Paint Program by forming a process action team and sending two employees to training to learn the requirements and procedures to mitigate the lead exposure risk. From October 29, 1992 through September 2, 1994, several regulations and laws were passed requiring military bases to perform surveys in all housing constructed prior to 1978, day care centers, and all areas frequented by children under six years old for the presence of lead-based paint and associated hazards. Many military bases chose to use X-ray Fluorescence testing which identifies lead on all painted surfaces in a building. This method does not eliminate or identify all existing lead hazards.

In September 1994, RIA formed the Lead-based Management Team. The team was chaired by the RIA Commander with representatives from Public Works, Housing, Medical, Environmental, Safety, Legal, and Public Affairs, along with the Family Child Care Coordinator and the Child Development Services Coordinator. The assessment approach was to consider that all painted surfaces contained lead and placed the emphasis on identifying lead hazards and their source. A rating system was developed for housing units to be used to assign personnel. Personnel with children or pregnant women are assigned to housing with the lowest risk of exposure. The ratings are based on the potential for lead exposure, based on dust samples from the interior of the houses, soil samples, and deteriorated paint samples. The RIA Medical Department has also implemented an aggressive blood level screening program for all children six years old or younger. All tenants are given information on lead-based paint hazards regardless of the rating on the housing they are assigned.

A significant monetary savings on the initial surveys was realized. The children are protected through selective assignments on housing, and the screening program has identified several children living in off-base housing who had excessive exposure to lead. The interim controls versus whole house abatement programs have also provided considerable savings.

Manufacturing Technology Consortium

The Manufacturing Technology Consortium (MTC) is a technology outreach program for RIA Industrial Operations facilities. The program was developed as part of a national technology transfer initiative to assist small and medium-sized manufacturers to understand and implement new plant automation and management techniques to improve their competitive stance.

The consortium consists of five members — Black Hawk College, Quad City Development Group, Rock Island Arsenal, Western Illinois University, and Eastern Iowa Community College District. Services available from RIA include technical assistance, applied research, augmenting partnerships, and training. The Arsenal has hands-on learning facilities for manufacturing, safety, Computer Aided

Design/Computer Aided Manufacturing/Computer Integrated Manufacturing, environmental, and quality programs. Typical manufacturing assistance includes contract manufacturing and/or engineering services.

An example of the training benefit of the MTC at RIA is demonstrated by the ability of a new manufacturer to train employees at RIA before its own facility was completed. The educational members of the consortium have also used the equipment and classrooms at the Arsenal for instruction. Several projects have resulted in benefits to manufacturers including support of design and testing of a 60,000 lb. load cell; integration of programmable controllers into machining operations; contract machining for a machine tool company; Finite Elemental Analysis for a company; and production of a component for a particle accelerator that was considered unproducible. These are benefits which would have been difficult to achieve or would have not occurred without the MTC.

Math and Science Are Great Program

The Math and Science Are Great (MASAG) program is an educational awareness and mentoring program aimed at young students in the seventh and eighth grades to increase their level of interest in math and science. The program, initiated by RIA for local students, was the catalyst for Army arsenals and depots throughout the U.S. to adopt similar programs.

In 1988, the Education Enterprise Division of RIA launched an effort to address the math and science deficiencies of the youth in the local community that would make up the future workforce pool for the RIA and the Quad City community workforce. At the same time, a Presidential Executive Order on education encouraged and allowed federal activities to participate in outreach and support activities that increased the educational awareness in math and science for the youths of the Nation. The order was based on the fact that fewer students are pursuing careers in science and engineering. While 12% of freshman entered engineering college in 1982, only 9% entered in 1987; more than 50% of Ph.D.s in engineering are foreign students; and, although woman and minorities are projected to make up 55% of the workforce in the year 2000, they are under represented in the scientific fields. Driven by these statistics, RIA took action to develop an educational awareness and mentoring program.

