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REPORT OF SURVEY CONDUCTED AT

NAVAL AIR WARFARE CENTER
LAKEHURST, NJ

AUGUST 1998

Best Manufacturing Practices

1998 Award Winner

INNOVATIONS IN AMERICAN GOVERNMENT

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

Foreword

This report was produced by the 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 the Naval Air Warfare Center, Lakehurst in Lakehurst, New Jersey conducted during the week of August 10, 1998. Teams of BMP experts work hand-in-hand on-site with the company to examine existing practices, uncover best practices, and identify areas for even better practices.

The final survey report, which details the findings, is distributed electronically and in hard copy to thousands of representatives from industry, government, and academia throughout the U.S. and Canada – *so the knowledge can be shared.* BMP also distributes this information through several interactive services which include CD-ROMs, 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.

The Naval Air Warfare Center, Lakehurst operates as the Aircraft Platform Interface Group for technical mission support. This specialized niche of Naval Aviation pertains to the equipment, services, and processes needed to assure that fixed and rotary wing aircraft can operate from aircraft carriers, other air capable ships, and Marine Corps expeditionary sites. Among the best examples were the Naval Air Warfare Center, Lakehurst's accomplishments in carrier operations analysis; geographic information system; defense standardization program; and parts control program.

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

I encourage your participation and use of this unique resource.

Ernie Renner
Director, Best Manufacturing Practices

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Section 1

Report Summary

Background

Navy Lakehurst, as it is collectively known, occupies 7,412 acres in the million-acre Pinelands National Reserve in central New Jersey. Here, the Naval Air Engineering Station provides the facilities and services to support the people and programs of Navy Lakehurst as well as other activities, units, and tenants on the base. The Station is also home to the Naval Air Warfare Center (NAWC), Lakehurst. As the largest occupant of the base, NAWC, Lakehurst operates as the Aircraft Platform Interface Group for technical mission support. This specialized niche of Naval Aviation pertains to the equipment, services, and processes needed to assure that fixed and rotary wing aircraft can operate from aircraft carriers, other air capable ships, and Marine Corps expeditionary sites. Navy Lakehurst is responsible for the catapults that launch the aircraft; the landing aids that guide them back to the ship; the arresting gear that recovers them on the deck; and all of the support equipment to move, service, and maintain aircraft. The base employs 1,898 civilians, 251 contractors, and 218 military personnel, and had a fiscal budget of $469 million in FY97.

Lakehurst began as a remote ammunition proving ground for the Russian Imperial Government in 1915. Acquired two years later by the U.S. Army, Lakehurst continued in this function until 1921 when it was commissioned as an air station for the U.S. Navy. Between 1921 and 1961, Lakehurst operated as a Lighter Than Air Center for rigid airships, and became the Nation's first trans-Atlantic international airport. At one time or another, all of the Navy's rigid airships were housed in Hangar One, as well as Germany's two most famous ones – the *Hindenburg* and the *Graf Zeppelin*. Today, Hangar One is a registered historical landmark, and the home of the Carrier Aircraft Launch and Support Systems Equipment Simulator, a one-quarter scale model carrier deck used for training Navy personnel. Nearby is the Hindenburg Memorial which marks the site of the 1937 crash. With the demise of dirigibles, Lakehurst turned its focus to aircraft carriers, helicopters, and airplanes. These innovations enabled air power to be interwoven with sea power, eventually leading the base to its current mission. Lakehurst features many unique facilities such as a 12,000-foot dedicated test runway, a catapult launch test site with deadload launch capability, a runway arrested landing site, an elevated fixed platform, a jet blast deflector area, a jet car track site, and a manufacturing complex. Among the best practices documented were Lakehurst's carrier operations analysis; geographic information system; defense standardization program; and parts control program.

Navy Lakehurst is the critical link between air Navy and sea Navy. In addition to supporting this vital mission, Lakehurst provides outstanding community outreach programs; partners with local businesses and academia; and pioneers environmental and energy conservation efforts. The base has received numerous awards including the Quality Improvement Prototype Award (equivalent to the Malcolm Baldridge Award); the Environmental Showcase Installation Award; the Silver Gull Award; the Gold Nugget Award; and the Aviation Week Quality Center Award. The accomplished workforce at Navy Lakehurst is dedicated to total quality leadership and cost effective, reliable, technology superior support. 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 NAWC, Lakehurst:

Information

The following information items were documented at NAWC, Lakehurst:

Engineering Data Management System

NAWC, Lakehurst's Engineering Data Management group wanted to establish an integrated data system that tightly incorporated all technical competencies and activities, and an infrastructure which fostered process improvement, business partnerships, and information sharing. Using an integrated desktop approach for easy accessibility, the group developed the Engineering Data Management System which operates as a single point of entry for all official engineering data, and is accessible via the Internet.

Producibility Engineering Process

NAWC, Lakehurst developed a process and an organization that would handle producibility engineering services using a concurrent engineering approach. Modeled after MIL-HDBK-727, the Producibility Engineering process looks at general aspects of design; specifications and standards used; drawings; inspection and test; materials; manufacturing processes; joining methods; coating materials and methods; and heat treating. The Producibility Engineering organization participates early on in the design phase to provide producibility criteria and conduct a producibility analysis.

Requirements Analysis Procedure

Fully implemented in 1997, the Requirements Analysis procedure was designed to optimize Fleet requirements, benchmark solution performance, identify prospective solutions, improve equipment performance, develop clear test and evaluation metrics, and measure affordable readiness. This procedure also ties into ensuing processes such as trade studies, technical performance reviews, Test and Evaluation Master Plan preparation, functional analyses, and specification development.

Software Design Process

NAWC, Lakehurst's Automatic Test Equipment Software Center wanted to develop better software products, reduce project costs, improve organization, and meet/exceed industry compliance through the use of the Software Engineering Institute's Capability Maturity Model. As a result, the Center implemented the Software Design process which establishes a more structured setting via policies, plans, procedures, and software reviews.

Aircraft Launch and Recovery Equipment Certification

NAWC, Lakehurst is responsible for certifying the installation and subsequent operational performance of all shipboard and shorebased Aircraft Launch and Recovery Equipment. A significant cost factor in certifying launchers is the deadload launch requirement. NAWC, Lakehurst eliminated this requirement (except for initial installation situations) by developing a computer program that can simulate a deadload launch.

Aviation Engine Test System

NAWC, Lakehurst uses an Aviation Engine Test System to detect incremental degradations in aircraft engine performance prior to catastrophic failure, and to certify acceptable performance of all aircraft engine types prior to installation in aircraft. This effort involves a test facility correlation, and the subsequent certification by NAWC, Lakehurst.

Data Acquisition Receive and Transmit System

The Data Acquisition Receive and Transmit system is the primary means of collecting dynamic event data at the NAWC, Lakehurst test sites and on shipboard projects. Capabilities of this system include data acquisition, post processing and validation, analysis, and archiving.

Test Site Equipment Certification

The Test Site Equipment Certification for aircraft tests provides the framework for modifying the test site configuration, installing the test site unique data retrieval devices, and ensuring that the site is ready for conducting tests with aircraft. The certification process enables the Navy to conduct shore-based testing and component checkout safely, economically, and with the highest degree of reliability before using these systems and components on aircraft carriers at sea.

Parts Control Program

The Navy's Parts Control program is a coordinated effort between prime contractors and procuring activities to promote and optimize the use of standard parts; minimize the use of company unique and peculiar parts; and prevent the use of parts with built-in failure mechanisms. NAWC, Lakehurst's role is to provide oversight of the process for the Navy to ensure integrity of the contractor's process and compliance with the program.

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Section 2

Best Practices

Test

Cross Deck Pendants

High speed fly-in and recovery of fixed wing aircraft aboard an aircraft carrier is accomplished via an arresting engine. The connectivity between the aircraft and the arresting engine requires a specially designed tailhook, attached to the aircraft frame, to engage one of several cross deck pendants (arresting wires) on the aircraft carrier's deck. Cross deck pendants must endure extreme stress during fly-ins, and withstand a highly corrosive environment of sea water and sulphur dioxide from the exhaust of ships and aircraft. A failure of an arresting wire or its attached fittings would produce a catastrophic accident, resulting in the loss of a multi-million dollar aircraft (a certainty), the high risk of death or severe injury to the pilot and crew (barring sufficient time for a proper escape), and the endangerment of sailors on the deck of the aircraft carrier.

The Naval Air Warfare Center (NAWC), Lakehurst is the only facility in the world that manufactures and assembles cross deck pendants for the Navy. The following steps outline the quality assurance process:

Certification of Wire

- 100% batch lot sampled and deadload tested
- Eight-foot sample tensile tested to breaking point for each reel
- Data recorded and maintained

Certification of Die Material for Press

- Material is best that industry has to offer, carpenter 11, grade A
- Milling performed on outside dimensions
- Clamp blocks together to bore barrel
- Heat treat
- Magnetic particle inspect
- Hand grind to finished dimensions
- Magnetic particle inspect
- When dies are changed in the process, another eight-foot sample tensile test is performed

Certification of Terminals

- Manufacture from raw material 4130
- Composite of raw material to ensure proper heat code is analyzed by Materials Branch
- Dimensionally inspect terminals
- At several places during the process, check terminal hardness. Must be Rockwell C and 100% check on every cable
- Magnetic particle inspect entire terminal
- Ultrasonic test eye hole and 100% check

Certification of Swaged Cable

- Verify deadload and tensile test results of cable reel to be utilized
- For each reel utilized, another eight-foot sample is manufactured and tested
- Wire is cut and metal tags are placed on each wire to mark the reel number and manufacturer
- 10% of swaged assemblies from each reel are proofloaded
- Measure diameter of cable so inner dimension of terminal has interference fit between 0.00 and 0.016 inch
- Terminals are etched with hit number which records operator, reel used, press used, and heat code of terminal
- Cables are prepositioned and inspection hole is checked
- Cables are swaged
- Measurements of strand gap spacing checked
- Magnetic particle inspect entire terminal
- Ultrasonic test entire barrel

Test Data

- All data is reviewed, certified, logged, and then shipped with the cable

These steps ensure that every cross deck pendant manufactured at NAWC, Lakehurst is of the highest quality. Quality is imperative because the safety factor of the wire rope is limited to 1.14 of the requirements. Otherwise, the arresting wire's mass would adversely affect the fatigue life of the aircraft. NAWC, Lakehurst's skilled artisans have acquired years of experience in this quality assurance process, and no aircraft losses can be attributed to the failure of more than 95,000 cross deck pendants manufactured to date.

Production

Customized Tool Kit Program

NAWC, Lakehurst uses a Customized Tool Kit program to design and develop tool kits for the Department of Defense (DOD) and other government agencies. A core group of dedicated tool control and manufacturing planning control, operating in modern facilities, configures the kits to meet the specific needs of the Navy (e.g., aircraft weapon platforms, support personnel), and ensures that world-class quality tool kits are delivered on time and at the right price. Various tool box and cabinet configurations are used in designing the kits, which house specific sets of manually operated and/or automated tools. In addition, the tools are selected based on the customer's requirements and stored in designated areas inside the kit through the use of slotted locators, shadow/silhouette techniques, and foam inlays. The customized kits provide easy access to the proper tool, offer instant site inventory, and allow quick detection of missing tools to minimize foreign object damage.

