REPORT OF SURVEY CONDUCTED AT
RAYTHEON
NETWORK CENTRIC SYSTEMS
MANUFACTURING CENTER
LARGO, FL
FEBRUARY 2007
This report was produced by the Office of Naval Research’s Best Manufacturing Practices (BMP) Program, a unique industry and government cooperative technology transfer effort that improves the competitiveness of America’s industrial base both here and abroad. Our main goal at BMP is to increase the quality, reliability, and maintainability of goods produced by American firms. The primary objective toward this goal is simple: to identify best practices, document them, and then encourage industry and government to share information about them.

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

BMP identifies and documents best practices by conducting in-depth, voluntary surveys such as this at Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida. 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 that include CD-ROMs and a World Wide Web Home Page located on the Internet at http://www.bmpcoe.org. The actual exchange of detailed data is between companies at their discretion.

Raytheon Company is comprised of six major businesses that include Network Centric Systems (NCS), Missile Systems, Integrated Defense Systems, Space & Airborne Systems, Intelligence & Information Systems, and Raytheon Technical Services Company. Raytheon’s integrated businesses assure mission success with a broad range of products and services in defense, homeland security, and other government markets throughout the world. The BMP Survey was conducted at Raytheon’s NCS Manufacturing Center in Largo, Florida, the week of February 19, 2007.

The BMP Program is committed to strengthening the U.S. industrial base. Survey findings in reports such as this at Raytheon’s NCS Largo Manufacturing Center 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.

Rebecca Clayton
Director
Best Manufacturing Practices
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Section 1

Report Summary

Background

Raytheon Company is a technology leader specializing in defense, homeland security, and other government markets throughout the world. With a history of innovation spanning 85 years, Raytheon provides state-of-the-art electronics, mission systems integration, and other capabilities in the areas of sensing, effects, command and control, communications and intelligence systems, and a broad range of mission support services. The company’s six major businesses include Network Centric Systems, Missile Systems, Integrated Defense Systems, Space & Airborne Systems, Intelligence & Information Systems, and Raytheon Technical Services Company. The BMP Survey was conducted at the Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, the week of February 19, 2007.

With headquarters in McKinney, Texas, Raytheon NCS develops and produces mission solutions for networking, command and control, battlespace awareness, and air traffic management. Programs include civilian applications, command and control systems, integrated communications systems, and netted sensor systems. NCS serves all branches of the United States military, the National Guard, the Department of Homeland Security, the Federal Aviation Administration, and other U.S. national security agencies as well as international customers. The NCS Largo, Florida, facility designs, develops, manufactures, and supports products, systems, and software that provide critical command, control, and communications capabilities that include antennas, radios, cables, and vehicle integration parts. Ninety-five percent of the products manufactured are for the military at Largo’s 343,000-square-foot facility, where product designs are received from five NCS design centers that support 28 major programs. NCS design centers are located in Marlborough, Massachusetts; St. Petersburg, Florida; Fort Wayne, Indiana; Towson, Maryland; and Fullerton, California.

The NCS Largo facility is home to 725 Raytheon employees, 60% of whom are manufacturing personnel. The remaining 40% of the Largo facility population work in functions such as Quality, Security, Contracts, Engineering, Facilities, Finance, Information Technology, Supply Chain, and Human Resources. Supply Chain is approximately 15% of the Largo workforce.

The facility that houses the Largo Manufacturing Operations dates back to 1956 when it was constructed by General Electric (GE). It was then sold to the Atomic Energy Commission who, in return, awarded GE a contract to operate the facility for 25 years. In March 1995, the Department of Energy sold the Pinellas Plant to the Pinellas County Industry Council. The name of the facility changed to the Pinellas Science, Technology and Research (STAR) Center.

Raytheon became the STAR Center’s anchor tenant in August 1998 and leases approximately 42% of the Center’s space. The same year, the Pinellas STAR Center was renamed the Young-Rainey STAR Center to honor two Pinellas residents most influential in making the Center successful – Congressman C. S. Young and Charles Rainey, former chairman of the Pinellas Country Board of County Commissioners.

In July 1998 Raytheon combined 11 manufacturing sites into one at the Young-Rainey STAR Center to blend and leverage the superior capabilities by consolidating manufacturing and establishing centers of excellence. Raytheon’s consolidation efforts focused on opportunities to improve efficiency and schedule performance, which was accomplished by consolidating manufacturing for efficient facility use, deploying best manufacturing systems and processes, establishing manufacturing core competencies, linking product design with production capabilities, and realizing increased purchasing power. While the Largo site provided a single manufacturing facility with optimal size, location, and cost, the Tampa Bay area provided a solid resource of professionals with its three million residents, many colleges and universities, government and military installations, and abundance of high-tech and manufacturing businesses. The area is also strongly supported by local, state, and federal governments and offers an attractive quality of life and highly competitive wages.

Raytheon Largo has made great strides to improve business and growth under very progressive leadership with a directed vision for the future suc-
cess of the business. Management has a solid understanding of the Raytheon culture, especially the principles of Raytheon Six Sigma (R6S). More than 600 Largo employees are currently trained in R6S, with the facility’s goal to fully implement lean across the organization in support of its lean vision “to become the supplier of choice through a culture where all employees strive for manufacturing perfection using lean thinking.”

One of Raytheon Largo’s key processes is its Integrated Product Development System (IPDS), which facilitates the successful management of complex systems. By maintaining a thorough and well-developed 10-gate review process, Raytheon ensures improved decision-making capability through the full product life span, from proposal development through program shutdown. The goal of the IPDS is to mitigate risks so that transition to production is smooth and predictable performance. The IPDS is systems-engineering-focused and fully supports Raytheon’s direction toward being a premier Department of Defense (DoD) systems integrator.

Raytheon Largo places great emphasis on the well-being of its employees and has implemented a variety of processes to ensure that Human Resources has a system for identifying, mentoring, and providing career growth paths for employees and a rotational program that keeps employees motivated and reenergized. Another outstanding program at the Largo facility is the Diversity and Inclusion process that focuses Employee Resource Groups (ERGs) on common goals for individual and business growth. All ERGs are tied together under the Raytheon Leadership Diversity Council (RLSDC) that focuses on areas of mentoring, diversity, and training.

Some of Raytheon Largo’s most impressive processes are its Point-of-Use Replenishment System (POURS), Supplier-Managed Inventory (SMI), and Supplier-Owned Inventory (SOI) – an innovative way to minimize working capital. Procurement groups are now better aligned through improved material planning and strategic commodity management system. By outsourcing many of its processes such as paint systems, environmental testing, and machine piece parts, the Largo facility is able to focus on its core competencies: assembly, integration, and test.

Raytheon Largo also has an impressive Mentor-Protégé Program with Tampa Brass & Aluminum (TBA), a small, disadvantaged, veteran-owned manufacturing company in Tampa, Florida. The Largo Mentor-Protégé program has improved the capabilities and core competencies of TBA, which has improved TBA’s ability to provide quality castings and machined parts that fully support DoD customers and ultimately the warfighter. Raytheon Largo began its mentoring program by training TBA employees in Six Sigma. A single-process flow was developed and implemented along with other Lean/agile manufacturing processes.

Raytheon Largo has maintained a 97% on-time delivery rating, a 97.5% quality rating, and ISO 9001:2000 certification. Strategic planning was improved by initiating a 5-year strategic plan, capacity-planning analysis, a facilities layout expansion plan, and business systems integration and training. These improvements resulted in a 15% increase in revenue, a 13% increase in new business, a 12.5% increase in new customers, and a 400% increase in new business capture.

The BMP Survey Team congratulates Raytheon’s NCS Largo Manufacturing Center for winning the 2007 Best Manufacturing Practices Award for Excellence and considers the following practices in this report to be among the best in industry and government.

**Point of Contact:**

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

Mr. Thomas Greenawalt
Business Area Manager
Tactical Communications Systems
Raytheon Network Centric Systems Manufacturing Center
M/S 2580
7887 Bryan Dairy Road
Largo, Florida 33777
Phone: 727-768-8423
Fax: 727-768-8399
E-mail: Thomas_H_Greenawalt@raytheon.com
Web site: www.raytheon.com
Section 2
Best Practices

Design

Engineering Assembly Shop Rapid Prototyping

Raytheon Network Centric Systems’ Engineering Assembly Shop located at the company’s Fort Wayne, Indiana facility provides design engineering a complete resource for rapid prototyping by implementing a parametric, model-driven process for electrical and mechanical assembly at the company’s Largo Manufacturing Center. The use of Pro-E design tools has enabled the Engineering Assembly Shop to develop a more producible product for the Largo facility, which has significantly reduced time and cost and improved product quality.

The Raytheon Network Centric Systems (NCS) Fort Wayne, Indiana facility houses the Engineering Assembly Shop (EAS) that designs the engineering work prior to its transition to production at the company’s NCS Manufacturing Center in Largo, Florida. EAS provides electrical and mechanical prototyping, including inspection and testing, in a rapid-response fashion for design engineering using Pro-E model-driven design tools to develop three-dimensional (3-D) models for use by Largo Manufacturing personnel.

The former EAS process was driven by paper documentation designed and created by engineers as a two-dimensional drawing package, which ultimately resulted in inferior configuration control. Parts were fabricated and assembled by interpreting the paper-based Technical Data Package, a method that was both time-consuming and labor-intensive, with proof of design not possible until after the fabrication of the first piece. Mechanical parts were machined from drawings, an expensive process that resulted in many mistakes and changes. Engineering changes and redlines were common. Any design-for-producibility function was accomplished after the design baseline.

The new rapid prototyping process is model-driven, with engineers designing and creating 3-D parametric models in less time. Information necessary for fabrication and assembly is contained in and annotated on the model. Proof of Design and Design for Producibility are accomplished prior to fabrication and assembly using software tools. The model directly drives the fabrication both in-house and at outsource locations including nonmetallic rapid prototyping machines at Raytheon NCS in McKinney, Texas and Raytheon NCS in Indianapolis. Assembly is paperless, enabling technicians to view, explode, section, and annotate the model and component part information.

Raytheon’s use of the Pro-E model design tool has enabled engineers to design and create mechanical parts in a paperless assembly process that provides detailed model requirements for use by technicians to view, explode, section, and annotate the model and its component part information before it is sent to the Largo Manufacturing Center, eliminating costly mistakes and man-hours. Any changes required are now made to the model prior to production, which reduces configuration management activities. Product quality is also enhanced through analysis, configuration control, assembly, and inspection.

Integrated Product Development System – Concurrent Engineering

Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, implemented an Integrated Product Development System concurrent engineering approach that is a shift from the previous design-centric system to one where the design and manufacturability of a newly developed product are taken into consideration throughout the entire product life cycle. By continually focusing on the design, manufacturability, and testability of a new product, Raytheon mitigates the risk of encountering problems when a new product is ready for production.

Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, has implemented a new system for internally reviewing new business opportunities that benefits both the contractor and the customer. By establishing a thoroughly developed Gate-10 Review process, Raytheon ensures an improved decision-making capability that captures variables from the proposal development phase through program shutdown. The improved product
development concurrent engineering approach also employs the use of standardized tools such as DFSS, factory simulation, and the Process Capability Analysis Toolset that quantifies the impact of key design features and characteristics of manufacturing processes, enabling trade-offs early in the design process. The goal of the Integrated Product Development System (IPDS) concurrent engineering approach is to mitigate risks so that transition to production is smooth and predictable, resulting in fewer (if any) surprises for the contractor and the customer.

Prior to using the new approach, Raytheon's product development was generally heavily design-focused, while the manufacturing elements of the new design were frequently an afterthought. As a result, certain programs transitioned from design to production with risks that impacted cost and schedule and contained a high volume of engineering change orders. The actual assembly, inspection, and test labor hours could exceed those Raytheon bid in its proposals. The assessment of any new product design was being performed too late at what is now considered the Gate-10 Review.

Raytheon now utilizes the IPDS Concurrent Engineering process on all development projects such as the Common Cabinet Design. In early 2007, Raytheon Largo held a six-week workshop with the goal of reducing common cabinet unit costs by 15% from its proposal baseline by improving and using common hardware, investigating common interconnect methods, and investigating common lowest-replaceable unit mountings. After brainstorming from a design and manufacturing approach and utilizing the IPDS design approach and common toolsets, Raytheon was able to significantly reduce the number of screws for electromagnetic interference cabinets at a cost savings of $504 per unit (or $7,500 per system).

The new IPDS Concurrent Engineering process is highly systems-engineering-focused, which is the direction Raytheon is taking to stand out as a systems integrator. From contract pre-award to production, this new product development system provides Raytheon management an internal review processes that gives equal and combined emphasis to product design and manufacturing.

The NCS Lean Maturity Model was developed in order to measure and track an enterprise’s progress toward becoming lean. It defines twenty categories of Lean Behavior that are scored. It will also assist organizations in developing a roadmap to become more lean by assisting them in understanding the practices, processes and behaviors exhibited by a lean enterprise.

**Figure 2-1. The NCS Lean Maturity Model**
Production

Lean Manufacturing

The implementation of Raytheon’s Network Centric Systems Lean Maturity Model has provided a needed measurement structure for tracking the progress of its Largo, Florida, facility in implementing Lean concepts and practices and for providing assistance in understanding the behaviors exhibited by a Lean enterprise. The model is driving positive changes in the way business is conducted at the Largo facility.

Prior to 2004, Raytheon’s Network Centric Systems’ (NCS’) Largo facility did not have an effective system in place to monitor its progress in applying Lean concepts within the operation. This led to a benchmarking effort both within and outside of Raytheon’s NCS business segment and ultimately to the development of the NCS Lean Maturity Model (LMM) in Figure 2-1. In tracking the progress of an enterprise toward becoming Lean, the LMM defines 20 categories of Lean behavior with scoring criteria and serves to assist in understanding Lean practices, processes, and behaviors. Both internal and external assessments are conducted on a yearly basis.

One of the central tenets of the LMM model involves a “product- /customer-focused organization.” As a result, Raytheon Largo has initiated a value stream organization structure that creates cross-functional Integrated Product Teams (IPTs) to ensure product focus and maintain functional consistency. The IPT approach has led to real savings in a short period of time. As an example, the transmitter module’s IPT achieved a 72% decrease in cycle time, a 36% increase in throughput, and a 25% decrease in labor cost within days of initial implementation.

Senior management has placed particular emphasis on implementing Lean in inventory in 2007, with significant goals to cut inventory levels and to increase inventory turns as illustrated in Figure 2-2. Raytheon Largo has also developed a “Lean Acceleration Gate Matrix” to maintain a commitment from all value streams to accelerate their Lean implementation.

Figure 2-2. Largo Inventory Turns and Metric for 2007
Micro D FOD Elimination

Raytheon’s Network Centric Manufacturing Center in Largo, Florida, implemented a Foreign Object Debris Elimination process to build cables that contain Micro D connectors. The unique requirements of the customer to X-ray, inspect, and clean the connectors has resulted in a 99.7% acceptance rate.