In 1989, the Education Enterprise Division launched the MASAG program. The program's key elements included awareness, mentoring, and recognition. The program was aimed at seventh and eighth grade females and minorities from the local community. Resources were drawn from the RIA workforce, primarily from the research and development group, consisting of engineers and scientists with Ph.D., M.S., and B.S. degrees. A mentoring program was established where RIA employees volunteered their time to mentor students, bring them to the worksite two to four times per month, visit their schools, and provide one-on-one personal counseling. Contests were held to encourage their interest in math and science. Students are recognized for their achievements through certificates and awards.

RIA was instrumental in obtaining public funds for the establishment of the Army National Science Center located in Atlanta, Georgia, which sponsors four mobile Discovery vans that travel all over the country to various Army installations for show and tell at each site. Each van is equipped with a driver, two presenters, math and science teaching aids, and videos. Typically, the vans stay at a site for one week and conduct a series of two to three hour long programs for 40 to 50 students at a time. When in the Quad-Cities, as many as 1,600 students experienced the Discovery van.

RIA continues to be an active contributor to the community and a catalyst for the Army in its math and science educational awareness MASAG program. The response by the youths in the area has rewarded RIA and the community with confidence that their interest in math and science is growing, and careers are being pursued in the scientific fields.

Outdoor Recreation

The Outdoor Recreation Division of the Directorate of Community and Family Affairs at RIA provides programs that assist Commanders in maintaining morale, esprit de corps, and mental and physical fitness of the Army family. Support of outdoor recreation activities for active and retired military personnel and their families, civilian Arsenal employees, and other individuals employed by the government is the primary mission of this Division.

The mission is accomplished by providing many types of outdoor recreational equipment for rent to qualified individuals. Inventories include bicycles, in-line skates, camping equipment, tents and party

canopies, winter time sports equipment, and pop-up and hard shell campers. The facility also has a recreational vehicle storage lot and several boats and trolling motors. All equipment and accessories are available for rent at reasonable rates.

The benefits gained from supporting family sports activities relate to unit cohesion associated with teamwork, mental and physical fitness, and technical competence resulting from skills development during sporting activities. Recreational involvement also reduces stress, tension, and boredom producing more alert and responsive individuals. All these benefits positively affect the Army family and influence the soldier's ability to deploy.

Strategic Business Planning

Since 1992, RIA has had a Strategic Business Plan in place which is updated annually. Major changes to the process were implemented beginning in 1996. Prior to these changes, the strategic plan was managed by a strategic planning board and coordinated with the labor unions. The plan incorporated short and mid-term plans and addressed long-range strategies and trends. Beginning in 1996, the strategic process was redefined and improved. Changes included restructuring and expanding the planning organization, benchmarking other planning processes, internal and external environmental assessments, defining customers, developing long-term major goals, and linking to the IOC plan. The expanded planning board incorporated the unions as active members along with key directors and office chiefs. The planning board also consults with mission oriented sub-groups and a new focused marketing and business team. The environmental assessment looks at external factors such as the Five Year Defense Plan. The internal assessment considers strengths, weaknesses, opportunities, and threats.

An important part of the new process is defining current and potential customers. The Arsenal has redefined its mission areas (and potential markets) in terms of manufacturing, logistics, and base operations. This expands its potential customer base and provides additional opportunities for growth. The plan established three major goals. Each goal has one or more sub-groups for which objectives, strategies, and measures are developed. Specific tactics for each objective are not included in the strategic plan and are developed separately based on the plan. The plan is updated annually.

The new planning process (Figure 3-2) has helped focus the strategic direction of the Arsenal more effectively than before, and made it more responsive to environmental changes. It has helped to define current and potential customers both in the government and private sectors. Goals are now supported by objectives, strategies, and tactics. Milestones and metrics have been identified to assess performance. RIA has learned that survival requires creative thinking, continuous planning, and measurement to understand the changing environment and customer base, and respond successfully. Future improvements include a six-year strategic plan and an electronic information system for tracking performance metrics.