When the Navy first introduced customized tool kits, the concept was not immediately developed into a core competency. Instead, various personnel performed the task as a collateral duty, no dedicated assembly area was identified, and no strategic plan to market for additional work existed. In FY96, NAWC, Lakehurst's Prototyping and Manufacturing Division (PMD) reviewed the Fleet's needs, realized the market potential, and developed resources offering integrated solutions for various support equipment requirements. PMD implemented the Customized Tool Kit program to meet the specific needs of its customers. An Integrated Product Team, consisting of Engineering, Prototyping and Manufacturing, and Supply Department competencies, re-examined the existing processes and procedures. Among the changes initiated by the team were management and operations systems to track job data using Excel; a Manufacturing Planning Control System using Oracle; a procurement request system; a computer controlled water jet cutter; a Federal Logistics Information System for procurement history and pricing data/availability; and CAD/CAM software for design and layout. The program's tool control facilities consist of 2,500 square feet of dedicated space equipped with table routers, band saws, a drill press, a finger brake, and a mechanical shear.

Documentation accompanies all tool kits, detailing the contents and placement of each tool in the kit and providing re-order information for replacement parts. The procurement request system eliminated the need to order individual tools by part number and, instead, uses a single order stock number assigned to each specific tool kit configuration. This improvement reduced procurement costs by thousands of dollars annually. Tool quality improved by stocking the kits with tools that comply with tool standards (e.g., Standardization and Control Industrial Quality Tools; American National Standards Institute; Aerospace). Smart working relations with top-of-the-line commercial vendors also enhanced negotiations of prices, deliveries, and full commercial warranties of the tools procured.

The entire process, from Request for Quote (RFQ) to shipping, has been streamlined to optimize the use of resources. Turnaround time for RFQs can be as little as two days; small jobs can be delivered in 60 days. Today, the Customized Tool Kit program is a core competency, and FY98 workloads are projected to increase by 35% over the previous year. PMD also envisions an increase in the existing market by expanding its customer base to other DOD services and federal agencies.

Fleet Emergencies and Contractor Defaults Process

NAWC, Lakehurst's PMD developed and implemented a Fleet Emergencies and Contractor Defaults process. This process enables PMD to provide an immediate response to Aircraft Launch and Recovery Equipment (ALRE) emergencies and investigations, as well as emergency manufacturing of Support Equipment (SE) due to supply system shortages or contractor defaults. Previously, the Naval Fleet relied on non-government contractors for emergency manufacturing support, resulting in long leadtimes for product deliveries and reduced Fleet readiness caused by contractor defaults (e.g., bankruptcy, missed delivery schedules, unacceptable units).

Responding to Fleet Emergencies and Contractor Defaults involves the rapid turnaround of products and services to the Fleet. PMD performs manufacturing modifications to malfunctioning equipment to comply with Fleet requirements and/or meet sail dates. This process relies on concurrent engineering practices, emergency budget authorization, departmental cooperation, emergency on-call personnel, and a manufacturing planning and control system capable of developing emergency project estimating. Concurrent engineering is handled by Integrated Program Teams composed of members from various

on-site departments (e.g., PMD, In-Service, Design, Test). The use of these teams and their relationship among various NAWC divisions enables PMD to be the first source for Fleet Emergencies and Contractor Defaults, and a key ingredient for successful Fleet support.

The Fleet Emergencies process starts when the Fleet contacts NAWC, Lakehurst to report a problem or an emergency situation. NAWC, Lakehurst personnel (e.g., in-service engineering support; test and manufacturing engineers; technicians; mechanics) investigate the situation at the problem site and assess possible solutions using the Lakehurst facilities. Discrepant or malfunctioning components may be shipped directly to Lakehurst where formal engineering investigations are initiated. If the emergency requires a new component, a redesign, and/or immediate repair, then the engineering, design, and manufacturing team personnel work together to achieve this goal. New or repaired items are installed and tested at NAWC, Lakehurst's test sites to verify form, fit, function, and performance. This step ensures the final products will meet or exceed the Fleet requirements, and facilitates shipboard installation. The components are then dispatched to the problem site, where the installation/modification is performed.

In the case of a Contractor Default, PMD brings all materials and assets in-house for full inspection. After inspecting the components, PMD determines the work required to complete manufacture. If redesign and/or process improvements are required, then a formal engineering investigation is performed and NAWC, Lakehurst personnel work together to develop and manufacture the components. After completing the repair and/or manufacturing effort, the components are dispatched to the ship for installation and/or to the Navy Supply System Agency.

Operating as the core team, PMD's well-trained, experienced staff provides immediate response and service during emergencies and default situations. The core team is usually on the scene within 24 hours after notification, and can perform analyses and/or cut material within an hour after assessment. In addition, no contract leadtime is required. NAWC, Lakehurst has funding and capabilities in place to support Fleet requirements or emergencies immediately. A typical example is the Forward Ground Handling Equipment situation. The Fleet required 12 units to be delivered within 30 days. The contractor estimated a delivery time of six months at a cost of $18,000 per unit. PMD reviewed the design and determined that the drawing package was incomplete. After generating a revised drawing package, PMD fabricated and delivered the 12 units within 30 days at a cost of $6,700 per unit, a savings of more than 62%.

Geographic Information System

The Geographic Information System (GIS) correlates the features on an electronic digital map to entries in a relational database. This smart map can query information for reporting and analysis. Although the initial setup required a large investment of time to collect and input the data, GIS has become an indispensable tool at NAWC, Lakehurst for environmental cleanup.

NAWC, Lakehurst occupies 7,412 acres of the New Jersey Pinelands. Like many government facilities, NAWC, Lakehurst supported different missions over the years, and accumulated large quantities of pollutants, wastes, and hazardous materials. Previous tracking and recording methods relied on manual generation of maps and procedures which, at best, were decentralized, labor intensive, and only as good as the technology afforded at the time. In addition, the environmental disposal practices of the past are no longer acceptable today.

In 1993, NAWC, Lakehurst's Environmental Group was chosen by the Chief of Naval Operations to demonstrate GIS applications for environmental cleanup. The GIS system, known as the Environmental Engineering Information System (ENVEIS), uses combinations of digital mapping and a relational database with information about the base (Figure 2-1). This digital map, similar to a site plan produced in AutoCAD, is a graphic file containing various layers corresponding to buildings, roads, utilities, and other features. Within an area, points and lines portray these features in a true coordinate system. The relational database, produced via Oracle, is similar to a list of information with columns indicating different fields (e.g., building name, year built, number of occupants). The advantage of ENVEIS over CAD drawings is that the database is linked to the drawings. Information can be retrieved via queries that reference the map and list together, and almost all data can be defined as a geographical relationship.

ENVEIS has contributed to NAWC, Lakehurst's reputation as a leader in the site's remediation process. This system enables NAWC, Lakehurst to accumulate and manage large volumes of text data; use DOS-based predictive models to show time and activity scenarios; and collect a wider variety of data such as soils, topography, wetlands, rare species, flood plains, and test sampling information. Maps and

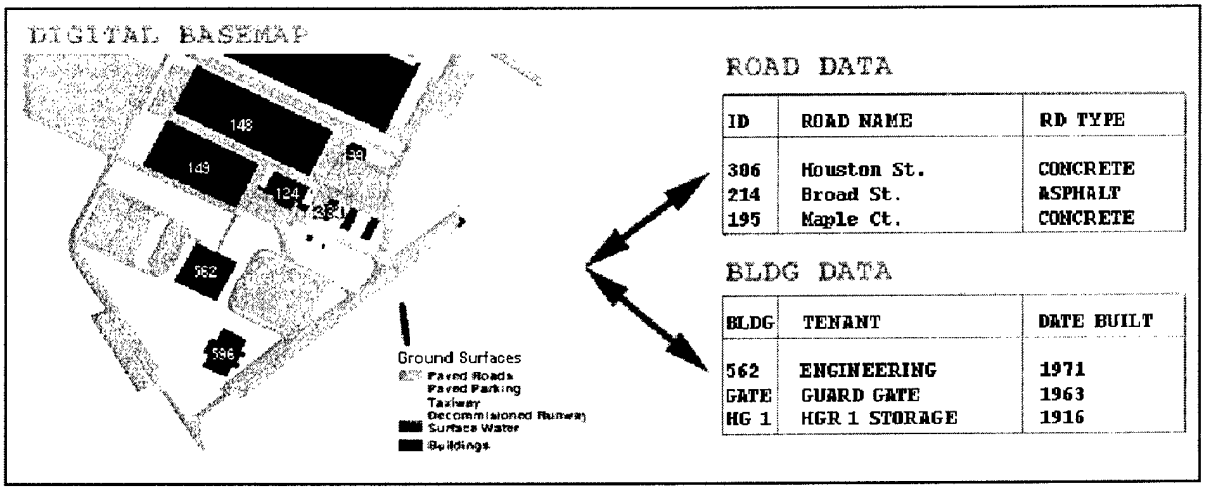


Figure 2-1. Digital Mapping with Database Information

data which took days/weeks to retrieve can now be accessed in seconds. The system reduced costs for choosing well sites that best supported groundwater cleanup, and gained regulatory and public approval for natural attenuation, saving millions of dollars. ENVEIS' success in aiding environmental cleanup has created a growing interest throughout the base. The Public Works Department uses ENVEIS to map utility systems (e.g., water lines, sewer locations). In addition, ENVEIS is available basewide on the LAN so other departments can extract data via their own desktops. This system would easily be transferable to other government bases and industrial sites to aid in environmental cleanups.

Manufacturing Planning Control System

As a result of major cost and scheduling issues (e.g., late delivery on central charging panels) which almost hindered the building of CVN-72, the Engineering Directorate mandated that a team review the problem. The team identified the lack of an automated, computerized, central processing system for job tracking as the primary reason for delays. This shortcoming contributed to missed delivery dates, mishandled job priorities, difficulty in financial status tracking, and inaccurate capacity surveys. The team also conducted an off-the-shelf study to locate a readily available system which could support a diversity of products and priorities. They found a system architecture and application being used by the Air Force in a MANTECH initiative, which could be assumed at no cost to NAWC, Lakehurst. After customizing it to the base's needs, PMD implemented the Manufacturing Planning Control System (MPCS) in 1991.

MPCS is an Oracle-based software tool which runs on an Alpha 2100 server. PMD uses this system to initiate, track, and verify any specific job from customer inquiry to delivery. MPCS handles all aspects of manufacturing resource planning such as quoting and estimating; order processing; bill of materials; process planning; work release; production control; quality control; and shop floor data. MPCS also interfaces directly with the Standard Labor Data Collection and Distributed Application System; NAWC, Lakehurst's Time and Attendance System; and several other software systems required for material acquisition, warehousing, and staging.

With the success of MPCS, this system is now serving more than 150 users including project managers, branch heads, production controllers, shop supervisors, schedulers, and administrators. Benefits include project/part visibility, single data point entry, fully integrated system, real-time status, capacity forecasting, and the ability to support all manufacturing elements. The system is providing important information to a variety of activities, ensuring the successful support of the Fleet.