In September 2005 Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, began manufacturing Micro D cables for the Missile Defense Agency (MDA). Micro D connectors are used to connect the communications cables in missile guidance systems with pins that are only 0.050 of an inch apart. The connector cannot contain any particles or foreign object debris (FOD) larger than 0.030 of an inch, roughly the thickness of a human hair (Figure 2-3). Because FOD detected in a cable connector renders the cable useless, the MDA required Raytheon Largo to photograph and X-ray every connector at each step of the manufacturing process, which resulted in each cable being photographed and X-rayed more than 150 times before completion of the final product.

Prior to 2005, the Raytheon Largo facility had no process implemented for FOD elimination in its manufacturing environment. Cables were manufactured in an area with overhead lighting, minimal traffic control, benches, and tooling on wheels. Material was stored in the work area in kits until use, and packing material was recycled for future use. The process was a single-station manufacturing process with shared test, inspection, engineering, and material resources. No specialized training was given to any employees, which resulted in a large amount of costly rework on rejected cables.

Raytheon Largo contacted several other companies in the semiconductor industry to gain knowledge in developing a FOD-free environment. Using the knowledge gained from other FOD-elimination experts, Raytheon Largo set up an enclosed Process Cell Isolation manufacturing area with access limited to a small number of vital employees who had taken FOD training. Tooling, shop supplies, chemicals, and cleaning agents were controlled and all personal items were removed to eliminate all possible sources of FOD, tooling. Benches, ovens, microscopes, cameras, chairs, waste baskets, and vacuum cleaners were studied and replaced if found to produce FOD. A material control plan that included component security and tracking throughout the build process was implemented along with a cleaning procedure, with a process control plan developed to assign and control test cables, soldering sequence control, use of connector savers, dedicated test and X-ray machines, audits, and the required use of laboratory coats. The Largo facility also established a partnership with a local company to receive the benefit of an independent and professional high-quality X-ray to ensure Raytheon Largo and its customer an acceptable FOD-free product.

Raytheon Largo’s Micro D FOD Elimination process has resulted in predictable and sustainable throughput, with first-past and test yields exceeding 99% and FOD eliminated in 99.7% of the interconnects manufactured. Cycle time has also been reduced 50%, and there has been a significant reduction in regressive flow. Process controls enacted identify potential issues as they occur. This process has also been recognized as a best practice by the MDA and the Center for Advanced Technologies.

Figure 2-3. Example of FOD
Overhaul and Repair Turnaround Time

Raytheon’s Network Centric Systems Largo, Florida, facility has consolidated its overhaul and repair operations and established common practices and standardizations that have resulted in significant improvements in the turnaround times for overhaul and repair items.

Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, is a consolidation of 15 separate manufacturing sites consisting of 80 programs and 7,000 to 9,000 warranty and non-warranty repair items processed annually. With no existing standard operation numbers, gathering plantwide data was almost impossible. The facility lacked a common reporting tool or common set of metrics, and Largo’s priorities were not aligned with Raytheon companywide initiatives. Hundreds of support hours were spent each month gathering program data, leaving little time to improve processes. Production activities received more attention than overhaul and repair activities, while support costs continued to escalate in the absence of long-term pricing agreements.

Raytheon Largo created an Overhaul and Repair (O&R) Organization to focus specifically on making overhaul and repair improvements at the Largo site. Long-term pricing agreements were forged with most major customers in which each customer pays a set price for every item repaired. The “alpha-like” contract is repriced and negotiated annually. The Largo facility also developed common practice guidelines for use by all overhaul and repair programs, standardized operation numbers to facilitate data gathering and mining, a Web-based work-in-process analysis tool, and a monthly reporting tool for site metrics to provide the information needed by management.

Raytheon Largo has successfully established O&R turnaround time (TAT) as a Raytheon “mission assurance” initiative. The average dock-to-dock TAT has been reduced from more than 180 days to typically less than 120 days. Administrative costs have been reduced by 50%, while plantwide data gathering and charting have been reduced from two weeks to six minutes.

Point-of-Use (POU) Replenishment System, Supplier-Managed Inventory (SMI), and Supplier-Owned Inventory (SOI)

In response to a challenge from manufacturing operations to improve material presentation, Supply Chain Management initiated a movement to a material management system aligned with how that hard-

Figure 2-4. Standard SOI Process
ware is consumed. The change has resulted in the elimination of processing time and space utilization as well as unnecessary working capital investment.

Raytheon’s Network Centric (NCS) Systems Largo, Florida, facility implemented significant improvements in the way material is procured and delivered to the end user within the operation after Supply Chain Management leadership was challenged to reduce the need for kitting and to establish a pull system for buy parts with signals going directly from the point of use (POU) to suppliers. Prior to this change, scheduled material receipts were aligned to operating system need-dates that did not accurately reflect usage. Time was required to convert requisitions to purchase orders, and POU inventory was managed only at the work-center level and was often inaccurate. The replenishment process was cumbersome and wasteful.

Supply Chain Management responded with a modified Material Management System based on POU replenishment, Supplier-Managed Inventory (SMI), and Supplier-Owned Inventory (SOI). The new POU Replenishment System revolves around electronically generated pull signals that feed directly to the supplier and rely on accurate inventory information coded to identify inventory to a specific bin within a work center. The SMI and SOI processes apply to material with predictable demand rates and require the supplier to have material available upon receipt of the pull signal from the factory. In the SMI process, the point of sale for the material occurs when received into the POU. The point of sale for the higher-value material occurs at a negotiated time in the SOI process, desired to be after installation and checkout of the unit in its next-higher assembly (Figure 2-4).

The changes have resulted in an automated pull system at the Largo facility complete with purchase order generation and receipt generation, reduced administrative processing time, and an 84% reduction in lead-time for SMI items. Combined with the SOI process, the changes have led to a reduction in the demand for inventory storage space and have improved cash flow by reducing working capital and increased material turns. The SOI process also benefits the supplier due to a better understanding of demand trends, improved communication, and a partnering relationship. This has led to an improvement in Supplier Rating System performance and the potential for additional business.

Production Readiness Review

Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, has standardized and implemented a Production Readiness Review process that confirms a production baseline definition and affordability and authorizes proceeding with either low-rate initial production or full-rate production. Thorough gate reviews and discipline subchecklists provide a complete review and eliminate the subjectivity in establishing pass/fail criteria for determining preproduction readiness and management authorization to proceed to production.

Prior to the implementation of a standardized Production Readiness Review (PRR), Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, lacked a formal preproduction readiness review process. There were no standard checklists or formal review requirement, pass/fail criteria was largely dependent on the knowledge of the reviewer, fewer topics were generally reviewed, and a less formal and rigorous process resulted in products being transitioned to manufacturing before they were ready.

In 2005, Raytheon Largo developed the Integrated Product Development System (IPDS) to standardize a formal Production Readiness Review (PRR) system in its Gate-10 PRR process. An extensive and comprehensive PRR checklist was developed to cover all aspects of production, including program management, structure, resources, and development as well as integration, verification, and validation plans. As part of the checklist, the Largo facility included a supply chain review to ensure obsolescence risks were addressed and mitigation plans were in place prior to production. All areas on the checklist were reviewed during the various IPDS stages so that all documentation and planning were thoroughly assessed at the Gate-10 review.

To eliminate program bias from influencing the Gate-10 PRR, Raytheon developed a system in which five or six independent subject matter experts (SMEs) were assigned to each PRR. By assigning the PRR to SMEs who were not part of the program and did not work on the earlier gate reviews, Raytheon Largo gained a fresh perspective and an independent review of a product’s readiness for production. If the PRR team was unable to find necessary documentation or plans identified in the PRR checklist, program team members would be contacted and assigned action items as necessary.
The results of implementing the PRR process have been documented and Raytheon Largo is now able to conduct consistent and thorough reviews prior to production. In 2006, the Largo facility conducted 30 PRRs of which 22 programs passed, 5 conditionally passed (i.e., action items were given), and 3 did not pass. These mandatory reviews have significantly reduced the risk in transitioning products to production, benefiting both Raytheon Largo and its customers.

Rapid Response

Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, has implemented a Rapid Response initiative focused on improving customer service by providing quick turnaround on bids and proposals, prototyping requests, and short-run production requests. The new approach has resulted in a significant reduction in process cycle time while better positioning the company to capture emergent business in the future.

Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, has implemented a Rapid Response initiative designed to drive growth by reducing turnaround time for bids/proposals, prototyping and production efforts. In the past, bids and proposals were frequently delayed by an inflexible bid process and the time required to organize a proposal team and receive material pricing for a complex bid. Limited capability existed at the Largo facility to handle quick turnaround production or repair requests.

Since March 2006, the Rapid Bid process has provided the flexibility to tailor the bid activity (including approval loops) depending on customer, type of contract, and technical data package status. Tailoring is decided by bid teams consisting of Value Stream Leaders and personnel representing Bids and Proposals, Manufacturing Engineering, Test Engineering, and Supply Chain Management functions. Strategies include using “similar-to” material pricing data and procurement data from other sites if same part numbers have recently been procured. Resulting bid turnaround times have significantly improved, ranging from 2 days to 19 days (previously 24 days to 60 days). A “Quick Reaction” production work area has also been established and staffed with skilled labor and support capacity, providing capability to quickly execute special requests.

Raytheon Largo intends to expand the scope of this initiative by engaging with both internal and external resources to form an infrastructure prepared to respond quickly to emergent needs. This approach provides a competitive edge, facilitating getting to market first.

Rapid Response (webplan)

In an effort to overcome limitations imposed by an aging operating system, the Raytheon Network Centric Systems Operations Systems team in the company’s Largo, Florida, facility developed a software solution to allow operating data to be extracted into various formats for use by functional organizations. Improved accessibility to data has eliminated the time spent searching through multiple screens, while increased accuracy in material tracking and added simulation capability have allowed more accurate responses to customer requests.

Prior to 2001, Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, was operating in an environment where extracting data from an aged Manufacturing Resource Planning (MRP) system was constrained by limitations of the system itself. With fragmented data obtainable only by accessing multiple screens and data extract tools requiring expensive and time-consuming programming, Largo was unable to gather meaningful reports needed to accurately monitor and/or trend operational performance. Process stakeholders could not easily obtain shortage information, visibly link supply to demand, or simulate capabilities based on part information.

This scenario changed in May 2001 when the company launched Rapid Response (webplan), a new capability to provide detailed reporting of operating system data in customized formats as designated by individual users or functional groups. Data are pulled directly from MRP into webplan and presented in customized Excel-based formats determined by the user. For example, the “Line-of-Balance Report” (Figure 2-5) serves as a visual indicator of manufacturing status in relation to MRP schedules, with color coding to highlight areas that require attention; the “Cycle Count” form is used to generate random lists for government inventory accuracy audits based on auditor input; the “Purge Process” form is used to identify the location of all
units of a particular part number within the factory or on a purchase order in case of emergent problems, which includes units in inventory, on open work orders, installed in next-higher assemblies, and on open purchase orders; and the “Raytheon Enterprise Material Sourcing” report is used to provide visibility of material needs to the corporate level to support companywide purchasing agreements.

The Rapid Response (webplan) capability now provides critical information needed across the Raytheon NCS operation to be available at a glance. Inventory valuation by program and location is immediate; shortage information is readily available and specific to work order; purchase orders and work orders can be visibly linked to independent demand; and Production Control and Procurement personnel can now collaborate online. Forecasting of capabilities is also more accurate since “what-if” scenarios can now be simulated based on part lead-time information to determine critical path.

Prior to 2003, Raytheon Network Centric Systems’ (NCS) Manufacturing Center in Largo, Florida, was not obtaining data on manufacturing products that were being reworked, reinspected, and retested (also referred to as regressive flow). Raytheon’s focus was on nonfinancial quality metrics such as yield and failures per unit. There was no insight into the cost of these issues or the resources expended in solving these problems. Raytheon had no data analysis tools to link failures to dollars spent correcting them, resulting in a lack of program focus and the

Regressive Flow/Structured Quality Information Data System

The use of regressive flow tools has given Raytheon’s Network Centric Systems Manufacturing Center teams the ability to identify the problems that are costing the most money and labor. The Largo, Florida, facility has shown steady improvement in regressive flow over the last four years, leading to bottom-line savings.
inability to identify and resolve systemic problems.

In 2003 Raytheon Largo initiated a plan to capture data utilizing the Structured Quality Information Data System (SQUIDS). SQUIDS compiles data in the areas of rework, reinspection, retest, troubleshooting, and data pertaining to engineering change notifications. This information enables teams to focus on the problem areas dealing with regressive flow. Year-to-date regressive flow issues improved 58% from inception in 2003 to January 2007 (Figure 2-6), a testimony to the success of the regressive flow analysis tools that provide program visibility, while the available data can link a dollar figure to assembly, inspection, and test. It also provides improved prioritization capability that focuses on how much is being spent and where it is being spent. This provides Raytheon with an overall site picture as well as individual program performance metrics. SQUIDS is able to link regressive flow activity to product indenture level (system, unit, module, CCA) and identify the category of failure that caused the regressive flow, enabling Raytheon Largo to prevent costly rework efforts (Figure 2-7).

Wire Assembly Work Directors

Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, has made changes to its wire/cable harness operations that greatly reduce the build errors and subsequent rework, resulting in lower overall cost and higher reliability. With the changed method of building and testing wiring harnesses concurrently, the company has been able to virtually eliminate rework due to wiring errors and reduce build cycle times by a factor greater than 4.

The building of cable and wiring harness assemblies is an exacting and time-consuming process. Any errors in the build process are not normally discovered until the completed harnesses are subjected to test and then must be sent back to the assembly area for repair/correction. This added “regressive flow” or rework contributes to added costs and possible added cable failures due to handling. Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, has made changes to its wire/cable harness operations that greatly reduce the build errors and subsequent rework, resulting in lower overall cost and higher reliability.

Many wiring harness manufacturers will typically determine the approximate length, type, and color of each wire in a harness; cut and mark the wire; terminate one end of the wire with crimp or solder pins; bundle all of the wires into a wire bundle; and pass this bundle on to an assembly person to complete the harness. Using assembly aids such as wiring harness boards, wiring tables, from-to paper wiring lists, and other aids, the assembly individual will then build the cable harness. Terminated wires are installed into one connector of the harness; wire numbers or other identifications are located on each wire; and that wire is prepared, terminated, and installed into the proper location of the connector at the end of the harness. This method is extremely labor-intensive and lends itself to many errors.