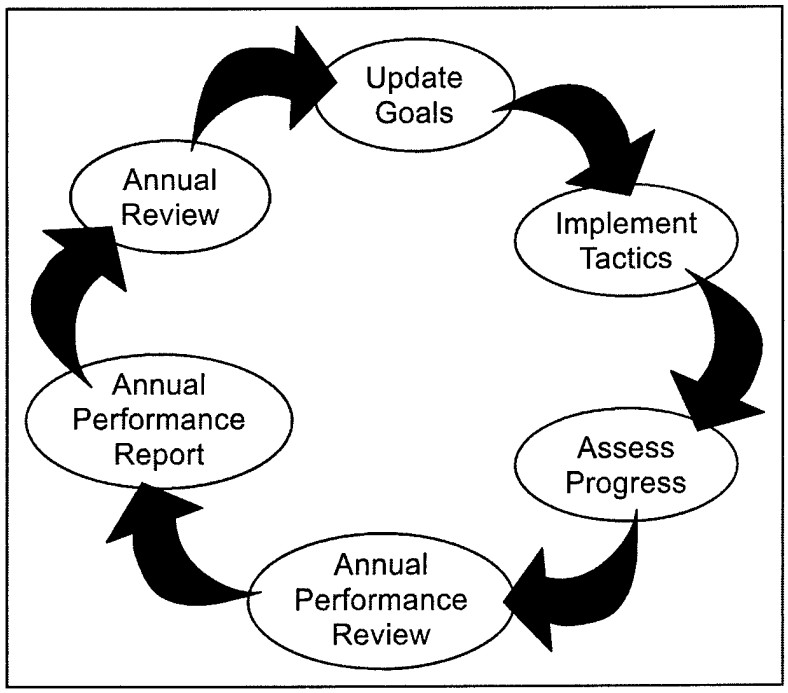


Figure 3-2. Strategic Planning Process

Appendix A

Table of Acronyms

Acronym	Definition
360 DPMS	360 Degree Performance Management System
AAP	Advanced Acquisition Plan
ADI	Austempered Ductile Iron
ADPE	Automated Data Processing Equipment
AIEP	Army Ideas For Excellence Program
AMC	Army Materiel Command
AMCCOM	Armament Munitions and Chemical Command
ARDEC	Armament Research Development and Engineering Command
BCL	Basic Control Language
BII	Basic Item of Issue
CAD/CAM	Computer Aided Design/Computer Aided Manufacturing
CAPP	Computer Aided Process Planning
CISP	Continuous Improvement in Safety Performance
CMTH	Contact Maintenance Truck Humvee
CNC	Computer Numerically Controlled
COTS	Commercial-Off-The-Shelf
CP2	Contractor Performance Certification Program
DNC	Distributed Numerical Control
DOD	Department of Defense
EVMS	Earned Value Management System
FWS	Flexible Welding System
GUI	Graphical User Interface
HEAT	Help Desk Expert Automation Tool
ICN	Iowa Communications Network
IEPA	Illinois Environmental Protection Agency
IMPAC	International Merchants Purchase Authorization Card
IOC	Industrial Operations Command
LAN	Local Area Network
LGV	Laser Guided Vehicle
LIP	Laying Away In Place
MASAG	Math and Science Are Great
MNS	Mission Need Statement
MRP II	Manufacturing Resource Planning System
MSDS	Material Safety Data Sheet
MTC	Manufacturing Technology Consortium

Acroynm	Definition
NMR	Nonconforming Material Record
OSHA	Occupational Safety and Health Administration
PC	Personal Computer
PC-LAN	Personal Computer Local Area Network
PCO	Program Change Order
PCS	Permanent Change of Station
PDF	Portable Document File
PIP	Product Improvement Proposal
PM	Preventive Maintenance
RFW/RFD/ECP	Request for Waiver/Request for Deviation/Engineering Change Proposal
RIA	Rock Island Arsenal
RMA	Rocky Mountain Arsenal
SDWT	Self-Directed Work Team
SIFS	Standard Industrial Funds System
SPC	Statistical Process Control
SSSC	Self-Service Supply Center
TAMMS	Tool and Maintenance Management System
TAPES	Total Army Performance Evaluation System
TC	Ton Container
TSG	Teaming Support Group
USE	Uncle Sam's Emporium