National Priorities List Program

Like other government facilities, NAWC, Lakehurst supported different missions over the years, and accumulated a variety of environmental problems. In 1987, NAWC, Lakehurst was placed on the Environmental Protection Agency's National Priorities List (NPL) as a facility with serious environmental issues. Faced with these challenges as well as strict environmental regulations, NAWC, Lakehurst's Environmental Branch implemented the NPL program.

Operating out of the Public Works Department, the Environmental Branch consists of nine engineers and one manager — each a Registered Environmental Manager. Each engineer has total responsibility for one or more programs; determines the proper blend of individual responsibility and teamwork; and manages contracts by providing directions to consultants and construction contractors as required. In addition, the engineers can write construction; operations and maintenance; and/or architectural and engineering service contracts. Through the Environmental Branch's efforts, NAWC, Lakehurst accomplished the following:

- Received teamwide training in groundwater modeling (e.g., 3-D subsurface modeling, geostatistical interpretation and visualization, program interfaces) which expanded the team's ongoing modeling and subsequent decision-making efforts.
- Met all Federal Facilities Agreement schedule deadlines. In May 1997, final Records of Decision were signed for three areas of groundwater contamination, with one scheduled for May 1999. In-house contaminant transport modeling is now the focus of efforts to accurately predict groundwater treatment completion times.
- Optimized soil and groundwater treatment facilities through in-situ treatment and natural restoration. NAWC, Lakehurst uses groundwater sparging and spraying to further reduce dependency on groundwater pump and treat technology.
- Reduced operational sampling costs through negotiations with regulators (a savings of $150,000 per year).
- Created a groundwater model of the base's 80-acre wetlands, which revealed (1) remediation by traditional pumping and treat technology would further damage the area, and (2) natural restoration methods would be the best alternative. Cost avoidance savings for construction, operations, and maintenance is expected to be more than $40 million.
- Developed solar powered groundwater treatment. Although currently in the experimental stage, this method is expected to be fully implemented in 1999. Solar panels are used to power pilot-scale air sparge wells and spray irrigation systems.
- Placed environmental data on NAWC, Lakehurst's website. Accessible by the public, this website includes information on the base's environmental projects, current status, and schedules for public meetings.

These accomplishments reflect the Environmental Branch's teamwork and expertise in solving problems. The Branch's efforts (e.g., in-house developments, aggressive community awareness program, state-of-the-art computer groundwater modeling) enabled NAWC, Lakehurst to gain the trust and support of the environmental regulators as well as the public. The NPL program, designated best in the Navy for FY97, is playing an important role in NAWC, Lakehurst's efforts to have the base removed from the NPL. Only 11 of 45 sites require further action, and all have remedial processes in place. The delisting process is scheduled to begin in May 1999.

Recycling Program

Prior to 1997, material disposal and recycling at PMD involved four different departments to document, handle, stage, transport, store, and sell the material. Each type of material was segregated and stored separately. Every disposal action required a disposal form and was treated as a separate transaction. Length had a limitation of six feet, so all cross deck pendant cables needed to be cut to size. This nine-step process for cables took several weeks, increased product cost through non-value added work, and involved six people to prepare the material for final disposition. In addition, the multiplicity of dumpsters, bins, and containers for every shop as well as the recycling yard created many logistic and housekeeping problems.

Recognizing the need for a less costly and more efficient method, PMD investigated the separate recycling operations managed by Morale, Welfare, and Recreation (MWR), an on-site organization. MWR collected glass bottles, aluminum cans, paper, and other recyclable materials, and sold them for profit. This action was allowed under guidance instructions, issued by the Chief of Naval Operations, which empowered the field activities to participate in the direct sales of recyclables. After several meetings, an agreement was reached between PMD and MWR. MWR would pick up, transport, and recycle all the scrap steel and aluminum generated by PMD. This Recycling program decreased PMD's operating costs by more than $28,000, reduced the number of dumpsters from 12 to five, and significantly improved disposal turnaround time — especially for cross deck pendant cables, which can now be prepared for final disposal in two simple steps.

The majority of recycling conducted at NAWC, Lakehurst is performed under the MWR Recycling

program. However, the Public Works Department, which is responsible for ensuring the base's compliance with all environmental laws, handles all other wastes according to appropriate cleanup and disposal procedures. Throughout NAWC, Lakehurst, a significant amount of unused acreage is covered by degrading asphalt and concrete. The Public Works Department initiated a program to systematically tear up the asphalt and concrete, and recycle the material. Once the degrading asphalt and concrete is removed, the Public Works Department plants wildflowers in this newly-exposed earth, eliminating lawn maintenance costs and allowing the area to return to its natural state.

All funds generated from the basewide Recycling program are used to beautify the base and support other MWR programs. MWR recycled 300 tons of materials and achieved $6,000 in revenue for FY96, and 745 tons of materials and $34,423 in revenue for FY97. NAWC, Lakehurst also realized a saving of $81,358 in landfill cost avoidance for FY97.

Facilities

Carrier Operations Analysis

NAWC, Lakehurst's Carrier Analysis Laboratory is a unique research facility that develops, analyzes, evaluates, documents, and archives data associated with the satisfactory operations of naval aircraft on surface ships. This secure, 3,300 square-foot laboratory simulates the layout of actual ships, aircraft, weapons and other support equipment (Figure 2-2), and provides shipboard aircraft operations problem-solving support to the Fleet. Using large layout boards, overhead cameras, scaled (1/96th) ship plans and aircraft templates, networked computers, and extensive CAD files, the laboratory offers solutions and/or alternatives to operational problems created by a new airwing composition, an inexperienced aircraft handling crew, a task force, or other changes that impact the operations of a ship.

Fleet personnel initiate the Carrier Operations Analysis process by sending a message to NAWC, Lakehurst with a proposed visit date and a description of the desired support. Once the visit is approved, preparatory research is initiated by NAWC, Lakehurst including setting up the layout board to show the flight deck, hangar bay, and air wing arrangement of the visitor's ship. The visitors (e.g., aircraft handling team, ordnance handlers, maintenance personnel) meet with NAWC, Lakehurst personnel in the Carrier Analysis Room. Solutions are proposed, evaluated, and discussed by the participants. The overall process involves drawing reviews; computer model generation and animation; overhead digital photography of various template board layouts; and successful solutions used by sister ships. Once the participants

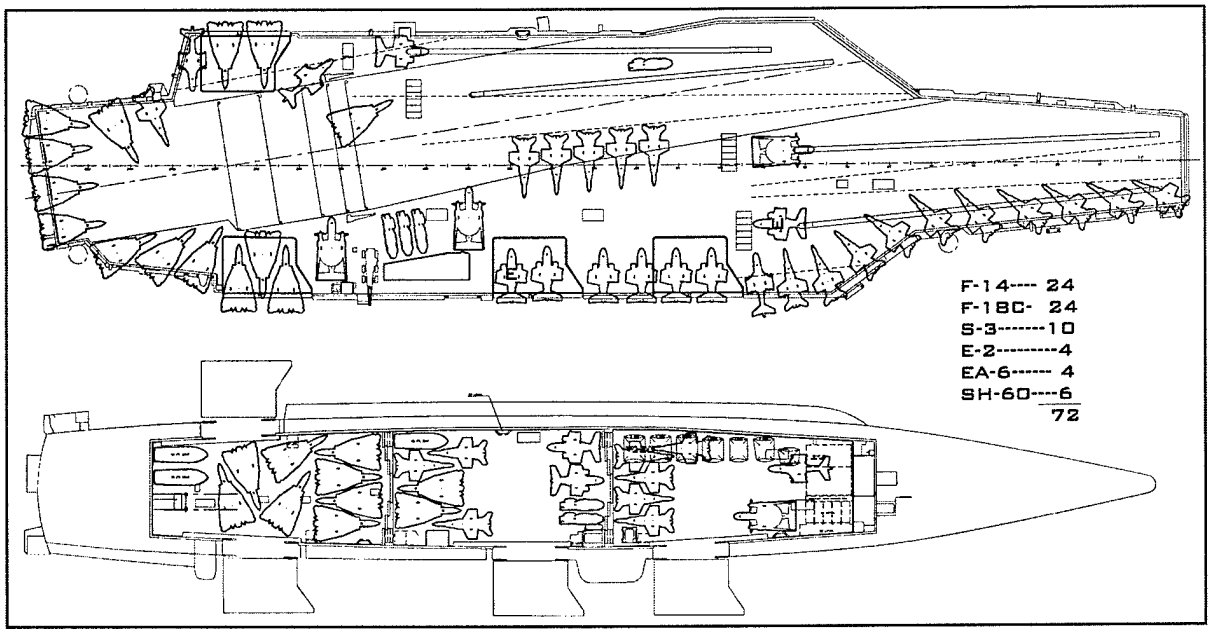


Figure 2-2. Overhead View of a First Go

agree on an acceptable solution, NAWC, Lakehurst assembles a complete technical package for the Fleet personnel which details the results, including a set of digital photographs and computer prints documenting the evolution; a transcript of the required sequence of aircraft movements; and spreadsheets quantifying the proposed ship layout.

NAWC, Lakehurst estimates a cost savings of 99.2 manhours and $3,840 per study for its Carrier Operations Analysis process. The turnaround time for a study is one-and-a-half days, compared with three days using the previous method (e.g., 35-mm camera shoots, outside laboratory for film processing, cut and tape method for documenting, delivery to ship). Future plans consist of continuous upgrading of the computer system, photography acquisition, peripheral equipment, application software, and direct technology transfer to on-board Fleet operators.

Logistics

Acquisition Logistics Support Plan

In the past, NAWC, Lakehurst manually typed, copied, and processed its Acquisition Logistics Support Plans (ALSPs), which added time and cost to the finished product. Each plan was arranged in a paragraph format, followed military specification instructions, and included volumes of redundant information. Searching these documents for particulars was very time consuming, and required extra reading and research by the user.

Wanting to reduce development costs and improve the readability of these documents, NAWC, Lakehurst turned to its in-house experts, and developed a PC-based ALSP program using Microsoft Access. This user-friendly program operates with drop down menus, and eliminates the need for extensive computer training. In addition, the program covers all possible support scenarios for developing a comprehensive plan, and enables the plans to be produced with consistent quality. Taking advantage of computer-generated plans, the ALSP program generates only relevant information in an easily understood format and language.