Raytheon Largo has changed the method that it uses to manufacture many of its wiring harness assemblies to improve quality and reduce errors, rework, and cycle time. By using a commercially available PC-based Cirris system, Raytheon Largo has been able to replace many of the old assembly aids with a highly reliable and accurate process for the assembly build operators. The new system, coupled with a mechanical interface, allows the operator to search a prepped wire bundle for wires through body conductance in lieu of visually looking for wire mark-
eng or identification. The operator then receives an initial visual and audible prompt that the correct wire has been selected followed by a second audible and visual prompt that the wire has correctly been terminated at its other end. This process is a “verify-as-you-go” approach that provides real-time feedback at each incremental level of harness assembly. This system uses wiring instructions guided by electronic media with enhanced graphics. The operator can see the proper wire termination point on the screen and is guided by color coding of the proper point, receiving audible verification that the wire is installed into the proper connector pin location.

Since implementing the Cirris system in 2003, Raytheon Largo has seen first-pass yields grow from approximately 82% to 98%, typical harness build cycle times have decreased by a factor greater than 4, and regressive flow due to missed wires has been virtually eliminated. All of this has yielded significant cost reductions for the company in the cable and wiring harness along with increased quality. By not having to handle the harness assemblies to test for continuity, test times are reduced and handling-induced wire breakage is eliminated.

Facilities

Energy Conservation

Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, has implemented an aggressive energy conservation program that has reduced kilowatt-hour consumption by 11% from 2005 to 2007. Grassroots efforts initiated by employee volunteers have transformed the company culture at the Largo facility, increasing awareness and stimulating interest in energy conservation.

When the Raytheon Network Centric Systems Manufacturing Center in Largo, Florida, came online in April 1999, the facility lacked a formal energy management program. As Raytheon’s use of floor space in the county-owned facility grew, several managers realized an effective energy conservation program was necessary. The goal of reducing energy consumption in a leased facility was challenging, but in the fall of 2005 several employees formed the Energy Committee. Members of the newly formed committee reviewed power usage in the facility and immediately identified an increase in kilowatt-hour power consumption from 19,431,519 in 2004 to 21,659,418 in 2005. The committee further determined that roughly 45% of the energy consumption was tied directly to the HVAC and that reducing HVAC costs would prove to be difficult in a county-owned facility.

The Energy Committee realized that implementing an effective energy conservation policy would require heightened employee awareness to stimulate interest and generate creative solutions. The facility landlord, representing the county, was invited to be a part of the team and work with Raytheon team members to develop short- and long-range plans for energy conservation upgrades at the facility. This included implementing changes that went beyond changing out traditional light bulbs for fluorescents. Raytheon worked with the county to set the air-conditioning at 77 and the heat at 68. While the change was initially unpopular, employees quickly worked with facility managers to monitor and balance air circulation throughout the factory to eliminate uncomfortable temperature differences.

Raytheon has also begun to deploy thin-client desktops with LCDs to replace traditional desktop PCs and less power-efficient CRT monitors. Realizing that ad hoc break rooms for employees were also likely to contain power-hungry appliances (e.g., microwaves and miniature refrigerators), managers worked with employees to create three large, centralized break rooms. Raytheon also invited local power and HVAC companies to the facility for Earth Day to distribute both energy-efficient fluorescent light bulbs for the home and information on decreasing energy consumption. Stimulating interest in energy conservation among employees, management, and facility operators has proven to be the key to successful energy consumption measures at Raytheon’s Largo Manufacturing Center.

Logistics

Material Management

Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, has a Material Management system that embodies an array of proactive process change initiatives targeted at streamlining the movement of material from the receiving dock to a destination within the facility. These diverse methods changes are collectively producing a more efficient operation that is better able to meet daily operational goals while fostering consistent process improvements.
The logistics of getting needed material from a delivery truck, properly accepting it into stock, then resolving disposition for that material can be a costly and time-consuming operation if left solely to reactive methods. While deliveries may be scheduled to arrive within some prescribed date and time frame, freight carriers control the physical arrival of material on the dock. The system must be responsive to this somewhat unpredictable demand while trying to effect actions during the process that will quickly move it to a state of process control. Using more people to assist during demand peaks might work, but it might also drive higher costs from staff underutilization in the lower-demand periods. In addition to the issues surrounding the labor-intensive nature of material logistics handling, maintaining and managing the material inventory is a significant cost driver based on estimates that 80% of product costs for products manufactured at the Raytheon Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, is attributed to material costs.

Raytheon Largo has implemented several innovative process improvement initiatives to resolve the cost of moving materials to their destination, including the Logistics Dashboard that gives “real-time” visibility to operating parameters using data downloads at two-minute intervals. The dashboard provides a graphical representation using an automobile dashboard dial metaphor tracking the six major process steps of the dock-to-stock process as well as a color-coded indicator to show if the process is operating within the prescribed operational target goals. Since the program is Web-accessible, the performance can be monitored remotely, but of greater importance is the fact that the dashboard is projected to a large screen in the work area so that staff can quickly respond to processes that fall into the “red” condition. It is projected that the visibility afforded by the dashboard has facilitated a 20% increase in employee productivity and a 10% reduction in cycle times, which represents a significant improvement in overall traditional methods of trying to interpolate from historical data to determine what actions might improve performance.

A second initiative affecting the dock-to-stock process is the Supplier Barcode process—a cooperative effort between Raytheon Largo and its suppliers to ensure that packages shipped are marked with a barcode containing specified information. This smart barcode aids shipment receipt by enabling processing using handheld scanners in lieu of the traditional method of locating a shipping document and matching the information to a purchase order. The scanned receipt method has reduced receipt cycle time from an average of as much as 20 minutes using the traditional method to an average of 4 minutes. While the program is only six months old, 57% of all packages received have the necessary barcode. There is an ongoing effort to encourage additional supplier participation since the current result statistics are based on only 25% participation of the supplier base. To date, NCS Largo’s new process has allowed a 15% reduction in labor hours spent processing receipts and a 50% reduction in labor hours spent resolving “unreceivables” caused by difficulties reconciling shipping documentation with purchase order information.

MTrak is another Raytheon-specific, barcode-enabled tracking system that facilitates receipt, processing, and tracking nonstandard shipments not destined for the normal dock-to-stock process flow and inventory controls. These shipments are typically directed to the attention of an individual so as not to be entered into the production inventory. MTrak also provides a detailed tracking feature using the barcode location identifiers placed throughout the Largo facility. Whenever a package is processed under MTrak control, its location is scanned to capture locator information. Anyone interested in tracking a particular shipment is able to perform that function from the Web-based tracking utility. MTrak has proven its worth through both significant cost avoidance and labor-reduction impact.

A new Cycle Count process has greatly enhanced the inventory management auditing process. The specified inventory cycle counts needed to manage inventory accountability are being triggered by automatic downloads to the WaveTrak warehouse management system on a daily basis. All parts listed in inventory are categorized by A, B, C or G identifier codes to control the quantity of cycle counts conducted on a specific part number per year. Scheduling of the counts is an automatic system output that provides a blind count request to the inventory system operators. If the requested count does not match the total being carried in inventory, a second count is requested. If the second count does not match the expected total, someone from management must perform a root cause analysis with appropriate corrective action prior to completing the final adjustments. Between automating the daily count requests and implementing discrepancy procedural guidelines, inventory accuracy has risen to
Raytheon Largo developed a radio frequency identification system designated RFShip in response to contractual obligations. The system is fully integrated with APEX and Wide Area Workflow by design to allow advanced shipment notification to the government.

Management

Audits and Compliance

Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, instituted an innovative audit and compliance program of the processes critical to the facility’s operational performance by agreeing to partner and create a joint auditing process with the Defense Contract Management Agency. This partnership has resulted in a reduction in duplicated efforts and interruptions to manufacturing personnel and the development of appropriate metrics and effective solutions to issues found.

Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, has instituted a comprehensive audit and compliance program of all processes critical to the facility’s operational performance. Under the Largo facility’s previous auditing process, management system audits were completed annually by Quality Systems; audits and manufacturing process audits were completed monthly by program quality engineers (QEs). Additional customer audits were conducted independent of other audit activity at the request of the Defense Contract Management Agency (DCMA) in accordance with agency requirements. Shortfalls to this process included a conflict of interest created by internally trained QEs auditing the programs they supported, a focus on program-specific issues versus potential systemic plant issues, and a labor-intensive manual data-collection process.

The Quality Systems and Audits group and a select core team of eight lead auditors trained in ISO 9001:2000 and AS 9100 requirements now manage all internal audit activity. Audits are conducted by personnel who are not part of the program being reviewed. A groundbreaking agreement was reached with DCMA to partner and create a joint audit process. Audit planning and scheduling at Raytheon Largo is now performed jointly with DCMA, reducing duplication of effort and interruptions to manufacturing personnel. This agreement with DCMA includes mutual discussion of concerns and solutions. Raytheon Largo also provides training to the DCMA representatives. Management system audits that were accomplished annually now have follow up performed throughout the year on action items to ensure that problems areas are not dormant for prolonged periods of time. The Quality Systems and Audits group has also implemented an effectiveness metric that is applied to all solutions to audit findings. This measure discourages “quick” or short-term fixes since solutions can be rejected if not effective, impacting the group’s effectiveness metric.

Benefits have been dramatic and include a leaner audit process that no longer requires Raytheon Largo to support duplicate audits (reducing support hours); more positive customer relationships and earlier engagement with DCMA on concerns at a point where fixes are quicker and easier if needed; improved data collection with tablet PCs and the Microsoft Office InfoPath tool that streamlines data capture; the ability to measure effectiveness in terms of solutions/closures being effective or ineffective, which encourages better root cause analysis; and the ability to attack repeat problems and systemic plantwide problems. Raytheon Largo has found that these changes have resulted in control and improvement of all critical plant processes.

Auto Estimate-at-Complete Reporting Tool

The Auto Estimate-at-Complete Reporting Tool provides Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, an automated Web-accessible means to produce a timely Estimate-at-complete financial report on an average 22-day cycle, with minimal analyst report-generation intervention once key control identification data has been established. With all reports produced using a consistent data set, the tool has improved the quality of standardized reporting across programs.

Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, produces vast amounts of data that management uses to make positive business decisions. Data collection must be structured to produce a useful report that will aid the management decision process. When producing a key financial performance measurement like the Estimate-at-Complete (EAC) report, data covering all
active charge numbers associated with a given program must be compiled into a spreadsheet from 17 different sources. In the absence of data collection tools, financial analysts must build the report on spreadsheets that reside on their respective computer desktops, relying on labor-intensive manual search/compile routines that could take up to 40 hours for programs with extensive lists of charge numbers. The EAC quarterly report resulting from this process is not easily shared since it resides on an analyst's computer. Manual data entry and compilation is error-prone, and report inconsistencies may occur in these separate reports due to analyst preferences. The combination of these factors renders the manual methodology a less than optimum solution for generating a useful EAC report.

To gather structured and error-free data, Raytheon Largo has developed the Auto EAC Web-based report tool that greatly facilitates quarterly report generation with features that include:

- Web-based maintenance of key data such as program cost identifiers
- Automated retrieval and report compilation time reduction from a maximum of 40 hours to 5 minutes
- Reduced report cycle time from 35 to 40 days to an average of 22 days
- An intuitive Web access screen allowing anyone with data access rights to view the available reports
- A centralized location for Value Stream Leaders (VSLs) to identify and maintain program risk and opportunity information
- Standardized and consistent data reporting through spreadsheet and PowerPoint frameworks
- Report archiving and retrieval from the Web site
- Improved report accuracy due to a significant reduction in manual data entry

Reduced cycle times now provide Raytheon Largo’s financial analysts time to analyze more timely and accurate report data. With the reports now residing on a centralized Web site, business area managers, material program managers, and VSLs have ready access to report data previously hidden on an analyst’s computer and enhances their ability to make better risk assessments and implement proactive management decisions based on accurate financial data. The report generation utility ensures that the formal quarterly EAC report is produced in a consistent manner formatted to the specified report criteria.

Business Continuity Planning Program

Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, implemented a comprehensive and executable business continuity plan for hurricanes and other potential disasters. The new process provides clear lines of communication and responsibility, provides satellite and other more reliable communications, coordinates with higher-level continuity plans for engaging corporate support as needed, provides continuity plans in an easy-to-use plan book and on the corporate Web site for easy reference, and prioritizes available regional recovery resources.

Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, required a comprehensive and executable business continuity plan for hurricanes and other disasters. A new business continuity plan was developed to overcome previous shortfalls that included unclear lines of communication and responsibility, limitations from unreliable land-line and cell phone communications, inconsistencies between local and NCS business-level plans, a large and difficult-to-use plan book, and no prioritization of regional resource response-sharing.

The new plan is consistent with Raytheon enterprise preparedness initiatives, an example of which includes the use of a dialogic mass notification system to supplement phone-tree notification, and provides needed coordination of resources (Facilities, IT, Security and Human Resources) between Raytheon’s adjacent Largo and St. Petersburg sites. The recovery plan also flows down actions to the department functional level in the organization. Expanded communications are provided that include satellite phones, broadcast notification systems, walkie-talkies, amateur radios, emergency operations control software, and PDA text-messaging to supplement vulnerable land-line and cell phones. Other features include integrated Largo and St. Petersburg IT recovery plans, a definition of “up-the-line” coordination with NCS headquarters, a minimum of two exercises a year, expanded employee training and awareness that includes a comprehensive set of emergency procedure tags to attach under ID cards, and emergency phone contact-number tags.

The new business continuity plans have corrected the previous shortfalls in contingency and recovery planning, with the following benefits to the Raytheon Largo (and St. Petersburg) facilities:
• Prioritized recovery plans that ensure a logical progression of recovery efforts with their shared resources
• Establishment of a dedicated severe weather management team to provide an effective severe weather response
• Department-level plans that focus recovery responsibility on appropriate functional managers
• New, more capable communication tools that greatly reduce the possibility of being unable to communicate
• Expanded employee training and awareness that have increased the efficiency of response efforts and increased employee confidence

Community Involvement

The Raytheon Six Sigma approach to streamlining fundraising activities at Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, has resulted in tripling annual donations without increasing man-hour efforts.

Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, focuses its community involvement on the Junior Achievement (JA) program. The process previously included the work of two Human Resources (HR) employees who organized an annual company-sponsored bowl-a-thon fundraiser. HR was responsible for facilitating the event and manually kept track of monetary pledges, teams, and shirt orders. Miscellaneous sponsorships in other community involvement activities were approved by site executives.

In 2004 Raytheon Largo’s HR group used a Six Sigma approach to streamline its process. The number of fundraising activities increased from 2 to 8 events. The events are now run by different committees, which provides more innovative ideas such as raffling a “by-the-entrance parking spot.” The donations mechanism is now Internet-based, with a link on the Raytheon Largo homepage. Bowl-a-thon planning tools are also Internet-based, with bowling team captains now entering teams, shirt information, and donating money online.

Internet-based activities allow for more effective use of time, eliminating manual input and providing a more accurate accounting system for donations. While the total number of man-hours spent on JA activities has not changed, donations have more than tripled to $33.5 thousand, making the Raytheon Largo facility the leading JA contributor in Pinellas County, Florida, two consecutive years.