Appendix B

BMP Survey Team

Team Member	Activity	Function
Larry Robertson (812) 854-5336	**Crane Division** **Naval Surface Warfare Center** Crane, IN	**Team Chairman**
Sherri Weller (309) 782-7127	**Rock Island Arsenal** Rock Island, IL	**Technical Writer**
Guy Cabell (309) 782-7126	**Rock Island Arsenal** Rock Island, IL	**Technical Writer**
	Team 1	
Ron Cox (812) 854-5251	**Naval Surface Warfare Center** Crane, IN	**Team Leader**
Duane Maddock (909) 273-4617	**Naval Warfare Assessment Division** Corona, CA	
George Theisen (410) 278-3595	**U.S. Army Aberdeen Test Center** Aberdeen, MD	
	Team 2	
Darrel Brothersen (319) 295-3768	**Rockwell Collins Avionics and Communications** Cedar Rapids, IA	**Team Leader**
Edward Averill (717) 267-8400	**Letterkenny Army Depot** Chambersburg, PA	
Mark Porter (815) 654-4337	**Rock Valley College** Rockford, IL	

Team 3

Rick Purcell (301) 403-8100	**BMP Center of Excellence** College Park, MD	**Team Leader**
Dan Fazekas (703) 271-9055	**Production Technology, Inc.** Arlington, VA	
Len Janeski (815) 825-2086	**Northern Illinois Manufacturing Extension Center** **Kishwaukee College** Malta, IL	

Team 4

Larry Halbig (317) 306-3838	**Hughes Air Warfare Center** Indianapolis, IN	**Team Leader**
Bob Cale (518) 266-5300	**Watervliet Arsenal** Watervliet, NY	
Bob Yorke (909) 273-4618	**Naval Warfare Assessment Division** Corona, CA	