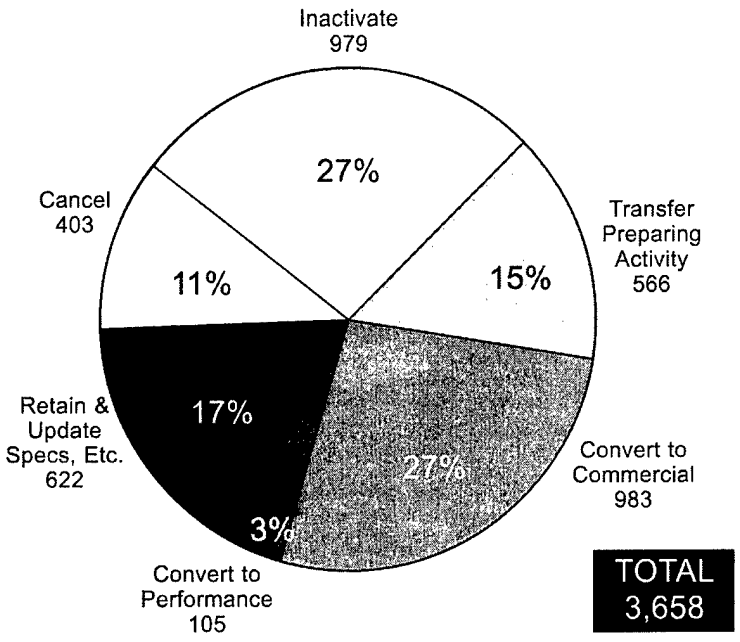
The ALSP program produces easy-to-read, fact only documents which cover all ALSP requirements. Since implementing this program, NAWC, Lakehurst reduced the development time by 60%, and improved the product quality by 50%.

Management

Defense Standardization Program

A major element of acquisition management by the military services is the process of developing and agreeing on uniform engineering criteria for products, processes, practices, and methods. DOD accomplishes this task through its Defense Standardization Program (DSP). NAWC, Lakehurst participates in and supports DSP to provide for configuration management, logistics, maintenance, and reprocurement of existing platforms, systems, and equipment, and to develop world-class standards in partnership with industry for future acquisition requirements. NAWC, Lakehurst's involvement includes serving as a lead standardization activity; preparing and maintaining the standards documents; reviewing and using the standards documents; and acting as a military coordinating activity. Currently, NAWC, Lakehurst is actively involved with nearly 15,000 military standards, specifications, handbooks, and other standards documents — either as a preparing activity, a custodian, or a reviewer.

The DOD acquisition reform policies have transferred much of the work for maintaining and converting military standards and specifications from the government to various industry standards development organizations. There is, however, a continuing requirement for management, oversight, and technical support. NAWC, Lakehurst is directly responsible for the technical management of all specifications, standards, and handbooks used in the acquisition or reprocurement of Navy aircraft parts, systems, and equipment for which the Naval Air Systems Command (NAVAIR) is the preparing activity. Maintenance of these documents includes revisions, amendments, inactivations, periodic five-year reviews, and issuance. Technical support involves helping contracting agencies, suppliers, and Fleet personnel handle issues like technical changes, contractual interpretations, technical data research, and environmental alternatives. Most technical service requests are handled by telephone or e-mail. NAWC, Lakehurst also supports the NAVAIR technical community in the development, maintenance, and conversion of military specifications to non-government standards which affect naval aviation systems design and acquisition. Currently, seven NAWC, Lakehurst standardization engineers are registered as partici-



Disposition Decision	Completed	In Progress (Active)	Awaiting Start	Total
Cancel	384	7	12	403
Inactivate	812	43	124	979
Transfer Preparing Activity	566	0	0	566
Convert to Commercial [1]	167	159	657	983
Convert to Performance [2]	37	56	12	105
Retain & Update Specifications, Etc. [3]	84	47	491	622
TOTAL	2,050	312	1,296	3,658

1 Nongovernment Standards Includes Specifications & Standards
2 Includes Interface & Standard Practice Standards, Specifications & CIDS
3 Includes Test Method, Manufacturing Process, and Design Criteria Standards, Handbooks, DTL & Federal Specifications

Figure 2-3. Standardization Improvement Program Status

pants with one or more of the following standards development organizations: AIA, ASTM, AWS, EIA, IEEE, ISO, and SAE. NAWC, Lakehurst is also designated as the NAVAIR subject matter expert for international standardization and interoperability, and provides members for international standardization committees.

NAWC, Lakehurst is responsible for the administration, maintenance, and customer support of several automated tools (e.g., ASSIST, PROTRACK) used in managing DSP within NAVAIR. ASSIST is the overall DSP management information system, and PROTRACK is NAVAIR's internal document maintenance process tracking system.

In recent years, acquisition reform initiatives have worked to eliminate military specifications and standards for new acquisitions, and to replace them with performance requirements developed in partnership with non-government standards organizations and industry. Figure 2-3 shows the current status of the NAVAIR standardization improvement program. Figure 2-4 shows the timeline for converting military standards to performance requirements. It is important to note that the wholesale cancellation or conversion of specifications which define parts and materials used in aircraft worldwide is not beneficial. These types of specifications are not cost drivers or military unique requirements. Instead, they constitute essential engineering information that defines as much as one third of the parts used on most of the aircraft built throughout the world. In essence, these military specifications have become de facto commercial and international specifications. In response to the prospective cancellation by DOD of many of these critical documents, AIA established an Early Warning Project

Group of which NAWC, Lakehurst is a member. This group identifies specifications such as this, and works to have them "reissued" as word-for-word conversions to commercial standards.

NAWC, Lakehurst is also involved in the development of a process to have an independent third party certify the Qualified Products Lists that are included in standards developed by recognized standards development organizations. This process will provide substantial savings to the government and industry by reducing the costs associated with qualifying parts.

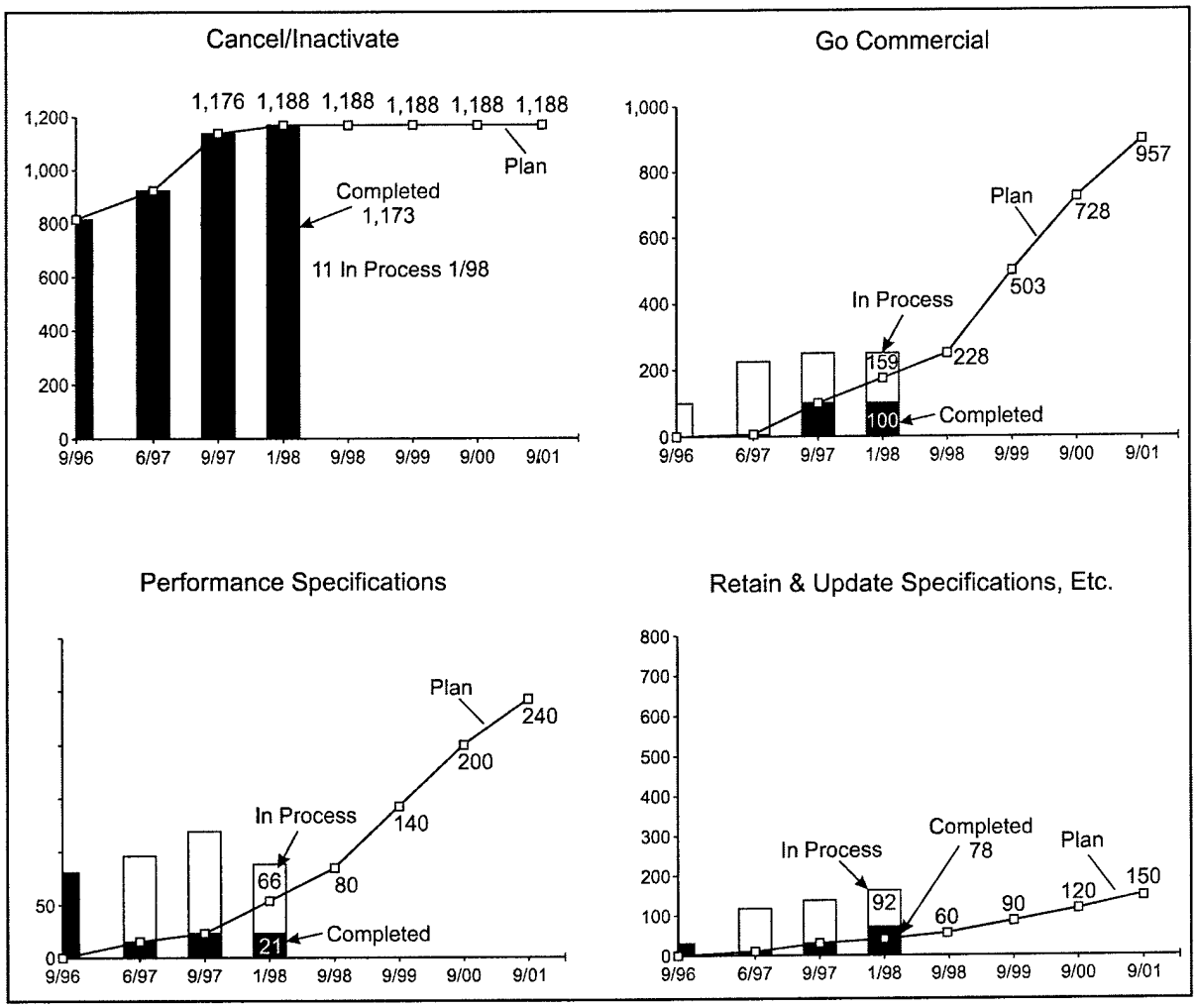


Figure 2-4. Standardization Improvement Program Timeline

Section 3

Information

Design

Engineering Data Management System

Prior to June 1998, NAWC, Lakehurst used an engineering data management method which relied on hardcopy master files. These files took up space and were susceptible to damage whenever a change was made. Although the drawings were scanned into a computerized system using Computer Aided Filing for Engineering Drawings (CAFED), users could only access them through dumb terminals, whose availability needed to be coordinated and scheduled. Configuration management procedures lacked clear revision control, and CAFED would not recognize any other information except the drawing number. The drawing approval cycle took two to five days, and consisted of routing the hardcopy master file to various authorities for signature, scanning it back into CAFED, and then comparing it to the hardcopy master drawing for verification. Transferring a drawing into the Joint Engineering Data Manufacturing Information Control System (JEDMICS) required six to 12 weeks. Here, the process called for photographing the hardcopy master file; creating aperture cards; generating an index data report from CAFED; mailing the information to the JEDMICS repository center; scanning it into JEDMICS; and keying-in the index data. Only then could the drawing be accessed through JEDMICS by other users.

NAWC, Lakehurst's Engineering Data Management group wanted to establish an integrated data system that tightly incorporated all technical competencies and activities, and an infrastructure which fostered process improvement, business partnerships, and information sharing. Using an integrated desktop approach for easy accessibility, the group developed the Engineering Data Management System (EDMS). This system is electronically connected to all necessary interfaces so data can be transferred quickly. EDMS operates as a single point of entry for all official engineering data and is accessible via the Internet. Activities like work breakdown structure, access rights, and responsibilities can be identified within the system to maintain control. Drawings are searchable via drawing number, project number, activity code, or other pertinent data. Related information is now tied to the drawing and available for review by the user. Electronic signatures, improved workflow, elimination of duplicates, and faster transfers have decreased the drawing approval cycle (Figure 3-1) to just a few minutes. JEDMICS can be updated the same day via electronic transfers.

NAWC, Lakehurst relies on EDMS for rapid access, accurate configuration control, and unlimited storage. Since implementing EDMS, Lakehurst significantly improved the efficiency and quality of its engineering data management functions.