Miscellaneous sponsorship activities have been combined with Raytheon corporate, allowing employees to participate in other corporate-endorsed activities. Raytheon Largo leaders believe community involvement has multiple benefits that include community awareness of Raytheon, publicity, employee awareness of issues in the community, and the potential to attract future Raytheon Largo employees.

Contract Line On-Time Delivery Reporting Tool

The Contract Line On-Time Delivery reporting tool provides easy Web accessibility to key product delivery performance data in addition to coupling that same source data to a three-month forecasting utility. It also includes an automated notification tool that facilitates awareness of open obligations to provide key forecasting information updates.

Prior to developing the Contract Line (CLIN) On-Time Delivery (OTD) reporting tool, Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, satisfied senior management requests for a monthly CLIN delivery report by following a 51-step manual process that could entail three days of intense labor to complete. Since the report was targeted to address a senior management request, it was not intended to be share with lower-level managers. It also did not provide the level of data awareness needed to effectively improve OTD outcomes. Delivering product on a time schedule specified in the contract with a customer is one of the crucial elements of customer satisfaction, making on-time product delivery performance a key management metric for gauging overall manufacturing process effectiveness. Preparing historical reports that detail delivery information involves labor-intensive data mining, compilation, and preparation. Reports prepared using this methodology typically provide only a snapshot of the information. More important, correlating the report data to perform functions such as trend-line analysis is extremely difficult or virtually impossible without significant effort, resulting in senior managers receiving a requested report that lacks essential data.
Development of the CLIN OTD has resulted in the following features:

- Automated retrieval of relevant data from the Achieve Process Excellence (APEX) mainframe data source that ensures more consistent data
- Automated report generation that reduced the process from three days to approximately 10 minutes
- Effective data retrieval that makes report generation efficient for creating weekly and monthly reports feasible, with the potential for daily reports
- An intuitive Web access screen that allows anyone with data access rights to view the available reports
- Reports that identify delivery forecasts three months into the future in addition to reporting historical data
- Facilitated entry of delivery forecast data via a Web-based access that allows detailed descriptions of causes affecting potential delinquent deliveries
- An automated e-mail reminder system that gives managers an active role in developing forecast data and automatically notifies them of any open obligations

The CLIN OTD tool has significantly improved manager awareness on delivery performance by a more effective and timely sharing of consistent data. The expectation is that by making delivery obligations more visible, the essential planning needed to meet those delivery dates is enhanced, moving toward a desired goal of a 98% on-time delivery success rate. The improvement results to date indicate CLIN OTD has provided significant benefits since the on-time success rate has moved from 67.4% to 96.6%. One unforeseen outcome from making the CLIN data readily available has been the identification of incorrect or faulty contract data loaded in APEX that adversely affected the reported outcomes. The net result of correcting those detected problems is more accurate and consistent core data, producing a corresponding accuracy in the reported outcomes. Since timely entry of forecast data is essential to realize this benefit, the tool includes automated e-mail reminders sent to managers when their data entry obligations have not been met. This ensures that stakeholders are not only reviewing the data but are updating data to reflect status changes.

By automating what was formerly a labor-intensive data collection process, Raytheon Largo is now able to compile associated management data more frequently and effectively with the CLIN OTD tool, enhancing awareness on a key management metric – on-time delivery of Contract Line items. By providing the framework for defining three-month delivery forecasts, it serves as a useful data-based planning tool, facilitating proactive solutions resulting from awareness of potential delivery problems.

**Corrective Action Board**

The Corrective Action Board at Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, provides a systematic approach to quality management for all the facility’s business processes. The Corrective Action Board addresses issues identified in functional and product areas while focusing on long-term systemic corrective actions and providing effectiveness measurement tools for corrective actions and plantwide performance.

The previous business process review and improvement methodology at Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, previous consisted of different types of management reviews including monthly site reviews, Quality Assurance (QA) quarterly reviews, and program reviews with the customers. Reviews, however, were not integrated and lacked a consistent message. Not all functional departments participated in the review process and some reviews were conducted only by specific functional groups, creating the potential for gaps and/or scope overlaps.

In January 2005, the Raytheon Largo Corrective Action Board (CAB) was established as a forum to review all business processes, including technical disciplines, and all support functions such as Finance, Accounting, Safety, QA, Human Resources, and IT. The CAB includes management representatives from all functional groups at the Largo facility and has replaced other types of business process review meetings. The presence of all functions ensures that the organization responsible for improvement
is identified and that there is commitment from all knowledge areas at the plant.

At CAB meetings, each function presents key performance metrics that are reviewed by CAB members from Raytheon Largo’s senior leadership team. This type of collaborative peer review allows members to look across functions to identify common process issues and resource constraints. The metrics provide agreed-upon measurements of overall company health and the effectiveness of previously implemented corrective actions. CAB reviews also include identification of new metrics for functional departments and reconsideration of old metrics.

The CAB resolves systemic issues that were identified on the product side by Integrated Product Team Leaders (IPTLs). IPTLs are responsible for near-term solutions of these issues within their programs, then forward the functional systems process issues to QA for review and analysis before QA sends them to the CAB for long-term systemic corrective actions.

IPTL-identified issues go through the CAB multidisciplinary troubleshooting process during which the responsible functional area (or areas) is identified and new effectiveness measurement metrics are established that can be either cross-functional or specific to a functional department. Examples of results from process improvements introduced by the CAB include:

- A 30% regressive workflow cost reduction in 2005
- A 62% reduction in number of “standard repairs” in 2006
- An all-time-low calibration delinquency rate of .06%
- An Engineering Change Notice (ECN) cost estimating system that increased the number of fully costed ECNs from 13% in 2004 to 92% in 2006

Diversity and Inclusion

Creating a systemic approach to establishing and updating diversity goals, measuring the achievement of these goals, and collaboration with Employee Resource groups is helping Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, to build an improved workforce that can better adapt to changing business needs.

Prior to 2005 diversity and inclusion concepts were not integrated into the business goals and strategies of Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, and existed only as human resource initiatives, not business imperatives. There was no accountability for these concepts, which resulted in a lack of commitment from company leaders and employees. Because of the limited commitment to these areas, diversity councils previously formed did not have any real impact on the company. Company metrics focused on measuring attrition, hiring, and promotions data based on gender, race, and age; however, multiple categories rendered multiple numerical outputs that were not prioritized, making the results of the data collected difficult to interpret.

The Raytheon-Largo-St. Petersburg Diversity Council (RLSDC) was formed in 2005 with a vision “to foster an inclusive environment, embracing the differences to achieve common goals that inspire creative and stimulated individual and business growth.” RLSDC took the approach of integrating diversity and inclusion into Raytheon Largo’s strategic and tactical goals. This was done by making company leaders and managers individually accountable for integration of diversity concepts into their respective teams. Performance evaluations of company leaders and employees done through the newly developed People Index system now include leadership diversity participation and diversity training metrics. Leaders are evaluated on their participation in diversity activities and on their team’s participation in those activities to determine how well the diversity knowledge is being flowed down and supported.

The People Index system is reevaluated annually to prioritize and set goals for the next year’s diversity initiatives, which are subject to change based on the organizational climate and are prioritized and weighted for simple numerical analysis in terms of not meeting, meeting, and exceeding expectations. Progress is monitored quarterly to identify problem areas.

In the past and as part of the Diversity and Inclusion program, Raytheon Largo sponsored various Employee Resource Groups (ERGs) that are often formed on the basis of ethnic background, gender, and/or race. RLSDC took a unique step to align Raytheon business goals and ERG initiatives. ERG team leaders are now accountable for value added by their groups and routinely meet with the Diversity Council and Raytheon leaders to present the status of their efforts and discuss goal alignment. As a result, ERGs emerged as a retention aid and
as the resources for recruiting and the integration of new employees. ERGs also play a key role in organizing company diversity events, community outreach programs for brand-name recognition, and providing additional opportunities in networking and in personal and professional development.

One of the outcomes of collaboration between ERGs and the Diversity Council is the Raytheon Florida Region Rotation Program. Through rotations at other sites in Florida, the program provides opportunities for leadership skills development, knowledge transfer, and career development to employees who are limited by their geographic mobility or are not eligible to do so on a corporate level.

Employee Development Council

The Employee Development Council at Raytheon’s Network Centric Manufacturing Center in Largo, Florida, provides a systematic process that identifies employee concerns, addresses those concerns as a business need or gap, and develops solutions that are aligned with company goals. The Employee Development Council provides an infrastructure to bridge the gap between employee performance and the business that positively impacts employee satisfaction by providing career development needs for Raytheon and the Largo facility.

As part of its continuous improvement efforts, Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, conducts a biannual survey of its entire employee population followed by a detailed follow-up survey performed on 10-15% of the population. In the past, issues identified in the employee surveys were forwarded to Human Resources (HR) for improvement and follow up. Initiatives from HR were typically not connected to company strategic and technical goals, resulting in corrective actions that did not always have the commitment of the employee and management.

In 2005 Raytheon’s leadership team formed an Employee Development Council (EDC) specifically to address issues identified in employee surveys and provide solutions aligned with organizational goals. The EDC is comprised of strategic and tactical subteams. The EDC Strategic Team members are a subgroup of the Raytheon Leadership Team and functions to identify long-range needs and current gaps for the Largo site. The EDC Tactical Team is comprised of employees with an “above-expected” performance rating and is led by a member of the Raytheon Leadership Team. Members are salaried employees from various functional and product areas of the organization and include managers and non-managers, new hires, and veteran employees. The Tactical Team owns strategies and determines how to effectively address the needs and gaps identified by the Strategic Team. After a solution initiative has been rolled out, the Tactical Team responsible dissolves and a new Tactical Team is formed to address the next priority identified by the Strategic Team.

The EDC solutions are approved directly by the Raytheon Leadership Council and are rolled out as business initiatives tied into performance evaluations for employees and supervisors, when applicable, to improve and promote organizational commitment. This process results in an improved synchronization of employee performance and development with corporate goals. The EDC has the authority to tap into other available Raytheon organizations for collaborative solutions; for example, the Florida Region Rotation Program was developed in conjunction with the Diversity Council to provide career-broadening experience to the Largo employees.

Florida Region Rotation Program

The Florida Region Rotation Program was initiated to assist employees with career development and growth opportunities within the state. The corporate rotation plan at Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, now provides local job rotation opportunities to Florida-based employees.

Prior to 2006, employees at Raytheon Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, were limited to traditional corporate career development and growth programs. Employees at the facility did not have formal individual development plans, and follow ups to the annual Performance and Development plan were limited.

Raytheon Largo decided to supplement the corporate career development program with a Florida-specific program and implemented the “Florida Region Rotation Plan” in 2006. The plan is a collaborative effort between the Florida Diversity Council, Raytheon Largo’s Employee Development Council, and the Raytheon Largo/St. Petersburg, Florida engineering community. Two new rotational
paths were initiated and offered to Largo and St. Petersburg employees. The “Growth Path” is typically for employees who wish to rotate jobs within their given expertise or function. For example, an engineer from Largo could apply for the “Growth Path” program and rotate to an engineering job at St. Petersburg. The other program available is the “Leadership Development Path.” This program represents a cross-functional rotation, with the goal of further developing an employee’s skill base with the anticipation that the employee will assume key leadership positions upon completion of the rotation. Average rotation length is between two and three years. Both programs are formally chartered by the leadership team to enhance employee careers by providing a method of gaining diverse experience and training.

Human Resources

Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, implemented an improved tracking and review system to better assist employees and managers pursue leadership development of the facility’s top performers.

In 2006 Raytheon Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, revamped its Human Resources (HR) program to better evaluate and track employee performance and progress. Prior to 2006 the Raytheon corporate-required Individual Development Plan was the sole document used to evaluate employee performance. Employees were evaluated on an annual basis only, which led to inconsistent performance tracking and career planning. The facility’s top performers were often known to segments of senior leadership but were frequently unaware of their own special status. Furthermore, succession plans were being verbalized among Raytheon Largo leadership, but formal documentation was not created on a consistent basis.

Raytheon Largo management decided that to better evaluate employee performance, a quarterly review was an essential supplement to the annual review. Tracking sheets were implemented to better assist employees and management track and monitor career planning, mentoring, coaching, mobility, and job assignment goals. Largo’s top performers were also treated differently under the new HR system. The top 10% of all employees evaluated are considered “People on the Move” and are now required to establish a “Key Development Plan,” a collaborative document created by both the employee and management. The entire leadership team at the Largo facility was made aware of all “People on the Move” throughout the plant to better enhance top performers’ career development. Managers were also evaluated by how well they helped mentor Raytheon’s high-potential employees. Raytheon Largo also formalized its succession plans by documenting those candidates most qualified to assume key leadership roles in the future.

The increased frequency of employee reviews has helped improve career development and growth opportunities. Employees are better able to actively manage their careers and have a better understanding of their job performance. Leadership is also better able to assess employee talent, which has led to increased skills and career development support. Top performers are formally made aware of their up-and-coming status within the company and are challenged with increased goal achievement. Those employees that are not in the top 10% of their peers have something to strive for if they want to rise through the company ranks. This can only benefit the individual and Raytheon as employees seek to reach their full potential. Formal succession plans are intended to ensure that talented and qualified employees are receiving the appropriate training and skill mix necessary to achieve upward mobility in the organization as new management positions become available.

Material Earned Value Management System Reporting Tool

The Raytheon Network Centric Systems Manufacturing Center in Largo, Florida, developed a Material Earned Value Management System Reporting Tool that enables the material program managers to analyze program parts and material utilization. Operating in conjunction with the Estimate at Complete reporting tool, the Material Earned Value Management System utilizes the Project Evaluation Review Technique methodology to capture more complete analysis data.

Determining with accuracy the value or cost to a program for parts and material received for work in process and reporting that information in a manner that allows for effective analysis is an ongoing challenge. The assumption is frequently made that
the budgeted cost of work scheduled (BCWS) equals the budgeted cost of work planned (BCWP). This optimistic assumption makes it difficult to detect variances from plan or budget and devalues the Schedule Performance Index (SPI) calculations. Raytheon Largo developed its Material Earned Value Management System (EVMS) Reporting Tool to overcome these shortcomings by providing tools for material program managers (MPMs) to better manage material inventories using data captured by the Estimate at Complete (EAC) reporting tool to perform this specialized analysis. The unique enhancement of the EVMS is its use of the Project Evaluation Review Technique (PERT) calculation methodology to overcome the faulty assumption that BCWS automatically equals BCWP, making it feasible to calculate a more realistic SPI. Features of the Material EVMS reporting tool include:

- An intuitive Web access screen that allows anyone with data access rights to prepare and view the available reports
- Dynamic linkage to data from the Manufacturing Resource Planning (MRP) program
- Better inventory management through linkage to MRP data
- Prohibits credit for early deliveries to mask problems with late deliveries
- Allows for analysis visibility down to the individual part number
- Automated data compilation
- Automatically calculates SPI
- Use of existing EAC data reduces the unique resource requirements

The Material EVMS reporting tool gives the MPMs the needed automated analysis utilities to more thoroughly manage material inventories. Being based on the proven PERT methodology provided through a centralized tool means comparative analyses for variance will yield consistent results that will encourage more precise delivery scheduling of material.