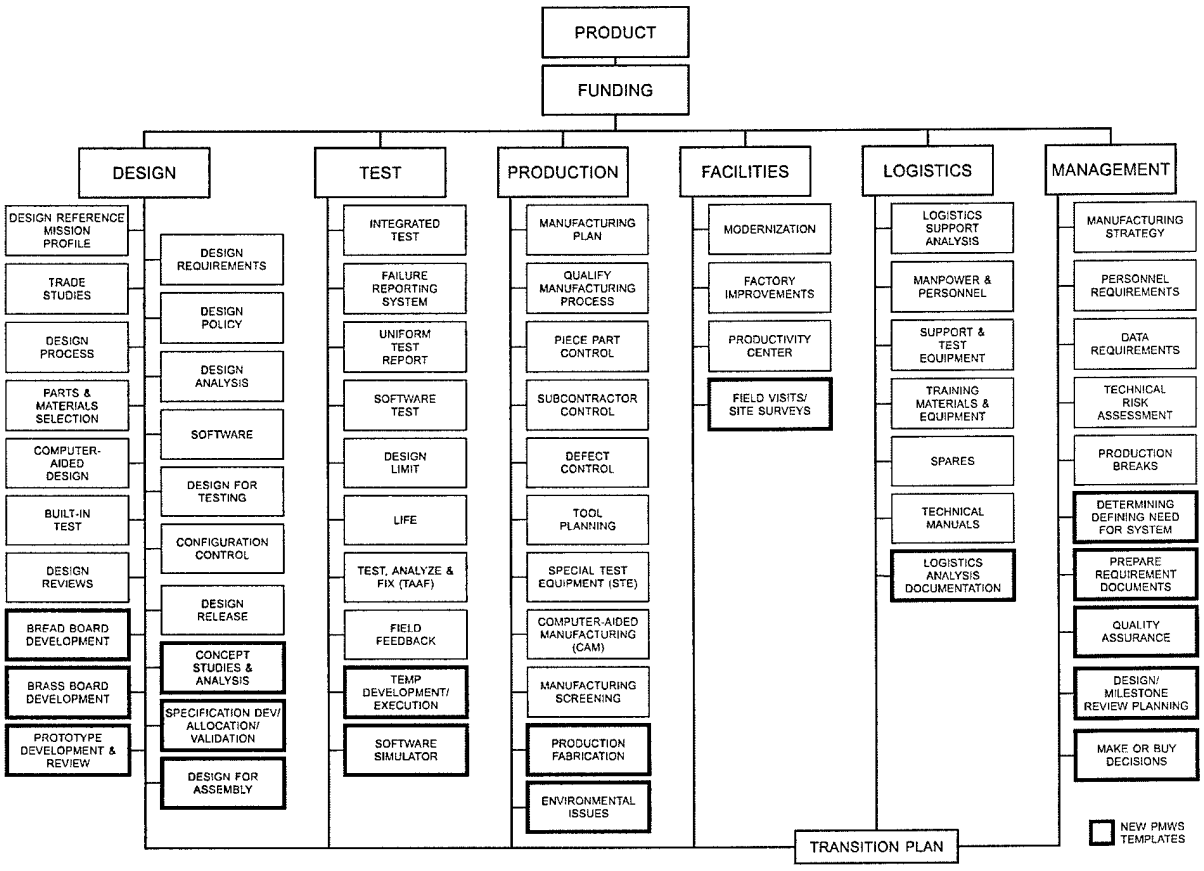
Appendix C

Critical Path Templates and BMP Templates

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

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

"CRITICAL PATH TEMPLATES FOR TRANSITION FROM DEVELOPMENT TO PRODUCTION"

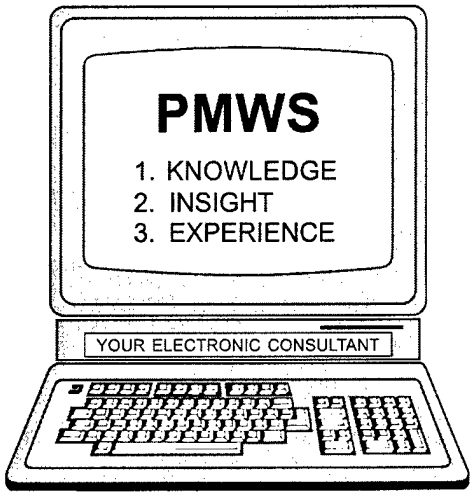


Appendix D

BMPnet and the Program Manager's WorkStation

The BMPnet, located at the Best Manufacturing Practices Center of Excellence (BMPCOE) in College Park, Maryland, supports several communication features. These features include the Program Manager's WorkStation (**PMWS**), electronic mail and file transfer capabilities, as well as access to Special Interest Groups (SIGs) for specific topic information and communication. The BMPnet can be accessed through the World Wide Web (at http://www.bmpcoe.org), through free software that connects directly over the Internet or through a modem. The PMWS software is also available on CD-ROM.

PMWS provides users with timely acquisition and engineering information through a series of interrelated software environments and knowledge-based packages. The main components of PMWS are KnowHow, SpecRite, the Technical Risk Identification and Mitigation System (TRIMS), and the BMP Database.



KnowHow is an intelligent, automated program that provides rapid access to information through an intelligent search capability. Information currently available in KnowHow handbooks includes Acquisition Streamlining, Non-Development Items, Value Engineering, NAVSO P-6071 (Best Practices Manual), MIL-STD-2167/2168 and the DoD 5000 series documents. KnowHow cuts document search time by 95%, providing critical, user-specific information in under three minutes.

SpecRite is a performance specification generator based on expert knowledge from all uniformed services. This program guides acquisition personnel in creating specifications for their requirements, and is structured for the build/approval process. SpecRite's knowledge-based guidance and assistance structure is modular, flexible, and provides output in MIL-STD 961D format in the form of editable WordPerfect® files.