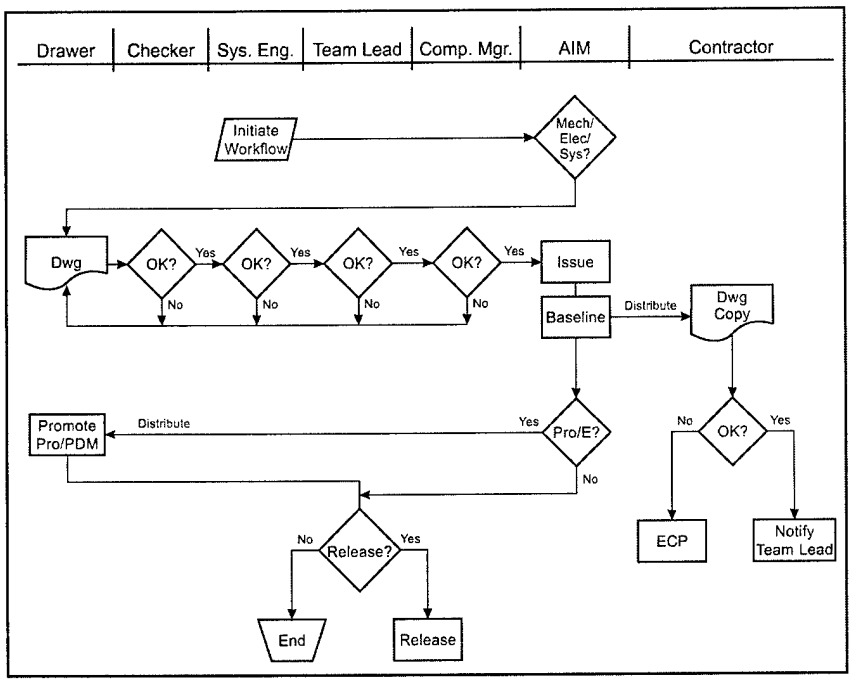


Figure 3-1. Approval Process

Producibility Engineering Process

After a late delivery of government furnished equipment (GFE) jeopardized the production schedule for the CVN-72 and CVN-73 aircraft carriers, NAWC, Lakehurst examined its producibility engineering process. NAWC, Lakehurst identified drawing problems with the GFE documentation as the primary reason for delays. A complete drawing review was performed which pointed to the need for manufacturing input during the product design phase. In response, NAWC, Lakehurst developed a process and an organization that would handle producibility engineering services using a concurrent engineering approach.

Modeled after MIL-HDBK-727, the Producibility Engineering process uses a checklist approach to review producibility issues. The process looks at general aspects of design; specifications and standards used; drawings; inspection and test; materials; manufacturing processes; joining methods; coating materials and methods; and heat treating. The Producibility Engineering organization participates early on in the design phase to provide producibility criteria and conduct a producibility analysis. In addition, the organization develops manufacturing strategies; prepares cost estimates; performs risk analysis; evaluates availability of critical materials/processes; reviews component leadtimes and available substitutes; determines the need for limited production; and conducts production readiness reviews.

Issues maximized by the Producibility Engineering organization include the simplicity of the design; number of potential suppliers; process repeatability and predictability; ease and speed of assembly; and the use of standard parts, proven technology, economical materials, and CAD/CAM capabilities. Issues minimized by the organization include procurement leadtimes; special production tooling and test systems; skill levels required to manufacture the product; design changes during production; removal of excess material; specification of unrealistic tolerances; and the use of critical materials and processes, unit costs, limited capability items and processes, and proprietary items. NAWC, Lakehurst's mainstreamed process now looks at producibility early on in the design phase to prevent unwanted occurrences from happening later in the production cycle.

Requirements Analysis Procedure

In the past, no documented ALRE/SE requirements process or tools existed at NAWC, Lakehurst. Other obstacles were a lack of configuration management, no clear set of requirements/baselines, and under utilized equipment. In 1993, NAWC, Lakehurst's Systems Engineering Department began designing a requirements analysis procedure that could develop and validate ALRE/SE requirements. These requirements establish the baseline for developing a functional system which can operate effectively and meet its mission. Fully implemented in 1997, the ALRE/SE Requirements Analysis procedure was designed to optimize Fleet requirements, benchmark solution performance, identify prospective solutions, improve equipment performance, develop clear test and evaluation metrics, and measure affordable readiness.

The ALRE/SE Requirements Analysis procedure also ties into ensuing processes such as trade studies, technical performance reviews, Test and Evaluation Master Plan (TEMP) preparation, functional analyses, and specification development. As the foundation of any new program, requirements definition provides the fundamental knowledge for engineering design, development, and manufacture. Regarding ALRE/SE, requirements analysis serves as the bridge between customer requirements and deriving requirements from which solutions can be generated. Fleet needs, objectives, and requirements are analyzed in the context of Fleet missions, utilization environments, and required system capabilities. Requirements analysis is initiated by validating and verifying the mission and the operational needs. This effort results in the determination of functional and performance requirements for each primary function of the system.

The ALRE/SE Requirements Analysis procedure consists of nine steps: task agreement (customer); system engineer coordination (supplier); generation and validation of mission/operational needs; mission need analysis; operational requirements analysis; requirements trade-off analyses; preparation of operational requirements document/report; systems requirement review; and output. The output of this process supports the following: TEMP preparation, functional analysis, functional baseline specification, and allocated baseline specification.

Complex/mission critical systems require a structured systems engineering approach to requirements definition. Requirements analysis is complex, and requires strong leadership and good analytical skills in many disciplines including field experience. The ALRE/SE Requirements Analysis procedure enables NAWC, Lakehurst to make better decisions, determine the requirements of a product, and maintain the traceability of requirements.

Software Design Process

In the past, quality software development at NAWC, Lakehurst was hindered by weak software baselines, poor configuration management, minimal quality checks, moving/changing requirements, and no clear allocation of undefined resources. To remain competitive, NAWC, Lakehurst's Automatic Test Equipment (ATE) Software Center needed to alter its philosophy and operate the facility more like private industry. The Center wanted to develop better software products, reduce project costs, improve organization, and meet/exceed industry compliance through the use of the Software Engineering Institute's (SEI's) Capability Maturity Model (CMM). As a result, the ATE Software Center developed and implemented the Software Design process.

The ATE Software Center supports various aircraft systems' ATE software development and support projects, including the versatile avionics shop tester, hybrid test station, computerized automated tester, radar communication tester, and consolidated automated support system. The Software Design process establishes a more structured setting via policies, plans, procedures, and software reviews. The process also uses SEI's CMM, MIL-STD-498 guidance, defined documentation, configuration management, quality assurance, and metric analysis. The ATE Software Center has received Level 2 SEI CMM certification (October 1998) which covers six key process areas (KPAs): requirements management, project planning, project tracking and oversight, configuration management, quality assurance, and subcontractor management. MIL-STD-498 deliverables and data item descriptions are linked to the Level 2 KPAs as defined procedures. As a part of the overall process, the ATE Software Center generated a Software Development Plan (SDP) which describes a developer's plan for conducting a software development effort. The SDP provides insight, organization, monitoring tools, software development processes and methods, approaches for each activity, project schedules, and resources.

Since implementing the Software Design process, the ATE Software Center realized many benefits. These include established guidance and standardization for software development on all projects; a definition of metrics (e.g., lines of code, deviations, completion times); increased communication; improved morale and working environments; a streamlined organization with better utilization of resources; and increased capability to handle larger, more complex programs with the same size workforce.

Test

Aircraft Launch and Recovery Equipment Certification

NAWC, Lakehurst is responsible for certifying the installation and subsequent operational performance of all shipboard and shorebased ALRE. ALRE certification is required of all new installations as well as any equipment which undergoes significant modification or repairs. In addition, the Type Commander, who is responsible for providing safe, reliable, and ready ships to the operational warfighting Fleet Commander, can also request a certification/recertification on equipment. In the past, major modifications or repairs were only done on ALRE during the time-phased, regular overhaul cycle (six- to eight-year intervals) of aircraft carriers. Today, the focus of aircraft maintenance has shifted to a condition-based maintenance methodology — shorter but more frequent intervals.

A significant cost factor in certifying steam catapults is the deadload launch requirement. NAWC, Lakehurst tests the entire launch cycle by using a properly weighted deadload to replicate a fully-loaded aircraft. The deadloads, which float, are launched from the ship's catapult system. After launch, deadloads are recovered in an extremely manpower-intensive procedure, which requires salvage personnel for locating the deadload; riggers for lifting; hook up and retrieval to the flight deck; and shipyard personnel to drain and reballast for the next test. The Coast Guard or local Harbor Police are used to establish and enforce a keep-out, safety zone during the test.

By strategically placing appropriate sensors on the primary catapult machinery and valves, NAWC, Lakehurst has developed a computer program which can simulate a deadload launch. Except for initial installation situations (used to establish baseline data), this method eliminates the deadload requirement for steam catapult certification. In addition, the computer simulation can monitor the performance of all ALRE, and establish a database for measuring degradation which enables NAWC, Lakehurst to predict failures and take appropriate preventive measures.

The savings are significant as the simulation precludes replacing or overhauling equipment or parts on a periodic basis. NAWC, Lakehurst can focus scarce resources on degraded parts or equipment via a condition based maintenance methodology. By eliminating the deadload launch requirement (except for initial installation situations), NAWC, Lakehurst

achieved a 50% or better manpower reduction which translates into significant dollar savings.

Aviation Engine Test System

NAWC, Lakehurst uses an Aviation Engine Test System (AETS) to detect incremental degradations in aircraft engine performance prior to catastrophic failure, and to certify acceptable performance of all aircraft engine types prior to installation in aircraft. This effort involves a test facility correlation, and the subsequent certification by NAWC, Lakehurst. During a test facility correlation, two or more facilities (one being the reference facility) determine the performance parameters of a common engine, and compare the results to the baseline performance of that engine. A proper correlation will provide an accurate assessment of the engine.

NAWC, Lakehurst personnel use test correlation to identify variables that impact engine performance and to note performance trends which indicate degradations in engine performance prior to catastrophic failure. After assessment, one or more of the following actions may occur:

- Reject engines that fail minimum performance criteria
- Predict and schedule maintenance actions prior to costly failures
- Identify and correct flight safety issues
- Identify and correct environmental issues (e.g., air and noise pollution problems)

To achieve the maximum benefits from AETS, all deviations from the established reference facility must be properly identified, assessed for impact, and adjusted. Test correlation should be done for the following situations: after any airflow path modification and/or new construction/AETS installations; introduction of a new engine type/model/series; relocation of AETS equipment; performance baselining; and site engineering investigations.