Mentor-Protégé

The Mentor-Protégé program at Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, has been a highly successful undertaking for both Tampa Brass & Aluminum and Raytheon that has resulted in the development of a better-performing supplier capable of delivering a quality product to support the needs of the warfighter.

In 2004 Raytheon Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, started a program to mentor Tampa Brass & Aluminum (TBA), a small disadvantaged, veteran-owned manufacturing company in Tampa, Florida. The Raytheon Largo Mentor-Protégé program has improved the capabilities and core competencies of TBA, which has improved TBA’s ability to provide quality castings and machined parts that fully support Department of Defense (DoD) customers and ultimately the warfighter.

Raytheon Largo began its mentoring program by training TBA employees in Six Sigma. A single-process flow was developed and implemented along with other Lean/agile manufacturing processes. TBA has since maintained a 97% on-time delivery rating, a 97.5% quality rating, and ISO 9001:2000 certification. Strategic planning was improved by initiating a 5-year strategic plan, capacity-planning analysis, a facilities layout expansion plan, and business systems integration and training. These improvements resulted in a 15% increase in revenue, a 13% increase in new business, a 12.5% increase in new customers, and a 400% increase in new business capture.

Advanced manufacturing engineering was achieved by technology transfer in the areas of tungsten and steel alloys, Pro-E and Pro-M software integration, and collaborative engineering in new product development. Production and facility improvements were completed by increasing machining capacity, foundry modernization, shop floor reporting, visual factory implementation, packing and shipping instructions, and a foundry 5S project—all of which have resulted in a 40% increase in manufacturing capacity, a 20% improvement to existing floor space, and a 500% increase in melting capacity. TBA has also realized a 27% increase in profits and an increase in its workforce from 75 to 90 employees.

The introduction to and training in Raytheon Six Sigma, Lean manufacturing, quality system improvements, strategic planning, business development improvements, technology upgrades, and process innovation have enabled TBA to achieve unprecedented growth and respect. The company has been nominated for the 2007 DoD Nunn-Perry Award for Mentor-Protégé, an award it won in 2005, and the U.S. Small Business Association’s 2007 Jeffrey H. Butland Family-Owned Small Business of the Year Award. Raytheon Largo will continue to mentor TBA and is seeking other mentoring opportunities.
Operations Program Leadership

Raytheon’s Network Centric Systems Operations Program Leadership at the company’s manufacturing facilities in Largo, Florida; McKinney, Texas; and Waterloo, Ontario established a career and learning management certification process for Operations Program Managers to ensure that future program leaders acquire the appropriate skills and experience necessary to effectively run future programs. Operations Program Leadership certification levels are uploaded to a central Raytheon Network Centric Systems database that helps leadership identify qualified Operations Program Managers on a companywide level.

Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, recognized that Operations Program Managers (OPMs) were the driving force behind customer success and mission assurance. Fully qualified program leadership is paramount to stable, predictable program execution and company growth; however, Raytheon’s Largo facility did not have a formal OPM development program and managers did not have knowledge of OPM qualifications beyond specific business functions. Résumés for OPM positions were submitted through internal job posting; any additional training needed was recommended to OPM candidates by direct supervisors.

To improve the consistency of program performance, the Operations Program Leadership (OPL) Organization was initiated to provide a training pipeline and certification process for OPMs. Application for OPL certification was requisite prior to approval by the OPL Council. After being accepted into the OPL program, managers work toward receiving OPL certification by expanding their experience, performance, potential, learning, and education skills.

Criteria for OPL tier advancement are well-defined and measurable for the five tiers of certification possible. Each progressively higher tier represents increased levels of responsibility and complexity. Program tiers are also designed to better match program budget, size, and complexity to each manager’s skill levels. Programs are divided into five tiers in which smaller and less complex programs reside in tier 5 and the largest, most complex programs reside in tier 1. As OPMs achieve higher OPL certification levels, they become eligible to manage higher tier programs. OPL certification levels and program management experience are uploaded to an NCS database which leadership teams across the entire NCS sector can query to find OPMs with the appropriate level of OPL certification for new job opportunities.

Benefits of the OPM development program include:
- A well-defined list of potential candidates and their qualifications and experience level
- A defined complexity level for each Raytheon program that supports matching individuals to a program appropriate to their skill set
- The ability to identify and match talent to programs across multiple NCS geographic sites

People Development

Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, in response to internal assessment and employee surveys, embarked on a process to install a robust employee development process. The employee development system includes a documented mentoring process for which leadership is accountable, leadership learning and feedback from staff, Integrated Product Team leadership training, and personal development rotation.

Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, embarked on a process to install a robust employee development process that would include a documented mentoring process for which leadership was accountable, leadership learning and feedback from staff, Integrated Product Team (IPT) leadership training, and personal development rotation. In 2005 Raytheon Largo piloted the formal mentoring program that included mentor training, development workshops, a mentoring Web site, guidelines that included a one-year time limit for the mentoring relationship, and allowances for the need to terminate the relationship (if necessary) due to incompatibility. Leaders are expected to participate as mentors and are evaluated on their mentoring skills in performance appraisals.

A new form of mentoring is being added in the form of reverse mentoring – the process of a lower-paygrade employee providing feedback on leadership or other attributes to a more senior employee. The Raytheon Largo leadership team (senior executive leaders on site) are required to participate. Mentors will be volunteers and will not be selected by the senior “protégé.” Both mentors and protégés
will require a briefing and education on the process. Senior protégés will be asked to select an area for mentoring in which they are least knowledgeable. The benefits from reverse mentoring are anticipated to include open and candid discussions, with feedback to seniors on effectiveness of their leadership and technical approaches; presentation of alternative views, which protégés may not receive in their normal peer circles; and influential behavioral changes that develop more effective Raytheon Largo leaders.

IPT Leaders serve as key members of the Raytheon Largo plant leadership, reporting directly to Value Stream Leaders. As part of the employee development process for these personnel, IPT Leaders are being leaders for direction and leadership; this is an essential element of the development process. IPT Leaders also come from both operations and nonoperations backgrounds, with no single training pipeline to prepare them for being an IPT Leader. To ensure that IPT Leaders do not get stagnant or “burned out,” each IPT assignment is planned for a two- to three-year period, after which IPT Leaders rotate to a new job.

Raytheon Largo has realized benefits from this program that include knowledge transfer, different perspectives based on past experiences from diverse background functions, increased breadth of skills, and improved leadership development for its IPT Leaders.

Raytheon Six Sigma

At the beginning of the Raytheon Six Sigma program, projects were based on return on investment. The program now focuses on aligning Six Sigma projects with initiatives that mitigate risk and enable opportunities in the estimate at complete to focus on continuous improvement, the combination of which has enabled Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, to realize a significant improvement in company metrics.

Prior to 2003, Six Sigma projects at Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, were not in alignment with estimate-at-complete (EAC) risk and opportunity actions. The projects were being chosen by individuals who were taking part in the Raytheon Six Sigma (R6S) specialist program and were completing projects that did not necessarily impact strategic company metrics.

The Raytheon Largo facility has fostered a continuous improvement environment by establishing an aggressive R6S program and a vision to have all salaried employees trained as R6S specialists – the industry equivalent of Six Sigma Green Belts. This goal was accomplished between 2002 and 2006. The facility also now has five full-time R6S experts – the industry equivalent of Six Sigma Black Belts.

At the beginning of the R6S program, projects were based on return on investment. Once Raytheon-Largo realized the program’s potential to positively impact company metrics, the focus of the projects aligned with initiatives to mitigate risks and enable opportunities in the EAC. Spreadsheets are now used to track assignments and the status of each project. Program teams comprised of the Business Area Manager, the Value Stream Leader, and the Integrated Product Team Leader are responsible for ensuring R6S projects support continuous improvement efforts.

The Raytheon Largo approach to Six Sigma implementation has been a successful endeavor. Employees were quickly and efficiently trained in R6S methodology. More than 600 employees are currently trained in R6S versus 93 employees trained in 2002. Leadership roles and responsibilities have been adjusted to incorporate R6S principles as part of standard job descriptions. As a result of the aggressive strategy of deploying R6S, continuous improvement at Raytheon Largo has realized a steady climb in its EAC percent variance from 4% in 2002 to 15% in 2006.

Record Information Management System – Document Imaging

Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, was having a difficult time filing and retrieving a massive amount of documents. With the introduction of the Record Information Management System, a central document repository was created. Documents are now stored electronically and are easily retrieved and shared by all authorized employees.

Prior to 2000, finding a copy of a document at Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, was an arduous task. Records were kept in hardcopy version, in boxes, and in filing cabinets. Documents were also indexed by only one searchable criterion, which made document recall even more difficult. Docu-
ments were often misfiled or lost, which led to expensive document re-creation that, in turn, led to loss of productivity and frustration. Collaboration was also difficult because hardcopy documents had to be faxed, photocopied, or scanned from one employee to another.

In 2000 Raytheon Largo purchased the Record Information Management Systems (RIMS), a commercial off-the-shelf software solution that imported all the facility’s documents to an electronic, online, fully searchable format. All hardcopy documents were scanned into electronic format and imported into RIMS. An efficient and accurate optical character and barcode recognition tool were used to scan and file documents under multiple fields, which allowed for more powerful and effective document searches. Document retrieval and collaboration became a two- to three-minute process versus the multiple days it took under the previous hardcopy system. Data backup to tape also ensured that Raytheon Largo data would be safe and retrievable in the event of a system crash. Further security was added to the system with password protection at the system, application, and document levels. Raytheon Largo estimates that the implementation of RIMS has saved 3.5 man-years.

Safety Failure Review Board.

The Safety Failure Review Board at the Raytheon Network Centric Systems Manufacturing Center in Largo, Florida, analyzes systemic issues rather than individual incidents and takes Raytheon’s safety program to the next level.

Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, did not have a program in place to document recordable injuries and lost-time cases prior to July 2006. Investigations focused on individual incidents, data was reviewed regularly for systemic issues, and actions were taken but not always documented correctly. Safety audits and management walkabouts were conducted, but investigations focused on individual violations and did not explore systemic issues. A site-level team did not exist to review data sources in one forum.

In July 2006 the Raytheon Largo facility created a Safety Failure Review Board team. The team, comprised of members from Environmental, Health and Safety; Quality, Operations, Training, Logistics, Facilities, and Purchasing, created a charter applying a systemic root cause and corrective action to Raytheon Largo’s site findings (Figure 2-8). Data was collected from recordable injuries as well as lost-day cases, nurse visits, safety audits, management walkabouts, and quality audits. The team also created a standard investigation worksheet. Raytheon Largo’s Safety Failure Review Board provides a system for recording issues and events and analyzing data to identify trends or critical issues for identifying, implementing, and assessing the corrective action necessary to prevent recurrence (Figure 2-9).

The program promotes a safer work environment by increasing employee awareness of industrial
safety, workbench safety, and the use of personal protective equipment. The Largo facility has also improved ergonomics in its work areas, identifying several issues in the cable working areas and removing non-ergonomic microscopes throughout the facility.

Supply Base Optimization/Integrated Strategic Supplier Team for CCAs

Raytheon’s Network Centric Systems implemented the Supply Base Optimization initiative that focuses on maximizing commodity technology while reducing the number of highest-performing suppliers for the commodity. The Integrated Strategic Supplier Team structure promotes best-in-class supplier performance while assessing supplier capabilities to match program requirements and a goal to lower total cost with improved quality and delivery by the approved suppliers.

To remain competitive and grow, Raytheon’s Network Centric System’s (NCS) Manufacturing Center in Largo, Florida, needed a lean, capable, and performance-driven supply base for circuit card assemblies (CCAs). NCS consists of 20 geographically dispersed facilities. When NCS began the Supply Base Optimization (SBO) project, they had 38 CCA suppliers providing products to all locations. Managing 38 suppliers was scattered, dilated, and inconsistent; in some cases it was discovered that several NCS locations managed the same CCA supplier, which caused numerous problems that included vast performance variations and redundant CCA capabilities. When CCA process or product improvements were made, they were product-specific and varied greatly from program to program. In addition, points of contact within Raytheon were location-based, resulting in multiple nodes of communication between Raytheon and its 38 CCA suppliers. With wasteful and time-consuming program-by-program management, it was difficult to improve supplier performance when managing such a large CCA supply base.
To solve this problem, Raytheon Largo created two unique groups: a Virtual Commodity Team (VCT) and an Integrated Strategic Supplier Team (ISST). The VCT was formed first, using cross-functional and cross-regional resources from Engineering, Supply Chain, Quality, Operations, and Program Leadership. The VCT’s goal was to assess the current state of CCAs and determine which suppliers were the most capable of performing at the highest level. The VCT then prepared an Approved Supplier List (ASL) for use on future programs. Some suppliers were categorized as “Approved with Restrictions,” meaning these suppliers could finish current business but would not be eligible for future business on new NCS programs; the remaining suppliers were deleted. Ultimately, NCS was dealing with only six VCT-approved suppliers designated as eligible for new business at all NCS locations.

The ISST for each commodity is organized to include membership from Supply Chain, Operations, Program Leadership, Engineering, Quality, and representation from other Raytheon NCS organizations. The ISST provides an NCS-level strategy for CCAs that impacts production, i.e., critical commodities. Raytheon Largo then took this concept a step farther and hosted process and relationship Raytheon Six Sigma diagnostic workshops at each of its six ASL supplier locations to identify opportunities for more process improvements. As a result, approved suppliers are now more involved and are part of the NCS team in the delivery of superior products. As an example of this, Raytheon invited its approved suppliers as partners to a DDG-1000 Design for Manufacturing meeting to assist in strategy and planning. ISST also utilizes an “Add/Drop” process so approved suppliers can be assessed for current performance and capabilities. This ensures that the ASL becomes a dynamic list, with Raytheon NCS constantly searching for best-in-class suppliers.

The benefits of the SBO and ISST processes to NCS operations include:

- Management of six CCA suppliers versus 38
- ISST-promoted NCS-level strategy
- Increased supplier rating of 96.5%, up from 85% in one year
- Increased use of approved suppliers from 52% to 76%
- Coordinated and consistent process improvements
- Reduced points of contact with Raytheon and improved communication
- Implementation of a predictive design tool that has reduced new design-predicted defects-per-million opportunities from 1062 to 428
- Implementation of 24 best-value test strategies
- Similar strategies rolled out with the printed wire board commodity
- Planned implementation of the ISST process on distribution, power supplies, and other commodities in 2007
Section 3

Information

Design

Process Model™ Simulation

Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, has implemented Process Model™ simulation software to assist in the visualization and analysis of processes to improve productivity.

Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, uses Process Model™ software in its Integrated Product Development System to conduct process model simulation, which facilitates the visualization and analysis of a process to improve productivity.

Before using process model simulation, spreadsheets were used to estimate the throughput of a process. Spreadsheets were based on labor standards and the number of people involved in the process. Analysis based on these spreadsheets often did not account for shared resources and process variations; i.e., the influence of test equipment and manpower being shared among projects was seldom captured. Similar items were also frequently considered to have identical processes.

The new process simulation model begins by creating a flowchart of the value stream for the process. Flowcharts are progressively updated by the insertion of information for the process steps that include process step queue and transport times along with machine capacities, yields, and resource and labor allocations. Process experts then validate the model using historical data and data from similar processes. The simulation is run after validation is complete.

Process model simulation now provides quantifiable data on the target process or subprocess and the capability to improve manufacturing flows and cycle times while accounting for process variations. Constraints are identified, quantified and then modified or eliminated to create a more efficient and productive process. This method also allows for the ability to examine “what-if” scenario changes, which enable the optimization of resource allocations and provide for capacity planning.

Raytheon Largo has realized significant benefits from the use of Process Model™ simulation. The facility now has the capability to simulate, analyze, and improve manufacturing flow and cycle times. Process performance can be predicted using data (or estimates) accounting for variation and interdependencies. Current operations can be accurately evaluated to identify unnecessary process steps, duplication of effort, inappropriate resource allocation, constraints, and bottlenecks. Maximum throughput can be determined to enable Raytheon Largo to analyze resource requirements for personnel and equipment, while optimal lot sizes can also be identified to maximize resource utilization or minimize work in process.

Workplace Utilization

Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, has focused workspace utilization and capacity at a site-management level, which has resulted in reduced operating costs and an improved competitive posture through increased performance and capacity.

Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, has changed the way it manages workspace. The previous method addressed the capacity and utilization needs of individual programs and was managed at the program level. The new process coordinates and focuses on the capacity and utilization needs of the Raytheon Largo Manufacturing Center across programs and is managed as a sitewide effort.

To execute the workspace plans as a sitewide effort, Raytheon Largo uses the principles of the Raytheon Six Sigma (R6S) philosophy. The objective of the workspace plan is to reduce the facility’s floor space by 70,000 square feet prior to the end of 2007. The business case for the workspace reduction is to position the Largo Manufacturing Center for growth and improved competitiveness.

The initial state of the workspace leased by Raytheon Largo was 374,798 square feet. By applying the R6S principles, action was taken to identify program opportunities, align the program opportu-
nities across the programs, and identify opportunities to lease space back to the facility owner.

This action has resulted in reducing the square footage employed in production by 38,354 feet. Equipment utilization has also increased with the disposition of excess equipment, reducing overhead costs and positioning the facility to accept new work. Operating costs have also been reduced due to workspace being returned to the facility owner. Two projects are currently in process and an additional project authorized, with 19,997 square feet of workspace identified as future opportunities. The next steps include streamlining administrative office areas, area cleanups, and disposition of excess equipment.

By focusing workspace management at the site level, Raytheon Largo has increased performance, reduced operating cost, and enabled the acceptance of new workload – increasing the facility’s competitive posture.

Test

Standard Test Equipment

Standard test equipment at Raytheon’s Network Centric Systems facilities in Fort Wayne, Indiana and Largo, Florida, is used for module and radio-level testing and troubleshooting across multiple radio platforms that provide economies of scale while increasing collaboration.

Raytheon’s Network Centric Systems (NCS) Fort Wayne, Indiana facility is a design center that conducts the engineering work prior to its transition to production at the NCS Manufacturing Center in Largo, Florida. Part of this work is the development of the testing required for a product by NCS Fort Wayne that is realized at the NCS Manufacturing Center in Largo. The development of the testing includes identifying the automated test equipment (ATE) that will be used by the Largo facility.

In the past, special test equipment was developed for each product and ranged from unique test sets to different combinations of ATE. The development process, however, exhibited some systemic problems as it evolved that included a lack of a centralized data collection system, low or no visibility of manufacturing failures, and the lack of diagnostic tools for the technician. It also did not lend itself to monitoring supplier performance.

The new process uses standard test equipment located at both the NCS Fort Wayne and Largo facilities that is centered on the FSC0077 station and is used for module and radio-level testing and troubleshooting. The stations are used across multiple radio platforms, such as AN/ARC-222, Spitfire, Starblazer, and Skyfire, and managed by a Shared Resource Manager (SRM). The SRM stores the test data and provides diagnostic tools that can be used by engineering for statistical analysis. The test data is mirrored at NCS Fort Wayne to provide near real-time parametric data to the design engineers. While the SRM is supervising the FSC0077 stations, it is also collecting data from the Environment Stress Screening stations for analysis.

NCS plans to develop standard testers that can be used at multiple sites. Plans are also in place to move more module functional testing to the circuit card assembly subcontractor. Continued evolution of standard test equipment includes developing new NCS business unit standard tools that are more World Wide Web- and network-friendly and can be used by all NCS sites. These new stations will be capable of operating at multiple sites. Additionally, a more robust partnership with suppliers is planned to allow for increased testing at the supplier.

Since the standard test equipment can be shared by multiple programs, it is cost-effective and provides opportunities to increase manufacturing yields and monitor supplier performance. Since the test data is mirrored at Fort Wayne, this process has increased the collaboration between design and manufacturing and facilitates the establishment of the proper test limits for the products.

Production

Common Failure Review Board Process

Raytheon’s Network Centric Manufacturing Center in Largo, Florida, has standardized a process to correct manufacturing failures based on Six Sigma methodology and root cause analysis. Giving ownership of problems to a local root cause corrective action team now provides management the best and most cost-effective technical solutions, which has enabled Raytheon to promptly collect, analyze, prioritize, and alleviate manufacturing failures.

Prior to 2003, Raytheon’s Network Centric Systems (NCS) Largo, Florida, Manufacturing Center
did not have a common failure review board process in place. This resulted in a nonstandardized approach to problem resolution of manufacturing failures. There were a large number of participants in the problem resolution process at this time who were not localized to the Largo Manufacturing Center, which caused a communication discrepancy among key players. Solutions to most manufacturing failures were not data-driven, and the root cause of problems was frequently never discovered.

Raytheon Largo has developed a standardized method to analyze and correct manufacturing failures based on Six Sigma methodology. This process incorporates tools that include database tracking of failures, Web-based collaborative work environments, pictorial representation of failure points for a system, the development of root cause corrective action (RCCA) or tech team working groups, and the implementation of trend analysis to prioritize failures.

By implementing this new process, the company is able to attain rapid and accurate problem resolution. The root cause of failures is now documented and shared through a Lotus Notes database. There is also accountability and ownership of each manufacturing problem that was achieved by creating the RCCA working groups. By using a standard method, Raytheon no longer has multiple employees trying to solve problems independent of one another. The most important benefit to the Largo facility is being able to identify the root cause of failures and ensuring analytical problem resolution with thorough validation to prevent recurring defects.

**Inventory Management**

An active and proactive inventory management system has allowed Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, to realize the benefits of both inventory and cycle time reduction, product quality process improvement, improved supplier relationships and cash flow, and reduced overhead costs.

In early 2006 Raytheon Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, began an aggressive effort to gain control of material inventory, reduce inventory on hand, increase yearly inventory turns, and drive down the cost of the products built at the facility. The company characterized/stratified total inventory in four actionable categories: Lean/Outgoing, Incoming/Early Receipts, Business Case Analysis Tools, and Surplus Materials. Four individual teams and subteams were established to focus on both systemic process improvements and programs with process leaders and business area leaders (Figure 3-1). Tools were developed to set process improvement initiatives in motion and direct these initiatives to the appropriate focus area.

With its focus on Incoming/Early receipts to reduce or eliminate suppliers’ shipping materials to the company prior to the manufacturing need-date, Raytheon Largo sent a letter to all its suppliers notifying them that the company would no longer accept any material deliveries prior to the purchase

<table>
<thead>
<tr>
<th>Focus Area</th>
<th>Process Owner (Lead)</th>
<th>Business Area Owner</th>
<th>Functional Team Members</th>
<th>Scope</th>
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<tr>
<td>Lean/Outgoing</td>
<td></td>
<td></td>
<td></td>
<td>■ Cycle Time/Speed&lt;br&gt;■ Throughput Variability&lt;br&gt;■ Execution to Plan</td>
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<tr>
<td>Incoming/Early Receipts</td>
<td></td>
<td></td>
<td>■ Early Receipts&lt;br&gt;■ Purchasing Practices&lt;br&gt;■ Material Price vs. Total Cost (Including Risk)&lt;br&gt;■ PO Alignment to MRP Need&lt;br&gt;■ Early Receipts for Sales/Milestone Payments</td>
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<tr>
<td>Business Case</td>
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<td>■ Lifetime Buy/Obsolescence&lt;br&gt;■ O&amp;R Material Plan&lt;br&gt;■ Risk:Sales vs. Carrying Cost&lt;br&gt;■ Win Strategy (Price)&lt;br&gt;■ AR without Demand (FG)&lt;br&gt;■ Material Program Plan (SIOP)</td>
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<tr>
<td>Surplus</td>
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<td>■ Material excess to requirements</td>
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*Figure 3-1. Inventory Management Focus Area Chart*
order contract delivery date without prior written approval from Raytheon. The suppliers were further advised that any early deliveries would be blocked at the dock at the Largo facility and may be returned to the supplier at the supplier’s expense. This action contributed to increased inventory turns of 93% during 2006, which improved cash flow for the Largo facility. The policy also stopped $2.8M of the totals identified as “early receipts” totaling $4.4M in the first 50 days of implementation. Four months into the process, teams diverted $10.1M dollars of supplied material and aligned it to manufacturing need-date.

Building upon the success of its 2006 initiatives, Raytheon Largo has refined its inventory management strategies for 2007 with an overall goal of increasing inventory turns from 2.05 to 3.12 turns per year. Cross-functional teams have been established and inventory reduction strategies developed for each of the three action teams (Figure 3-2). Major inventory improvement initiatives for 2007 include accelerating lean processes across the Largo value streams to synchronize the entire supply chain and actively attack non-value-added inventory drivers. Accomplishing these two initiatives alone will reduce inventory carrying cost significantly and contribute to increased inventory turns.

**Supplier Engagements**

Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, uses a Six Sigma approach to incorporating supplier-owned inventory initiatives that has benefited both the company and its suppliers. The facility’s Supplier Engagement program is now a strategic process for determining how to improve its supplier base.

Prior to 2007, the Supplier Engagement process at Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, was random and disjointed and did not focus on achieving coordinated benefits for the Largo facility, its suppliers, and the program offices. Procedures such as Raytheon Six Sigma, a certified supplier program, and a supplier rating system were in place; how-

<table>
<thead>
<tr>
<th>Team #1</th>
<th>Scope</th>
<th>Inventory Strategy</th>
<th>Process Owner (Lead), BAM &amp; Team Members</th>
</tr>
</thead>
</table>
| INPUT   | Material Receipt Plan | − Bid Using Time-Phased Material Delivery Schedule (#17)  
          | Inventory Reduction Goal: | − Eliminate Early Receipts (#13)  
          |                      | − Early Receipts Block at Dock (#15)  
          |                      | − Compress Supplier Lead Times (#21,22)  
          |                      | − PO Alignment to MRP Need (#13)  
          |                      | − Long Term Agreements Aligned to MRP Need (#14)  
          |                      | − Enhanced Material Planning (#16,17,18)  
          |                      | − Institutionalize POUSM/SCI (#4,5,6,9,12)  
          |                      | − Supplier Lean (#5, 6, 9, 12, 13, 14, 17, 18, 21, 22)  
          |                      | − Incorporate Inventory Strategy in Material Program Plans/ #19, 20) | Numbers in parentheses correspond to KPMG Recommendation. |
| Team #2 | Lean and Manufacturing Execution to MRP | − Execute to MRP - Eliminate Past Due by Rescheduling MPS to Realistic Schedule (#4)  
          | Inventory Reduction Goal: | − Lean Acceleration Activity (#1,2)  
          |                      | − Implement Gate Matrix for Lean  
          |                      | − Reduce Throughput Variability (#2)  
          |                      | − Cycle Time Reduction (#3)  
          |                      | − Queue Time Compression – Reduce Lot Sizes, Create Flow Synchronization (#7,8)  
          |                      | − Product / Process Stabilization (#3,10)  
          |                      | − Reduce Regulatory Activity (#11)  
          |                      | − Accelerate Regulatory Resolution Time (#11)  
          |                      | − Better Forecasting and Controls for Finished Goods Inventory | |
| Team #3 | Historical Surplus and Aged Inventory | − Reduce Excess from Economic Buys and Minimum Buys (#18)  
          | Inventory Reduction Goal: | − Excess Material Disposition for Sunset Programs (Gate 11)  
          |                      | − Reduce Material for Attrition, Warranty Coverage and Advanced Buys / Segregate Material Held for OR Provisioning (#19)  
          |                      | − Review Validity of Repair BOM demand  
          |                      | − Implement Local Authorization for Disposition of Aged Inventory / Reduce Material Held Due to Obsolescence / Review Type I Obsolescence -inventory that no longer meets its own drawing requirements, e.g. drawing revision / Review Type II Obsolescence - Inventory that is no longer required to support the production of an authorized assembly, e.g. B8 of Material. (#20) | |

**Figure 3-2. 2007 Inventory Management Strategies**
ever, they were performed in a disorganized and illogical fashion.

The current process for supplier engagement at Raytheon Largo is led by a newly formed Critical Supplier Review team that consists of program, quality, purchasing, and manufacturing personnel. These employees are tasked with prioritizing, fully integrating, and determining the type and extent of supplier engagement required for Raytheon Largo’s critical supply base. The company currently has 37 critical suppliers and approximately 1,000 production suppliers.

Raytheon Largo recently launched an effort to communicate its need for supplier-owned inventory initiatives. A letter explaining what supplier-owned inventory is and what Raytheon will do to help suppliers become versed in the Six Sigma concept has been sent to 53 of the facility’s key suppliers. The facility plans on establishing R6S classes specifically for its critical suppliers to teach them supplier-owned inventory initiatives and their benefit to both Raytheon Largo and its business sectors.

Largo’s newly developed Supplier Engagement program has yielded the following benefits:

- A coordinated, fully integrated strategic process to determine where Raytheon Largo should focus its limited resources to improve the supplier base
- A flexible process to address tactical quality and delivery problems that arise unexpectedly
- Combined input from many key sources to address part issues
- Partnerships developed with critical suppliers to make them part of the manufacturing Integrated Product Teams

Transition Centers

Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, created production Transition Centers in 2005 to bridge the collaboration gap between design sites and manufacturing sites, allowing the Largo facility to take ownership of designs transitioning to production. The implementation of Transition Centers has enabled Raytheon to develop a more efficient transition for new products going from development to the production phase.