TRIMS, based on DoD 4245.7-M (the transition templates), NAVSO P-6071, and DoD 5000 event-oriented acquisition, helps the user identify and rank a program's high-risk areas. By helping the user conduct a full range of risk assessments throughout the acquisition process, TRIMS highlights areas where corrective action can be initiated before risks develop into problems. It also helps users track key project documentation from concept through production including goals, responsible personnel, and next action dates for future activities.

The **BMP Database** contains proven best practices from industry, government, and the academic communities. These best practices are in the areas of design, test, production, facilities, management, and logistics. Each practice has been observed, verified, and documented by a team of government experts during BMP surveys.

Access to the BMPnet through dial-in or on Internet requires a special modem program. This program can be obtained by calling the BMPnet Help Desk at (301) 403-8179 or it can be downloaded from the World Wide Web at http://www.bmpcoe.org. To receive a user/e-mail account on the BMPnet, send a request to helpdesk@bmpcoe.org.

Appendix E

Best Manufacturing Practices Satellite Centers

There are currently six 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; identify regional experts for inclusion in the BMPnet SIG e-mail; and train regional personnel in the use of BMP resources such as the BMPnet.

The six BMP satellite centers include:

California

Chris Matzke
BMP Satellite Center Manager
Naval Warfare Assessment Division
Code QA-21, P.O. Box 5000
Corona, CA 91718-5000
(909) 273-4992
FAX: (909) 273-4123
cmatzke@bmpcoe.org

Jack Tamargo
BMP Satellite Center Manager
257 Cottonwood Drive
Vallejo, CA 94591
(707) 642-4267
FAX: (707) 642-4267
jtamargo@bmpcoe.org

District of Columbia

Margaret Cahill
BMP Satellite Center Manager
U.S. Department of Commerce
14th Street & Constitution Avenue, NW
Room 3876 BXA
Washington, DC 20230
(202) 482-8226/3795
FAX: (202) 482-5650
mcahill@bxa.doc.gov

Illinois

Thomas Clark
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Rock Valley College
3301 North Mulford Road
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adme3tc@rvcux1.rvc.cc.il.us

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(717) 843-5054, ext. 225
FAX: (717) 854-0087
snyderss@mantec.org

Tennessee

Tammy Graham
BMP Satellite Center Manager
Lockheed Martin Energy Systems
P.O. Box 2009, Bldg. 9737
M/S 8091
Oak Ridge, TN 37831-8091
(423) 576-5532
FAX: (423) 574-2000
tgraham@bmpcoe.org

Appendix F

Navy Manufacturing Technology Centers of Excellence

The Navy Manufacturing Sciences and Technology Program established the following 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 Navy centers and laboratories. These COEs are consortium-structured for industry, academia, and government involvement in developing and implementing technologies. Each COE has a designated point of contact listed below with the individual COE information.

Best Manufacturing Practices Center of Excellence

The Best Manufacturing Practices Center of Excellence (BMPCOE) provides a national resource to identify and promote exemplary manufacturing and business practices and to disseminate this information to the U.S. Industrial Base. The BMPCOE was established by the Navy's BMP program, Department of Commerce's National Institute of Standards and Technology, and the University of Maryland at College Park, Maryland. The BMPCOE improves the use of existing technology, promotes the introduction of improved technologies, and provides non-competitive means to address common problems, and has become a significant factor in countering foreign competition.

Point of Contact:
Mr. Ernie Renner
Best Manufacturing Practices Center of Excellence
4321 Hartwick Road
Suite 400
College Park, MD 20740
(301) 403-8100
FAX: (301) 403-8180
ernie@bmpcoe.org

Center of Excellence for Composites Manufacturing Technology

The Center of Excellence for Composites Manufacturing Technology (CECMT) provides a national resource for the development and dissemination of composites manufacturing technology to defense contractors and subcontractors. The CECMT is managed by the GreatLakes Composites Consortium and represents a collaborative effort among industry, academia, and government to develop, evaluate, demonstrate, and test composites manufacturing technologies. The technical work is problem-driven to reflect current and future Navy needs in the composites industrial community.