NAWC, Lakehurst's AETS lowers engine maintenance costs, improves flight safety, and increases engine performance and engine longevity. In addition, AETS provides the following benefits to the customer:

- Test facility configuration and geometry assessment for proper engine testing
- Significant changes to the test cell or engine during correlation and the rationale for same
- Engine performance data and the calculations used
- Graphs of engine performance data versus baseline data
- Results of test facility airflow survey
- A complete list of all deficiencies with recommendations for correction

Data Acquisition Receive and Transmit System

The Data Acquisition Receive and Transmit (DART) system is the primary means of collecting dynamic event data at the NAWC, Lakehurst test sites and on shipboard projects. DART developed as an evolutionary system by the progressive application of improvements in data processing and instrumentation since the late 1970s. Over several generations of improvements, DART progressed from a mainframe-based system to a PC-based system capable of processing up to 64 channels with sample rates up to 5,000 samples/second/channel. The improvements were needed to produce repeatable data reduction in near real time; provide portable data recording; reduce acquisition costs; automate on-site post processing and analysis; provide improved data management; and reduce operational overhead.

New monitoring capabilities enabled improvements in data acquisition. Features were built into the system design to address the monitoring of parameters during setup and checkout as well as the viewing of recorded parameters. Previously, this type of checkout could not be done effectively, and was usually delayed until the data processing phase. Problems discovered during this phase often required rework and rerunning of the test. The operator's confidence has been raised considerably by the ease of use, repeatability, and presentation of useful information for troubleshooting. Customers are benefitting from more reliable data. LAN connectivity for all NAWC, Lakehurst test sites is providing rapid access to recorded data for all users.

Capabilities of the current system include data acquisition, post processing and validation, analysis, and archiving. Typical equipment which can be brought to the test site include a data acquisition workstation, an analysis workstation, sensors and signal conditioning equipment, and digital communication equipment (modems). The DART software was developed in-house using and incorporating numerous commercial applications. By utilizing commercial standards where possible and commercial software where appropriate, NAWC, Lakehurst has been

able to control in-house software development and incorporate new technology trends quickly.

The DART system can perform test data acquisition, processing, and analysis with fewer people while reducing costs and improving reliability. Utilization of common hardware and software platforms provide a multi-role asset that better meets the customer's needs.

Test Site Equipment Certification

The Test Site Equipment Certification for aircraft tests provides the framework for modifying the test site configuration, installing the test site unique data retrieval devices, and ensuring that the site is ready for conducting tests with aircraft. The certification process enables the Navy to conduct shore-based testing and component checkout safely, economically, and with the highest degree of reliability before using these systems and components on aircraft carriers at sea.

NAWC, Lakehurst's Catapult Complex consists of two aircraft carrier type steam catapults and a high pressure steam plant. Both catapults can launch aircraft or deadloads weighing up to 100,000 pounds, and can accelerate either up to 185 knots under normal conditions or higher for special tests. The catapults are extensively instrumented to allow engineers to gather data on catapult performance. Testing and design verification using actual aircraft is extremely expensive, but necessary to ensure the utmost reliability of new or modified catapult systems prior to installation in the Fleet. Uncertainty of test site configuration of equipment and/or instrumentation could lead to the need to reconfigure the test site and retesting. Besides possible safety issues, questionable test data, and schedule delays, downtime becomes extremely costly due to idle aircraft, equipment, and support resources while the test site is brought up to the correct configuration.

NAWC, Lakehurst uses a high level certification and documentation process to ensure proper test site equipment configuration. At all times, the site configuration baseline is known. Only authorized changes can be made to the baseline which are tracked through a formal checkout procedure to ensure they are documented in the new baseline. The test site can only be used for aircraft tests upon completion of the Certification of Equipment Readiness.

The Test Site Equipment Certification process eliminates the uncertainty of test site configurations. The process also avoids high costs by reducing the occurrence of lost test time and idle aircraft.

Production

Parts Control Program

The Navy's Parts Control program is a coordinated effort between prime contractors and procuring activities to promote and optimize the use of standard parts; minimize the use of company unique and peculiar parts; and prevent the use of parts with built-in failure mechanisms. The program is the result of DOD directives issued in the 1980s and early 1990s, which established and required the use of a mandatory parts control program to increase competitive bidding and hold down the prices for spare parts procured by the Services. MIL-STD-965 was the DOD standard that established and detailed parts control program requirements for use on newly designed and/or modified equipment.

In recent years, acquisition reform initiatives have introduced changes to the program including the addition of performance requirements, which address life cycle considerations (e.g., standardization, obsolescence, diminishing manufacturing sources, part reliability, quality) and are tailored in the statement of work to meet goals and objectives of different applications and acquisitions. Other changes include single process initiatives and contractor logistics support. The Navy and other Services have adopted an approach of working in partnership with industry. MIL-STD-965 was revised in 1997 into a performance based document (MIL-HANDBOOK-965) which shifts the emphasis of the program from piece part oversight to process insight. Under the new joint contractor/government approach, contractors are required to detail their comprehensive approach to parts control in either a parts control plan or via their response to the Request for Proposal. The overall objective of the parts control plan is to keep life cycle costs down as much as possible.

NAWC, Lakehurst's role is to provide insight into the process for the Navy and to team with the contractor to ensure program objectives and goals are achieved by highlighting parts and issues that present a risk to the successful execution of the program. Management responsibilities include developing performance based Statement of Work requirements; negotiating single process initiatives with contractors for block change proposals; establishing parts management program requirements and procedures; and conducting technical interchange and parts control program reviews. The base also provides techni-

cal expertise for parts selection, technical issues, part quality, life-cycle considerations, and other technical areas. NAWC, Lakehurst serves as a member of the Parts Standardization and Management Committee (PSMC), a joint industry and government working group that provides a forum for promoting effective parts management and standardization through commonality of parts and processes. PSMC promotes effective parts management through information, idea, and concept sharing between government and industry organizations.

Under the acquisition reform based approach to parts management, NAWC, Lakehurst established 16 performance based parts management programs, established and implemented 12 parts management integrated product teams (IPTs), and established a multi-program parts management IPT with Boeing (St. Louis, Missouri). Other benefits include reduced design documentation, reduced contractor part testing and qualification, and increased maintainability and supportability of Fleet systems.

Facilities

Integrated Sustained Maintenance Planning Process

NAWC, Lakehurst developed and implemented an Integrated Sustained Maintenance Planning Process (ISMPP) to help reduce the operations and support expenditures of ALRE/SE. Prior to ISMPP, NAWC, Lakehurst had no process to evaluate the actual requirements for maintaining this equipment. Operations and support costs consumed 80% of ALRE's budget and 60% of SE's budget, leaving little funding for upgrades to keep up with the rapid advancements in technology. Continued budget reductions compounded this problem even more.

ISMPP enabled NAWC, Lakehurst to solve its expenditures problem. A team of Fleet operators, maintainers, equipment engineers, logisticians, and a NAWC, Lakehurst facilitator evaluated equipment performance, failure modes and effects, support, and maintainability requirements to determine the actual requirements needed to keep this equipment operational. The analysis results were then entered into the ISMPP system. This PC-based system has the capability to develop detailed revised maintenance requirements based on real needs. Results of the new processes are monitored against a baseline established prior to the implementation of ISMPP.

NAWC, Lakehurst's ISMPP has been completely accepted by Fleet personnel and project managers as well as the cognizant field activities. Projected savings are expected to exceed $10 million over the next ten years.

NAVPLAN/NAVPRO

In the past, maintenance planning tools, such as Logistic Support Analysis Record (LSAR) software products, were the only methods available to produce maintenance plans (MPs) and provisioning documentation (PD). However, these tools lacked the flexibility needed to operate under the NAVAIR-emphasized constraints of commercial-off-the-shelf (COTS) or non-developmental item (NDI) acquisitions. A flexible, more effective solution was needed to streamline the acquisition process.

NAWC, Lakehurst developed NAVPLAN/NAVPRO under a government and industry partnership as an alternative to LSAR products. NAVPLAN is a PC-based, easy-to-use maintenance plan development system used for COTS/NDI acquisitions where limited data is available. As an extension of NAVPLAN, NAVPRO can produce provisioning documentation (completely compatible with Naval Inventory Control Point requirements) and support material lists (used to determine interim spare and repair parts support requirements). Both systems offer completely transportable documentation via electronic media.

NAVPLAN/NAVPRO uses a Graphical User Interface which allows users to work in a familiar Windows environment. The program's relational database reduces the input/documentation requirements by 50% while improving the quality and consistency of the plan data. Features such as On-line Help and Advice and Guidance supply additional information to users for plan development. This guidance information can be augmented or tailored to organization-specific needs without requiring any modification to the existing system. NAVPLAN/NAVPRO was specifically designed to operate within the source data and time constraints of COTS/NDI acquisitions.

NAVPLAN/NAVPRO's technologically advanced software applications have streamlined the maintenance planning procedures; significantly reduced the training and source data requirements; and dramatically increased the user's quality, consistency and performance. Since its implementation, the program reduced the MP and PD development times and costs by two-thirds. Projected savings for FY98 are expected to exceed $125,000.

Logistics

Integrated Logistic Support Workload Program

Previously, NAWC, Lakehurst's Integrated Logistic Support (ILS) group used an unstructured method to estimate its workload, budget, and associated costs. This method had neither a standard approach nor established time standards for the multitude of tasks needed to perform a thorough ILS review. The result was unreliable workload estimates; sponsor discontent due to the perception of budget overstatements; and no central storage and/or system to determine correlation and status against similar jobs. A standardized workload program was needed.

The ILS group developed the Integrated Logistic Support Workload program by assembling a list of applicable tasks required to perform the ILS review; assigning standard work times to each task; and adding an adjustment factor to handle the varying complexities of work. A logic program was created to select the tasks needed for the ILS review based on a particular project's criteria. Specific functional work areas were also incorporated so that the assignment of tasks, associated times, and costs were an automated process which could be rolled up into a final estimate for a particular project. Managed by the ILS group, the Integrated Logistic Support Workload program is stored on a mainframe and is available to personnel through a LAN.

The Integrated Logistic Support Workload program has become an important tool for ILS management by providing a single workload estimating method; a central depository of each project's work requirements; the ability to roll up department workloads; and a detailed task listing system that is defendable to the sponsor. The program also improved the ILS group's estimating accuracy by 85%.

New Construction Ships Outfitting Program

In the past, Type Commanders were responsible for coordinating the initial outfitting of intermediate-level aircraft maintenance support material for the construction of all new aircraft carriers and amphibious assault ships. However, the pressures on the Type Commanders to also provide maintenance support material to operational and deployed ships often resulted in new construction ship materials being diverted, especially in emergent and urgent requirements. Under these conditions, documentation was often inadequate to ensure a timely reorder or return of the diverted material. This method created costly delays during the outfitting process, and impacted those shipyards where prefabricated infrastructure components with specific footprints were required for some equipment installations. In addition, requisitioning was managed through the Supply Liaison, and Type Commanders relied on contractor support for technical publication and documentation delivery, installation, and verification. Accordingly, the overall method was fragmented and inefficient.

NAWC, Lakehurst implemented the New Construction Ships Outfitting (NCSO) program, which is managed by the Site Standup Branch. The NCSO program provides the initial outfitting of material while the ship is under construction. The goal is to have all support material in place and operational at the time the ship is commissioned. Due to long lead times, the material requirements must be identified early in the construction cycle, acquired, sent to a holding area, inspected, documented, delivered to the ship on time, verified, and certified. This process uses a computer-driven tracking system to ensure that the required material is available to support aircraft operations for deployment.