Prior to 2005, Raytheon’s Largo, Florida, manufacturing facility had less than optimal collaboration with its four main design sites located in Fort Wayne, Indiana; St. Petersburg, Florida; Marlborough, Massachusetts; and Towson, Maryland. Each facility designed a variety of radio frequency products for customers; however, a lack of collaboration among the four facilities led to inadequate manufacturing plans, materials plans, and test strategies when a new product made the transition from the design site to manufacturing. As a result, Raytheon’s Transition-to-Production process often produced cost growths from low yields and a loss of lessons learned on Engineering Development Units produced at any given design site.

In early 2005, Raytheon assessed each design site’s processes and capabilities—specifically tool sets, test strategies, rapid prototype build capabilities, and participation in the Integrated Product Development process. Largo’s production capabilities and the skills of its subject matter experts (SMEs) were also assessed for effective collaboration. Raytheon developed a process to ensure a smoother transition from development to production by integrating a series of improved and common tool sets among the design sites and the Largo manufacturing facility, resulting in the creation of Production Transition Centers that have bridged the collaboration gap with design sites and allowed Raytheon Largo to take ownership of designs transitioning to production. All sites have common Pro-E workstations, common producibility templates, and access to Raytheon’s Process Capability Analysis Tool Set.

The transition changes have proved to be beneficial to both Raytheon and its customers. The lead-time for first units decreased along with many costs associated with the previous inefficient transition process. By matrixing SMEs into the Transition Center process, Raytheon has been able to decrease transition costs and produce more cost-competitive proposals. The change has also allowed Raytheon to more effectively document lessons learned in the development process, which has reduced total cycle time. This has proven to be a real asset to Raytheon in conducting its rapid prototyping at design sites, providing a conduit for the effective and efficient transmission of information to the Raytheon Largo Manufacturing Center.
Troubleshooting Guides

Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, developed troubleshooting guides to capture the knowledge and experience of the design engineer for use by manufacturing and test personnel. The information contained in the guides provides detailed information that serves as a source of documentation for manufacturing to use in determining possible causes of failures.

Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, previously had no formal or documented process for transferring knowledge from design engineers to manufacturing personnel. When a program transitioned to manufacturing, design engineers were reassigned to new programs. Lessons learned by design engineers were not being communicated to manufacturing, and no detailed documentation existed that explained the circuit and module operation.

Raytheon NCS now prepares troubleshooting guides to transfer the knowledge from design to manufacturing. The guides are prepared by subject matter experts (SMEs) and provide the theory of operation at the module level, including a detailed description of circuit operations and key components, and simplified schematics to aid in troubleshooting specific sections of the circuitry. Troubleshooting notes are also included that explain possible causes of test failure based on the knowledge and experience of the design engineers.

Raytheon Largo’s troubleshooting guides are evolving into interactive guides based on hyperlinked word documents. Each step in the test sequence has a brief description of the test and the most likely causes of failure. By “control clicking” on the particular test in the document that failed, the most likely causes of failure are displayed. To date the interactive guide has been produced for only the Multi-Band/Multi-Mode Radio Synthesizer, with interactive guides planned for other products.

The development of the troubleshooting guides ensures that the knowledge of design engineers is transferred to manufacturing. This has accelerated the learning curve for troubleshooters at the manufacturing site who can refer to the guide to troubleshoot problems more efficiently and effectively based on documented lessons learned and detailed by the SMEs in the guides.

Management

Facilities Preventive and Reliability Maintenance

Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, has implemented an improved method of delivering facilities preventive and reliability maintenance information that will reduce risk and provide more visibility into the Preventative Maintenance program scheduling.

Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, is in the process of initiating a new Facilities Preventive and Reliability Maintenance System to track the status and scheduling of all preventative maintenance (PM) work orders. The six highly skilled maintenance personnel of Raytheon’s Facilities Maintenance Department’s will implement an improved system to determine the mean time between failure (MTBF) of critical assists or those assists having the potential to impact production.

PM work orders were previously not available for viewing by Raytheon Largo production personnel, and critical assets were neither identified nor tracked. To resolve this problem, the Facilities Maintenance Department will incorporate all facilities PM work orders into the Calibration Maintenance Management System currently used by other Raytheon groups to produce timely reports for distribution throughout the Largo facility. Raytheon production personnel will also have the ability to track PM work orders through the Consolidated Equipment System. Most important, MTBF information will be available for all critical assets, reducing the risk and impact to production.

Raytheon predicts the benefits of this program will include:

• Timely and current maintenance scheduling
• The ability of production personnel to view PM schedules
• MTBF analysis
• Validation of the Facilities PM program
Material Planning and Strategic Commodity Management

Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, has implemented an improved material planning and strategic commodity management system to better align procurement groups and reduce duplication of effort. Creating a new material planner position to coordinate all commodity purchases has saved money, reduced production time, and increased productivity throughout the plant.

Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, initiated a new material planning and strategic commodity management methodology in June 2006 that reduces cost and saves time. Raytheon Largo began this process by creating a Materials Planning group to centralize all commodity ordering. Material planners now approve purchase requisitions based on a wider view of plantwide commodity needs rather than on a per-program basis (Figure 3-3).

Prior to implementing a centralized Material Planning System (MPS), all purchases were made and aligned by individual commodity needs while production control was aligned by program. As a result, various programs within Raytheon Largo ordered their own parts, causing many problems for Raytheon buyers whose job it was to make all purchases. It also created problems for product control. One of the biggest problems was that many small requisitions would be created for the same parts at different times for various programs throughout the plant. As a result, Raytheon Largo was not able to leverage quantity purchases from vendors and had little visibility into opportunities

![Material Planner – New Position](image_url)

**Figure 3-3. Material Planners Streamline the Process**

- **UDE:** Material Planning is NOT being effectively executed
  - SITE: Potential Segue for procurement direct charging
  - Monthly Streamline: 50 Hours
- **Synergy Benefits:**
  - Increased Negotiation Leverage (Supplier Bundling / Horizon)
  - Direct Impact on Inventory position
  - Increase working Capital Turns
  - Strategic SMEs
  - Tighter Control of Inventory Adjustments
  - Increased SMI / POU with Suppliers
- **Assumptions:**
  - Good Training Plan
  - Communication with IPT via MPM
  - Commodity Based – Direct Charge
  - Strong Control MRP System Knowledge
- **Risks:**
  - Loss of Program Knowledge
- **Production Control:**
  - Inventory Assign
  - Requisition Approval
  - Horizon Buy Analysis
  - Pointers
  - Requisition Changes
  - PO/POC – Cancellations
  - Shrink Implementation
  - Monthly Streamline: 200 Hours
- **Procurement:**
  - Requirement Review
  - Raytheon Furnished Matl to Suppliers
  - Monthly Streamline: 122 Hours
- **Logistics:**
  - Master Scheduling:
    - Inventory Assign
    - BOM Alt Investigation
    - Requisition Approval
    - Horizon Buy Analysis
    - Req Bundling / Supplier
    - CTC Coding
    - Obsolete Matl Mgmt
    - Program Matl Close Out - Research
    - Establishing Effectivity
  - Monthly Streamline: 380 Hours
for commodity bundling. Lack of a consistent material planning strategy across programs led to duplication of efforts within supply chain functions or items “falling through the cracks.” Raytheon also had no clear way to determine who generated a requisition if problems developed with the order.

Raytheon Largo realized cost savings after implementing centralized material planning and the Material Planning group. Raytheon’s estimated saving in excess of 380 hours a month is only one part of this success story. By combining master scheduling, logistics, production control and procurement, the Largo facility has realized additional benefits that include a savings of $2.5M from centralized material planning. As the central hub that communicates with all groups, the Material Planning group now facilitates clear lines of communication between programs and procurement and increased negotiation leverage due to supplier bundling and horizon buying. Planners now check if enterprisewide agreement options are available prior to approving requisitions. Raytheon’s enterprise agreements save time and money by leveraging Raytheon’s buying power.

In 2005 use of enterprisewide agreements were at 5%; in 2006 use rose to 19.8%; and the goal for 2008 is 30%. Raytheon’s material planners are now considered subject matter experts in material strategies throughout the plant, with responsibilities that include:

- Serving as the focal points for supplier-managed inventory (SMI) initiatives
- Spearheading point-of-use implementation to further facilitate SMI/supplier-owned inventory opportunities
- Auto-release for appropriate items so that no requisition is generated, reducing the cycle time of the purchase order process

The success of centralized material planning and the introduction of material planners also allow each functional group within Raytheon to place more focus on its core competency. Procurement has more time to negotiate with vendors for better pricing; MPS has more time to load and manage new business; and Production Control has more time to manage the flow of material on the shop floor.

Metrics Oregon Productivity Matrix

Raytheon’s Network Centric Systems Manufacturing Center in Largo, Florida, has transitioned from having inconsistent goals among different programs to having a standard set of metrics by implementing the Oregon Productivity Matrix. The most important benefit that the company has realized is employee awareness, with every Largo employee able to easily interpret and impact the data that represents customer satisfaction.

Prior to 2003, the manufacturing capabilities of Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, were not meeting customer expectations. This was due in part to a lack of focus on common goals. Each program at the Largo facility had different goals, utilized manual data gathering, and lacked consistent reporting methods.

In late 2003 the Largo facility implemented the Oregon Productivity Matrix (OPM), a method of indexing performance metrics as a means for identifying critical data that impacts strategic decision-making processes. Performance metrics include on-time delivery, estimate-to-complete variance, energy, people index, safety, regressive flow, inventory, overhaul and repair turn around time, kit on-time delivery to material requirements planning, and critical path cycle time. Automated processes are used to consolidate data from several sources. The metrics are now made visible for all employees through the Raytheon Largo Web site, the internal communications wall, shared drives, and E-rooms. A consolidated metrics Web site was implemented.

The benefits to Raytheon Largo after implementing the OPM include a user-friendly format for employees to understand and evaluate company metrics, the capability to track OPM trends, and the ability to benchmark against other Raytheon sites. OPM has enabled Raytheon Largo to become aware of and accountable for customer satisfaction through a variety of measurable data.

Mission Assurance

Raytheon has a proactive approach to satisfying customer needs and mission requirements by leveraging technology while operating within the constraints of the customer.

Raytheon’s Network Centric Systems (NCS) Manufacturing Center in Largo, Florida, has changed its perception as a black-box builder to one of being a system integrator through its focus on mission assurance. Mission assurance has evolved from Raytheon Six Sigma and other prior quality philoso-
phies and is defined as “100% customer success every time with no doubt.” Mission assurance consists of four dimensions:

• Mission Definition – Raytheon helps the customer define how the mission will be accomplished
• Mission Execution ensures that the Raytheon product works as advertised and meets the stated requirements of the customer by asking them
• Mission Support is based upon a positive customer relationship that enhances improvement opportunities by understanding potential gaps between delivered product capabilities and limitations and customer expectations. Mission Support also involves a commitment to the total life cycle of the product and the customer’s mission and a continuous adaptation of the product to changing mission requirements
• Mission Enhancement is improving the performance of the product to enhance the conduct of the mission. Raytheon understands the mission and the customer’s constraints and leverages enabling technologies to enhance the conduct of the mission

Mission assurance has demonstrated positive results by reducing turnaround time for overhaul and repair products by 30%. Radio frequency identification capability has been established and provided for customers on demand. Rework has been reduced by 55% in a three-year period.

Supplier Diversity

The Raytheon Supplier Diversity Focus programs not only help the company comply with law, rules and regulations, and customer requirements for utilizing a diverse supplier base, it helps to develop and build strong suppliers that can meet the company’s needs for products that meet the company’s requirements for successful business operations. The company’s Network Centric Systems Largo program’s four-pronged approach helps to ensure a win-win program for both Raytheon and its suppliers.

Maintaining a strong supplier base of preferred and certified suppliers who are willing to partner with a company is a challenge. Companies strive to develop suppliers who are responsive to their needs for reduced cost, minimal or no inventory at the company’s facilities, just-in-time deliveries, and willing to own all inventory until the company uses the parts and sells its product to its customers. While developing this supplier base, the company must also be sensitive to the needs of developing a strong supplier diversity program that is designed to drive supplier source selection strategy and ensure compliance with public law, Federal Acquisition Regulations, customer requirements, and company policy.

The Raytheon Network Centric Systems (NCS) facility in Largo, Florida, has developed a strong strategy to be more aggressive in the area of Supplier Diversity by taking a four-pronged approach to ensure Supplier Diversity in its supply chain. The first focus area is a comprehensive, small business subcontracting plan for use in all Department of Defense (DoD) contracts. The second focus area is a master scheduling plan for use in all government contracts. Third is the establishment of a set of Raytheon Largo Supplier Diversity strategies that include participation in state and national trade shows, participation in industry conventions pertaining to supply chain, establishment of a mentor-protégé program with prospective suppliers, awards and recognitions for small business suppliers, and establishing individual buyer goals for material. The fourth and key element of the Raytheon Largo Supplier Diversity program is the effort toward outreach being the number one method for sharing Raytheon strategy and objectives. The company has received a significant number of requests to support customer, industry and advocacy organization initiatives and events.

This four-pronged approach has been accepted and signed by the Raytheon Supplier Diversity vice president and by representatives of the Defense Contract Management Agency. These efforts will collectively help to ensure Raytheon’s compliance with public law, federal acquisition regulations, customer requirements, and company policy.

Value Stream Organization

Raytheon Network Centric Systems Manufacturing Center in Largo, Florida, has changed its organizational structure to one centered on value stream management. The new organization and associated processes have resulted in more adept use of continuous improvement methodology across the entire value stream. Reductions in manufacturing cycle time, rework, and depot turnaround times are some of the noteworthy results.

Raytheon Network Centric Systems (NCS) consolidated the production operations of a number of facilities at Largo, Florida. The NCS Manufacturing Center in Largo initially operated with functional
and business elements supported by an informal matrix organization. This organization focused on internal issues and tended to optimize activities within the individual functional areas. Optimization across the value stream was conducted with difficulty because of the inward focus of the functional areas that this organizational structure promoted. The value stream was often defined as “starting and ending within a functional area’s domain of control.”

To develop an organizational structure that would take full advantage of Raytheon Six Sigma continuous improvement methodology, Raytheon Largo mapped all major value streams of the organization. The organization then assigned leaders for each of the major value streams. Integrated Product Team (IPT) leaders all report into one of the value stream managers, and a matrix “home room” supports all the people resource needs of the IPT Leaders and their Value Stream Leaders.