Point of Contact:
Dr. Roger Fountain
Center of Excellence for Composites Manufacturing Technology
103 Trade Zone Drive
Suite 26C
West Columbia, SC 29170
(803) 822-3705
FAX: (803) 822-3730
rfglcc@glcc.org

Electronics Manufacturing Productivity Facility

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 industry, university, and government participants, led by the American Competitiveness Institute under a CRADA with the Navy.

Point of Contact:
Mr. Alan Criswell
Electronics Manufacturing Productivity Facility
Plymouth Executive Campus
Bldg 630, Suite 100
630 West Germantown Pike
Plymouth Meeting, PA 19462
(610) 832-8800
FAX: (610) 832-8810
http://www.engriupui.edu/empf/

National Center for Excellence in Metalworking Technology

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. The NCEMT, operated by Concurrent Technologies Corporation, 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
National Center for Excellence in Metalworking Technology
1450 Scalp Avenue
Johnstown, PA 15904-3374
(814) 269-2532
FAX: (814) 269-2799
henry@ctc.com

Navy Joining Center

The Navy Joining Center (NJC) is operated by the Edison Welding Institute and 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.

Point of Contact:
Mr. David P. Edmonds
Navy Joining Center
1100 Kinnear Road
Columbus, OH 43212-1161
(614) 487-5825
FAX: (614) 486-9528
dave_edmonds@ewi.org

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 energetics. The focus of the EMTC is on process technology with a goal of reducing manufacturing costs while improving product quality and reliability. The COE also maintains a goal of development and implementation of environmentally benign energetics manufacturing processes.

Point of Contact:
Mr. John Brough
Energetics Manufacturing Technology Center
Indian Head Division
Naval Surface Warfare Center
Indian Head, MD 20640-5035
(301) 743-4417
DSN: 354-4417
FAX: (301) 743-4187
mt@command.nosih.sea06.navy.mil

Manufacturing Science and Advanced Materials Processing Institute

The Manufacturing Science and Advanced Materials Processing Institute (MS&AMPI) is comprised of three centers including the National Center for Advanced Drivetrain Technologies (NCADT), The Surface Engineering Manufacturing Technology Center (SEMTC), and the Laser Applications Research Center (LaserARC). These centers are located at The Pennsylvania State University's Applied Research Laboratory. Each center is highlighted below.

Point of Contact for MS&AMPI:
Mr. Henry Watson
Manufacturing Science and Advanced Materials Processing Institute
ARL Penn State
P.O. Box 30
State College, PA 16804-0030
(814) 865-6345
FAX: (814) 863-1183
hew2@psu.edu

- **National Center for Advanced Drivetrain Technologies**
  The NCADT supports DoD by strengthening, revitalizing, and enhancing the technological capabilities of the U.S. gear and transmission industry. It provides a site for neutral testing to verify accuracy and performance of gear and transmission components.

  Point of Contact for NCADT:
  Dr. Suren Rao
  NCADT/Drivetrain Center
  ARL Penn State
  P.O. Box 30
  State College, PA 16804-0030
  (814) 865-3537
  FAX: (814) 863-6185
  http://www.arl.psu.edu/drivetrain_center.html/

- **Surface Engineering Manufacturing Technology Center**

  The SEMTC enables technology development in surface engineering—the systematic and rational modification of material surfaces to provide desirable material characteristics and performance. This can be implemented for complex optical, electrical, chemical, and mechanical functions or products that affect the cost, operation, maintainability, and reliability of weapon systems.