Since implementing the NCSO program, the Site Standup Branch reports a significant improvement in the overall outfitting process as well as customer satisfaction. The Branch also realized a sizable cost savings by preparing the technical documentation in-house, and initiating a searchable inventory system. This search feature enables the Site Standup Branch to search the entire Navy inventory for reusable equipment from decommissioning ships, and to assess these items for refurbishment and reissue when feasible in lieu of new procurement — a function not previously performed by the Type Commanders.

Procurement of Material and Services

Prior to a major realignment and the creation of the Acquisition Management Competency, procurement of ALRE/SE was a fragmented process involving several organizations at NAWC, Lakehurst. The result was a lack of clearly defined roles and responsibilities; inconsistencies in procurement documents; no standardized procedures; and an underutilized Automated Data Processing (ADP) system. Despite best efforts by all, essential equipment was often not ordered on time or at all, and the duplication of

materials resulted in wasted dollars and excessive inventories.

Today, the Acquisition Management Competency assumes responsibility for the entire process, and provides guidance for the procurement of ALRE/SE material and services. The department revised the process by drafting and implementing standard operating procedures; revising the quality assurance handbook; and optimizing ADP support. All sub-processes were also incorporated into the standard procedures manual, and specific guidance on procurement procedures was promulgated.

Benefits realized from the new procurement process include on-time delivery of the proper equipment to the customers; a reduction in inventory by eliminating double procurements; better inventory control resulting in no losses; and significant dollar savings. ADP maximization also reduced manpower with attendant savings and, most importantly, increased customer satisfaction.

Training Execution and Personnel System

NAWC, Lakehurst's Logistics Department developed and implemented the Training Execution and Personnel System (TEAPS), which can be used to store, retrieve, and manipulate employee training data. Prior to this system, all training course listings, individual training plans, individual development plans (IDPs), off-site course listings, and personnel training histories required manual paperwork.

TEAPS is an automated system that contains three major databases, which are integrated and used to create IDPs, career training paths, employee training history records, and 40-hour Completion Status Reports. Developed through a cooperative effort between government and industry, TEAPS operates in Microsoft Access, and is Windows compatible. This user-friendly system requires little or no training, and can be easily modified.

Similar to other Windows-based software, TEAPS' user interface features recognizable check boxes, text boxes, tool bar, and drop down lists. The system has three levels of accessibility: administrative, superuser, and user. Administrative has access to all capabilities, including adding or deleting user accounts, editing data on all personnel, and running all reports without restrictions. Superusers can only enter/edit data on individuals and generate reports which pertain to their own code or department. Users can only enter/edit data and pull IDP reports for their own accounts. The system allows all users to display and review course offerings, and electronically submit forms for approval and scheduling.

TEAPS provides NAWC, Lakehurst with valuable capabilities and benefits. Employees can select courses from internal course catalogs, electronically import them, and automatically generate IDPs. Numerous ad hoc reports can be created such as the 40-hour Completion Status Report which identifies the completed cumulative course hours, lists employee training history, and prioritizes the required coursework cited on IDPs. Another benefit involves employee morale. Prior to TEAPS, only 20% of the courses requested by employees were approved. This percentage has increased to 85% for employee approved courses. Although the Logistics Department spent $10,000 to develop TEAPS in-house, the department estimates that $30,000 is saved annually — a 75% cost reduction from the previous system.

Management

ISO-14001 Implementation

NAWC, Lakehurst has been designated by DOD as a participant in a two-year pilot program to determine if other government installations should be certified to ISO-14001. ISO-14001 is an international standard for demonstrating that the registrant has an Environmental Management System (EMS) in place for managing the entire life-cycle and environmental impact of its business operations. The study's intent is to determine the feasibility of making ISO-14001 certification a requirement for doing business with DOD. NAWC, Lakehurst is developing an EMS to comply with this international standard.

Currently, there are no formalized compliance requirements imposed by DOD to manage the environmental impact of programs and business operations throughout the entire life-cycle. DOD selected NAWC, Lakehurst because of its successful environmental programs and recognized accomplishments. ISO-14001 requires the development of an umbrella environmental policy that is approved and supported by the base's highest level of authority. Any processes or activities that interact with the environment must be addressed under this policy. Priorities are set relative to the impact that activities have on the environment. Other requirements include establishing objectives and targets for compliance; documenting and sharing processes/procedures with site technicians and regulators; implementing a well-defined, but flexible EMS

structure which emphasizes good communications and documentation configuration control; applying metrics that accurately measure the results of improvements being made; and performing a self-assessment for site compliance and continuous improvement.

The project's two-year timeline indicates completion by March 1999. Since April 1998, NAWC, Lakehurst initiated a basewide environmental policy, and completed ISO-14001 coordinator training. Approximately 80 aspects have been identified and ranked, and the list is growing. By October 1998, targets of opportunity will have been identified, the EMS plan drafted, and the documentation control plan initiated. Full-scale training, documented procedures, an EMS manual, a documentation control program, and a metrics process are due for completion during the November 1998 to March 1999 timeline. NAWC, Lakehurst's accomplishments to date for the pilot program include a partnership with the Army, an on-line reporting capability with DOD, funding for the documentation control program, and an ISO website.

The successful completion of the pilot program at NAWC, Lakehurst will provide valuable input for DOD's evaluation and implementation of ISO-14001. In addition, this program will greatly enhance NAWC, Lakehurst's business opportunities.

Quality Assurance

Previously, NAWC, Lakehurst had a quality system that was modeled after MIL-Q-9858 and relied on policing methods. This quality system, typically used throughout the military and government, enlisted a standalone group that went out onto the manufacturing floor and performed quality reviews. Today, NAWC, Lakehurst employs a Quality Assurance (QA) process that integrates the quality group with the manufacturing department, and promotes a teaming approach to ensure product quality. By sharing the responsibility for quality assurance, the quality group and the manufacturing department can detect problems early and find applicable solutions.

The QA process is comprised of quality reviews; in-process reviews; final product evaluations; first article tests and evaluations; evaluations of fleet emergencies; and partnering with contractors. The quality review is an upfront planning effort that involves drawing reviews, manufacturing orders, and detailed QA requirements, and generally makes sure that QA is present at the start of a project. The in-process review involves destructive/non-destructive testing and material analysis, as well as ensures that the product is progressing through the manufacturing process. Various tools are used in this effort. One in particular, which has been very beneficial to NAWC, Lakehurst, is the coordinate measuring machine manufactured by Giddings & Lewis. This machine has more than paid for itself by providing inspection accuracy and repeatability, and by measuring complex and irregular-shaped objects without the need for unique inspection fixturing. Another noteworthy instrument is the Arc-Met 930 optical spectral emissions tester manufactured by Metorex. NAWC, Lakehurst uses this non-destructive testing tool to perform material analysis down to the carbon composition level.

Final product evaluation involves final testing and all necessary reporting and packaging requirements. First article test and evaluation is performed on new engineering designs and first-time vendor manufactures. Along with this, production lot testing on flight critical equipment is also performed. During Fleet emergencies, the quality group works with the engineering department to investigate Fleet problems, and provides resolutions that work immediately and throughout the operational life of the product. As for contracts, NAWC, Lakehurst has partnered with industry to accomplish numerous QA functions including source selection; first article test and product evaluation; QA program reviews; data package preparation; and configuration management.

Strategic Planning

Recognizing that its future viability and success will require dramatic and substantial changes, NAWC, Lakehurst has begun to implement a Strategic Planning process that will define and shape the future of the base. The base's primary mission, Aircraft Platform Interface, has been recognized as a critical niche to Naval Aviation. This recognition was the reason that NAWC, Lakehurst was one of the few installations to be removed from the proposed 1995 Base Realignment and Closure list. As the stewards of this unique and critical mission, NAWC, Lakehurst is preparing to implement a long term, disciplined process for strategic planning to meet the competitive challenges ahead.

NAWC, Lakehurst has chartered a full-time strategic planning team of senior managers to develop the overall approach. Their job is to characterize the changing environment, identify what needs to be done to respond to this environment, recommend how to proceed, and then sustain transformation efforts over

the long term. The disciplined process consists of scanning the environment, focusing in on what to do, and then acting. Scanning involves identifying the key drivers and lessons learned from others. Focusing includes envisioning the future, assessing the gaps, and developing strategies to achieve the desired future state. Acting includes developing and implementing detailed plans. Figure 3-2 depicts the strategic management model used by NAWC, Lakehurst. A key first step in characterizing the environment was to engage in dialogue with a number of relevant sources including key stakeholders and senior commanders as well as other installations such as Army and Air Force sites. This dialogue helped establish an environment favorable and receptive to change, and a realistic understanding of the challenges ahead.

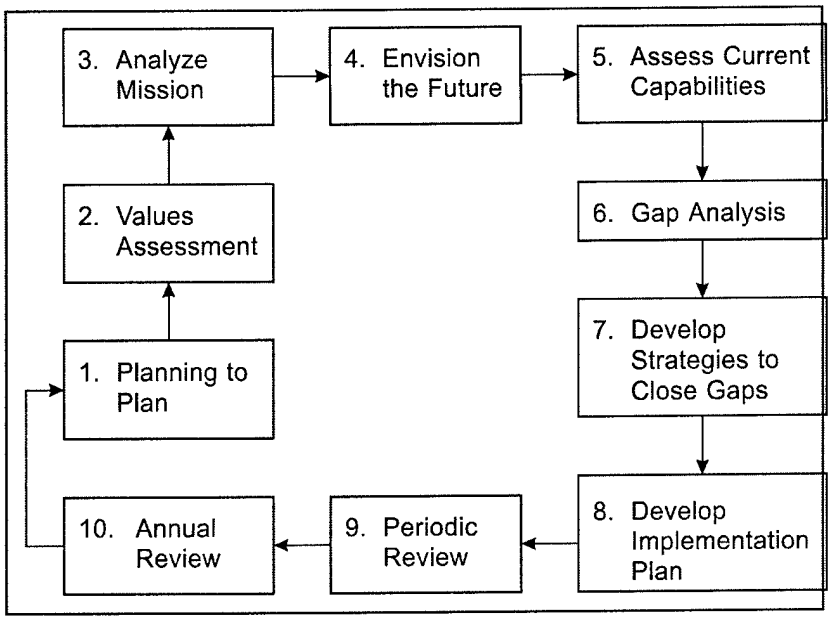


Figure 3-2. Strategic Management Model

Currently, the leadership team is involved in developing potential scenarios which will help to envision the future and assess current capabilities. This part of the process is designed to gather and transform information of strategic importance into fresh perceptions that result in better decisions about the future. This effort will provide the basis for developing the enabling strategies to achieve the desired future state. To date, three vision elements and seven enabling strategies have been proposed as a roadmap to the future, and are being reviewed and validated. The next steps will include combining the strategic planning team with the business development team; using effective communications to create a shared vision; defining in detail the vision elements and enabling strategies; and then implementing them.

Appendix A

Table of Acronyms

Acronym	Definition
ADP	Automated Data Processing
AETS	Aviation Engine Test System
ALRE	Aircraft Launch and Recovery Equipment
ALSP	Acquisition Logistics Support Plan
ATE	Automatic Test Equipment
CAFED	Computer Aided Filing for Engineering Drawings
CMM	Capability Maturity Model
COTS	Commercial-Off-The-Shelf
DART	Data Acquisition Receive and Transmit
DOD	Department of Defense
DSP	Defense Standardization Program
EDMS	Engineering Data Management System
EMS	Environmental Management System
ENVEIS	Environmental Engineering Information System
GFE	Government Furnished Equipment
GIS	Geographic Information System
IDP	Individual Development Plan
ILS	Integrated Logistic Support
IPT	Integrated Product Team
ISMPP	Integrated Sustained Maintenance Planning Process
JEDMICS	Joint Engineering Data Manufacturing Information Control System
KPA	Key Process Areas
LSAR	Logistic Support Analysis Record
MP	Maintenance Plan
MPCS	Manufacturing Planning Control System
MWR	Morale, Welfare, and Recreation
NAVAIR	Naval Air Systems Command
NAWC	Naval Air Warfare Center
NCSO	New Construction Ships Outfitting
NDI	Non-Developmental Item
NPL	National Priorities List

Acronym	Definition
PD	Provisioning Documentation
PMD	Prototyping and Manufacturing Department
PSMC	Parts Standardization and Management Committee
QA	Quality Assurance
RFD	Request for Quote
SDP	Software Development Plan
SE	Support Equipment
SEI	Software Engineering Institute
TEAPS	Training Execution and Personnel System
TEMP	Test and Evaluation Master Plan

Appendix B

BMP Survey Team

Team Member	Activity	Function
Larry Robertson (812) 854-5336	**Crane Division** **Naval Surface Warfare Center** Crane, IN	**Team Chairman**
Cheri Spencer (301) 403-8100	**BMP Center of Excellence** College Park, MD	**Technical Writer**
	Team 1	
Rick Purcell (301) 403-8100	**BMP Center of Excellence** College Park, MD	**Team Leader**
Larry Halbig (317) 306-3838	**Raytheon Systems Company** Indianapolis, IN	
RADM Robert Reimann USN (retired) (703) 444-9024	**Rumpf Associates International** Arlington, VA	
	Team 2	
Nick Keller (812) 854-5331	**Naval Surface Warfare Center** Crane, IN	**Team Leader**
Jack Tamargo (707) 642-4267	**BMP Satellite Center** Vallejo, CA	
Nick Tambakis (301) 403-8100	**BMP Center of Excellence** College Park, MD	

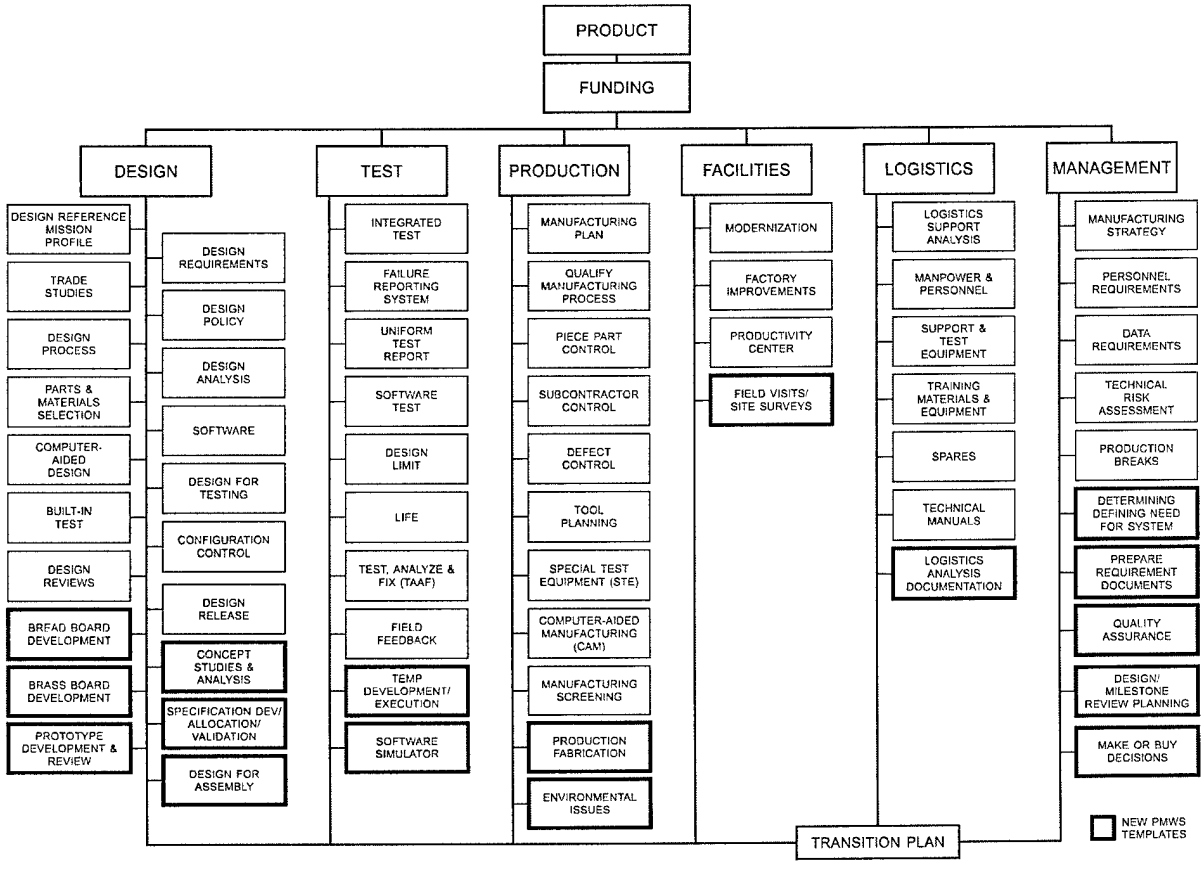
Appendix C

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.

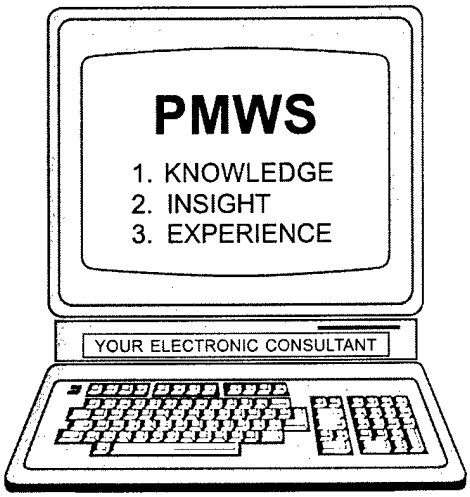
"CRITICAL PATH TEMPLATES FOR TRANSITION FROM DEVELOPMENT TO PRODUCTION"



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 nine 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 nine 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

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257 Cottonwood Drive
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(707) 642-4267
FAX: (707) 642-4267
jtamargo@bmpcoe.org

District of Columbia

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(202) 482-8236/3795
FAX: (202) 482-5650
cweller@bxa.doc.gov

Illinois

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BMP Satellite Center Manager
Rock Valley College
3301 North Mulford Road
Rockford, IL 61114
(815) 654-5515
FAX: (815) 654-4459
adme3tc@rvcux1.rvc.cc.il.us

Iowa

Bruce Coney
Program Manager
Iowa Procurement Outreach Center
200 East Grand Avenue
Des Moines, IA 50309
(515) 242-4888
FAX: (515) 242-4893
bruce.coney@ided.state.ia.us

Louisiana

Dr. Kenneth L. McManis
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Gulf Coast Region Maritime Technology Center
University of New Orleans
810 Engineering Building
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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 Great Lakes 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
c/o GLCC, Inc.
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
One International Plaza
Suite 600
Philadelphia, PA 19113
(610) 362-1200
FAX: (610) 362-1290
criswell@aci-corp.org

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
c/o Concurrent Technologies Corporation
100 CTC Drive
Johnstown, PA 15904-3374
(814) 269-2532
FAX: (814) 269-2501
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
1250 Arthur E. Adams Drive
Columbus, OH 43221-3585
(614) 688-5096
FAX: (614) 688-5001
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, and safe energetics. The focus of the EMTC is on process technology with a goal of reducing manufacturing costs while improving product quality and reliability. The EMTC 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
101 Strauss Avenue
Building D326, Room 227
Indian Head, MD 20640-5035
(301) 744-4417
DSN: 354-4417
FAX: (301) 744-4187
mt@command.ih.navy.mil

Institute for Manufacturing and Sustainment Technologies

The Institute for Manufacturing and Sustainment Technologies (iMAST), was formerly known as Manufacturing Science and Advanced Materials Processing Institute. Located at the Pennsylvania State University's Applied Research Labortory, the primary objective of iMAST is to address challenges relative to Navy and Marine Corps weapon system platforms in the areas of mechnical drive transmission techologies, materials science technologies, high energy processing technologies, and repair technology.

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

National Network for Electro-Optics Manufacturing Technology

The National Netowork for Electro-Optics Manufacturing Technology (NNEOMT), a low overhead virtual organization, is a national consortium of electro-optics industrial companies, universities, and government research centers that share their electro-optics expertise and capabilities through project teams focused on Navy requirements. NNEOMT is managed by the Ben Franklin Technology Center of Western Pennsylvania.

Point of Contact:
Dr. Raymond V. Wick
National Network for Electro-Optics Manufacturing Technology
One Parks Bend
Box 24, Suite 206
Vandergrift, PA 15690
(724) 845-1138
FAX: (724) 845-2448
wick@nneomt.org

Gulf Coast Region Maritime Technology Center

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

Point of Contact:
Dr. John Crisp, P.E.
Gulf Coast Region Maritime Technology Center
University of New Orleans
College of Engineering
Room EN-212
New Orleans, LA 70148
(504) 280-3871
FAX: (504) 280-3898
jncme@uno.edu

Manufacturing Technology Transfer Center

The focus of the Manufacturing Technology Transfer Center (MTTC) is to implement and integrate defense and commercial technologies and develop a technical assistance network to support the Dual Use Applications Program. MTTC is operated by Innovative Productivity, Inc., in partnership with industry, government, and academia.

Point of Contact:
Mr. Raymond Zavada
Manufacturing Technology Transfer Center
119 Rochester Drive
Louisville, KY 40214-2684
(502) 452-1131
FAX: (502) 451-9665
rzavada@mttc.org

Appendix G

Completed Surveys

As of this publication, 106 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
	Northrop Grumman Corporation - El Segundo, CA
	(Resurvey of Northrop Corporation Aircraft Division)
	Letterkenny Army Depot - Chambersburg, PA
	Elizabethtown College - Elizabethtown, PA
	Tooele Army Depot - Tooele, UT
1998	United Electric Controls - Watertown, MA
	Strite Industries Limited - Cambridge, Ontario, Canada
	Northrop Grumman Corporation - El Segundo, CA
	Corpus Christi Army Depot - Corpus Christi, TX
	Anniston Army Depot - Anniston, AL
	Naval Air Warfare Center, Lakehurst - Lakehurst, NJ