  Point of Contact for SEMTC:
  Dr. Maurice F. Amateau
  SEMTC/Surface Engineering Center
  P.O. Box 30
  State College, PA 16804-0030
  (814) 863-4214
  FAX: (814) 863-0006
  http://www/arl.psu.edu/divisions/arl_org.html

- **Laser Applications Research Center**

  The LaserARC is established to expand the technical capabilities of DOD by providing access to high-power industrial lasers for advanced material processing applications. LaserARC offers basic and applied research in laser-material interaction, process development, sensor technologies, and corresponding demonstrations of developed applications.

  Point of Contact for LaserARC:
  Mr. Paul Denney
  Laser Center
  ARL Penn State
  P.O. Box 30
  State College, PA 16804-0030
  (814) 865-2934
  FAX: (814) 863-1183
  http://www/arl.psu.edu/divisions/arl_org.html

Gulf Coast Region Maritime Technology Center

The Gulf Coast Region Maritime Technology Center (GCRMTC) is located at the University of New Orleans and will focus primarily on product developments in support of the U.S. shipbuilding industry. A sister site at Lamar University in Orange, Texas will focus on process improvements.

Point of Contact:
Dr. John Crisp
Gulf Coast Region Maritime Technology Center
University of New Orleans
Room N-212
New Orleans, LA 70148
(504) 286-3871
FAX: (504) 286-3898

Appendix G

Completed Surveys

As of this publication, 96 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 BMPnet. Requests for copies of recent survey reports or inquiries regarding the BMPnet may be directed to:

Best Manufacturing Practices Program
4321 Hartwick Rd., Suite 400
College Park, MD 20740
Attn: Mr. Ernie Renner, Director
Telephone: 1-800-789-4267
FAX: (301) 403-8180
ernie@bmpcoe.org

1985	Litton Guidance & Control Systems Division - Woodland Hills, CA
1986	Honeywell, Incorporated Undersea Systems Division - Hopkins, MN (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 (Paramax)
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 Standard Industries - LaMirada, CA Engineered Circuit Research, Incorporated - Milpitas, CA Teledyne Industries Incorporated Electronics Division - Newbury Park, CA Lockheed Aeronautical Systems Company - Marietta, GA Lockheed Corporation Missile Systems Division - Sunnyvale, CA Westinghouse Electronic Systems Group - Baltimore, MD General Electric Naval & Drive Turbine Systems - Fitchburg, MA Rockwell International Corporation Autonetics Electronics Systems - Anaheim, CA 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
	Naval Avionics Center - Indianapolis, IN
	United Electric Controls - Watertown, MA
	Kurt Manufacturing Co. - Minneapolis, MN
	MagneTek Defense Systems - Anaheim, CA
	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
	(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
	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
	Alpha Industries, Inc. - Methuen, MA
1994	Harris Semiconductor - Melbourne, FL
	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
	Stafford County Public Schools - Stafford County, VA
1995	Sandia National Laboratories - Albuquerque, NM
	Rockwell Defense Electronics Collins Avionics & Communications Division - Cedar Rapids, IA
	(Resurvey of Rockwell International Corporation Collins Defense Communications)
	Lockheed Martin Electronics & Missiles - Orlando, FL
	McDonnell Douglas Aerospace (St. Louis) - St. Louis, MO
	(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
	Department of Energy, Oak Ridge Operations - Oak Ridge, TN

1997	Headquarters, U.S. Army Industrial Operations Command - Rock Island, IL
	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

INTERNET DOCUMENT INFORMATION FORM

A . Report Title: Best Manufacturing Practices: Report of Survey Conducted at Rock Island Arsenal, Rock Island, IL

B. DATE Report Downloaded From the Internet: 12/20/01

C. Report's Point of Contact: (Name, Organization, Address, Office Symbol, & Ph #): **Best Manufacturing Practices**
Center of Excellence
College Park, MD

D. Currently Applicable Classification Level: Unclassified

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F. The foregoing information was compiled and provided by:
DTIC-OCA, Initials: __VM__ **Preparation Date 12/20/01**

The foregoing information should exactly correspond to the Title, Report Number, and the Date on the accompanying report document. If there are mismatches, or other questions, contact the above OCA Representative for resolution.