This organizational change resulted in a new focus supporting a broader Lean culture by having managers assigned and accountable for optimizing the entire value stream versus optimizing only within the former stovepipe functional area. Programs are now executed by IPTs comprised of functional and program team members reporting to an IPT Leader and the Value Stream Manager. Knowledge and commonality are leveraged by organizing the value streams around common products and requirements as defined by the customer. Value Stream Leaders are responsible for the entire value stream (and eliminating waste within it) from contract development and award to customer delivery and post-production services. Post-production services (in-service support, depot and warranty) have been found to be areas of growth and importance to customer satisfaction. Team performance accountability is achieved by having all team members’ performance reported on by both the IPT leader and the functional leads. Individuals have to interview and compete for these new leadership positions, with Raytheon Largo looking for the right mix of technical and leadership skills. Positions were opened up to hourly and salaried employees, with this becoming a more formal way to get promoted than the previous system.

Benefits seen from the new value stream focused organization include:

- Improved accountability to performance
- Improved response to internal and external customers
- Improved team building and team dynamics
- Expanded depth and breadth of talent pool for future operations leaders
- Improved the identification and resolution of systemic problems
- Provided a formal opportunity for people to cross-train and for job rotation
- Improved efficiency and competitiveness in Largo’s speed, cost, and service

The new organization and associated processes have resulted in an organization more adept at using continuous improvement methodology across the entire value stream. Reductions in manufacturing cycle time, rework, and depot turnaround times are some of the noteworthy key performance results.
# Appendix A

## Table of Acronyms

<table>
<thead>
<tr>
<th>ACRONYM</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-D</td>
<td>Three-Dimensional</td>
</tr>
<tr>
<td>ASL</td>
<td>Approved Supplier List</td>
</tr>
<tr>
<td>ATE</td>
<td>Automated Test Equipment</td>
</tr>
<tr>
<td>BCWP</td>
<td>Budgeted Cost of Work Plan</td>
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<tr>
<td>BCWS</td>
<td>Budgeted Cost of Work Scheduled</td>
</tr>
<tr>
<td>CAB</td>
<td>Corrective Action Board</td>
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<tr>
<td>CCA</td>
<td>Circuit Card Assembly</td>
</tr>
<tr>
<td>CLIN</td>
<td>Contract Line</td>
</tr>
<tr>
<td>DCMA</td>
<td>Defense Contract Management Agency</td>
</tr>
<tr>
<td>DoD</td>
<td>Department of Defense</td>
</tr>
<tr>
<td>DOE</td>
<td>Department of Energy</td>
</tr>
<tr>
<td>EAC</td>
<td>Estimate at Complete</td>
</tr>
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<td>EAS</td>
<td>Engineering Assembly Shop</td>
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<td>ECN</td>
<td>Engineering Change Notice</td>
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<td>EDC</td>
<td>Economic Development Council</td>
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<td>ERG</td>
<td>Employee Resource Group</td>
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<tr>
<td>EVMS</td>
<td>Earned Value Management System</td>
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<td>FOD</td>
<td>Foreign Object Debris</td>
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<tr>
<td>HR</td>
<td>Human Resources</td>
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<tr>
<td>IPDS</td>
<td>Integrated Product Development System</td>
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<td>IPT</td>
<td>Integrated Product Team</td>
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<tr>
<td>IPTL</td>
<td>Integrated Product Team Leader</td>
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<td>ISST</td>
<td>Integrated Strategic Supplier Team</td>
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<td>JA</td>
<td>Junior Achievement</td>
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<tr>
<td>LMM</td>
<td>Lean Maturity Model</td>
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<td>MDA</td>
<td>Missile Defense Agency</td>
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<td>MPM</td>
<td>Material Program Manager</td>
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<td>MPS</td>
<td>Material Planning System</td>
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<tr>
<td>MRP</td>
<td>Manufacturing Resource Planning</td>
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<td>Material Resource Planning</td>
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<td>MTBF</td>
<td>Mean Time Between Failure</td>
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<td>NCS</td>
<td>Network Centric Systems</td>
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<tr>
<td>O&amp;R</td>
<td>Overhaul and Repair</td>
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<td>OPL</td>
<td>Operations Program Leadership</td>
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<tr>
<td>OPM</td>
<td>Operations Program Manager</td>
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<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>OPM</td>
<td>Oregon Productivity Matrix</td>
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<tr>
<td>OTD</td>
<td>On-Time Delivery</td>
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<tr>
<td>PERT</td>
<td>Project Evaluation Review Technique</td>
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<tr>
<td>PM</td>
<td>Preventive Maintenance</td>
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<td>POU</td>
<td>Point of Use</td>
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<tr>
<td>PRR</td>
<td>Production Readiness Review</td>
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<td>QA</td>
<td>Quality Assurance</td>
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<td>QE</td>
<td>Quality Engineer</td>
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<tr>
<td>R6S</td>
<td>Raytheon Six Sigma</td>
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<tr>
<td>RCCA</td>
<td>Root Cause Corrective Action</td>
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<td>RIMS</td>
<td>Record Information Management System</td>
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<tr>
<td>RLSDC</td>
<td>Raytheon Largo-St. Petersburg Diversity Council</td>
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<tr>
<td>RSC</td>
<td>Raytheon Systems Company</td>
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<tr>
<td>SFRB</td>
<td>Safety Failure Review Board</td>
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<tr>
<td>SME</td>
<td>Subject Matter Expert</td>
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<tr>
<td>SMI</td>
<td>Supplier-Managed Inventory</td>
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<td>SOI</td>
<td>Supplier-Owned Inventory</td>
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<td>SPI</td>
<td>Schedule Performance Index</td>
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<td>SQUIDS</td>
<td>Structured Quality Information Data System</td>
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<td>SRM</td>
<td>Shared Resource Manager</td>
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<tr>
<td>STAR</td>
<td>Science, Technology, and Research</td>
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<tr>
<td>TAT</td>
<td>Turnaround Time</td>
</tr>
<tr>
<td>TBA</td>
<td>Tampa Brass &amp; Aluminum</td>
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<tr>
<td>VSL</td>
<td>Value Stream Leader</td>
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<tr>
<td>VTC</td>
<td>Virtual Commodity Team</td>
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</tbody>
</table>
# Appendix B

## BMP Survey Team

<table>
<thead>
<tr>
<th>Team Member</th>
<th>Activity</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Larry Halbig</td>
<td>BMP Field Office - Indianapolis</td>
<td>Team Chairman</td>
</tr>
<tr>
<td>317-891-9901</td>
<td>Indianapolis, IN</td>
<td></td>
</tr>
<tr>
<td>Gail Lavrusky</td>
<td>BMP Center of Excellence</td>
<td>Technical Writer</td>
</tr>
<tr>
<td>301-405-9990</td>
<td>College Park, MD</td>
<td></td>
</tr>
<tr>
<td><strong>TEAM 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Larry Robertson</td>
<td>Naval Surface Warfare Center – Crane</td>
<td>Team Leader</td>
</tr>
<tr>
<td>812-854-5336</td>
<td>Crane, IN</td>
<td></td>
</tr>
<tr>
<td>Rick Foley</td>
<td>Tobyhanna Army Depot</td>
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<td>570-895-8391</td>
<td>Tobyhanna, PA</td>
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<tr>
<td>Alex Holtet</td>
<td>Booz Allen Hamilton</td>
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<tr>
<td>619-680-4894</td>
<td>San Diego, CA</td>
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<tr>
<td><strong>TEAM 2</strong></td>
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</tr>
<tr>
<td>Rick Buentello</td>
<td>BMP Center of Excellence</td>
<td>Team Leader</td>
</tr>
<tr>
<td>301-405-9990</td>
<td>College Park, MD</td>
<td></td>
</tr>
<tr>
<td>Dave Mattingly</td>
<td>Raytheon Missile Systems</td>
<td></td>
</tr>
<tr>
<td>502-364-6766</td>
<td>Louisville, KY</td>
<td></td>
</tr>
<tr>
<td>Scott Eckhart</td>
<td>Tobyhanna Army Depot</td>
<td></td>
</tr>
<tr>
<td>570-895-8833</td>
<td>Tobyhanna, PA</td>
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<tr>
<td><strong>TEAM 3</strong></td>
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<tr>
<td>Don Hill</td>
<td>BMP Field Office - Indianapolis</td>
<td>Team Leader</td>
</tr>
<tr>
<td>317-849-3202</td>
<td>Indianapolis, IN</td>
<td></td>
</tr>
<tr>
<td>Ron Williams</td>
<td>BMP Center of Excellence</td>
<td></td>
</tr>
<tr>
<td>301-405-9990</td>
<td>College Park, MD</td>
<td></td>
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<tr>
<td>April Garrahan</td>
<td>Tobyhanna Army Depot</td>
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</tr>
<tr>
<td>570-895-9433</td>
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<td><strong>TEAM 4</strong></td>
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<tr>
<td>Al Lang</td>
<td>BMP Field Office - Charleston</td>
<td>Team Leader</td>
</tr>
<tr>
<td>843-818-9498</td>
<td>Charleston, SC</td>
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</tr>
<tr>
<td>Brian Keller</td>
<td>Space &amp; Naval Warfare Systems Command</td>
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<tr>
<td>619-829-6375</td>
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<tr>
<td>Alex Tsurikov</td>
<td>Naval Surface Warfare Center - Carderock</td>
<td></td>
</tr>
<tr>
<td>301-227-2074</td>
<td>West Bethesda, MD</td>
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</table>
Appendix C

Critical Path Templates and BMP Templates

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

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

“CRITICAL PATH TEMPLATES FOR TRANSITION FROM DEVELOPMENT TO PRODUCTION”
**Appendix D**

*The Program Manager’s WorkStation*

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

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

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

The **BMP Database** provides experience as a unique, one-of-a-kind resource with more than 4,000 best practices that have been verified and documented by an independent team of experts during BMP surveys. BMP publishes its findings in survey reports and provides the user with basic background, process descriptions, metrics and lessons learned, and a point of contact for further information. The BMP Database features a searching capability so users can locate specific topics by typing in keywords. Users can either view the results on screen or print them as individual abstracts, a single report, or a series of reports. The database can also be downloaded, run on-line, or purchased on CD-ROM from the BMP Center of Excellence. The BMP Database continues to grow as new surveys are completed. Additionally, the database is reviewed every other year by a BMP core team of experts to ensure the information remains current.

For additional information on PMWS, please contact the Help Desk at (301) 403-8179, or visit the BMP Web site at http://www.bmpcoe.org.
Appendix E

Best Manufacturing Practices Satellite Centers

There are currently 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, with the centers hosting informative, one-day regional workshops that focus on specific technical issues.

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

The nine BMP satellite centers include:

California

Izlay (Izzy) Mercankaya
BMP Satellite Center Manager
Naval Surface Warfare Center, Corona Division
Code QA-21, P.O. Box 5000
Corona, CA 92878-5000
(951) 273-5440
FAX: (951) 273-5315
izlay.mercankaya@navy.mil

District of Columbia

Brad Botwin
BMP Satellite Center Manager
U.S. Department of Commerce
Bureau of Industry & Security
14th Street & Constitution Avenue, N.W.
H3876
Washington, DC 20230
(202) 482-4060
FAX: (202) 482-5650
bbotwin@bis.doc.gov

Illinois

Robert Lindstrom
BMP Satellite Center Manager
Rock Valley College
3301 North Mulford Road
Rockford, IL 61114-5699
(815) 540-9843
lindy003@insightbb.com

Iowa

Ron Cox
BMP Satellite Center Manager
Iowa Procurement Outreach Center
2273 Howe Hall, Suite 2617
Ames, IA 50011
(515) 289-0280 or (515) 294-5240
FAX: (515) 294-4925
rcox@iastate.edu

Louisiana

Gregory T. Dobson, Ph.D.
BMP Satellite Center Manager
Site Director, Simulation Based Design Center
University of New Orleans, College of Engineering
Gulf Coast Region Maritime Technology Center
C/o NGSS-Avondale Operations
Station 721-1-1
5100 River Road
New Orleans, LA 70094-2706
(504) 654-2773
FAX: (504) 654-3880
greg.dobson@gcrmtc.org

Ohio

Larry Brown
BMP Satellite Center Manager
Edison Welding Institute
1250 Arthur E. Adams Drive
Columbus, OH 43221-3585
(614) 688-5080
FAX: (614) 688-5001
larry_brown@ewi.org
<table>
<thead>
<tr>
<th>State</th>
<th>Name</th>
<th>Title</th>
<th>Organization and Address</th>
<th>Phone</th>
<th>Fax</th>
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<tbody>
<tr>
<td>Pennsylvania</td>
<td>John W. Lloyd</td>
<td>BMP Satellite Center Manager</td>
<td>MANTEC, Inc. P.O. Box 5046 York, PA 17405</td>
<td>(717) 843-5054</td>
<td>(717) 843-0087</td>
<td><a href="mailto:lloydjw@mantec.org">lloydjw@mantec.org</a></td>
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<tr>
<td>South Carolina</td>
<td>Henry E. Watson</td>
<td>BMP Satellite Center Manager</td>
<td>South Carolina Research Authority - Applied Research and Development Institute 100 Fluor Daniel Clemson, SC 29634</td>
<td>(864) 656-6566</td>
<td>(843) 767-3367</td>
<td><a href="mailto:watson@scra.org">watson@scra.org</a></td>
</tr>
<tr>
<td></td>
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<tr>
<td>Tennessee</td>
<td>Duane Bias</td>
<td>BMP Satellite Center Manager</td>
<td>Y-12 National Security Complex BWXT Y-12, L.L.C. P.O. Box 2009 Bear Creek Road Oak Ridge, TN 37831-8091</td>
<td>(865) 241-9288</td>
<td>(865) 574-4614</td>
<td><a href="mailto:biasdl@y12.doe.gov">biasdl@y12.doe.gov</a></td>
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</table>
Appendix F

Navy Manufacturing Technology Centers of Excellence

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

Best Manufacturing Practices Center of Excellence

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

Point of Contact:
Rebecca Clayton
Best Manufacturing Practices Center of Excellence
4321 Hartwick Road
Suite 400
College Park, MD 20740
Phone: (301) 405-9990
FAX: (301) 403-8180
E-mail: rebecca@bmpcoe.org

Institute for Manufacturing and Sustainment Technologies

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

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

Composites Manufacturing Technology Center (operated by the South Carolina Research Authority)

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

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

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

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

Electro-Optics Center (operated by the Pennsylvania State University’s Applied Research Laboratory)

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

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

Navy Joining Center (operated by Edison Welding Institute)

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

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

Navy Metalworking Center (operated by Concurrent Technologies Corporation)

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

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

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

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

Center for Naval Shipbuilding Technology

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

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

Gulf Coast Region Maritime Technology Center (operated by the University of New Orleans College of Engineering)

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

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

### Completed Surveys

As of this publication, 152 surveys have been conducted and published by BMP at the companies listed below. Copies of older survey reports may be obtained through DTIC or by accessing the BMP Web site. Requests for copies of recent survey reports or inquiries regarding BMP may be directed to:

Best Manufacturing Practices Program  
4321 Hartwick Road, Suite 400  
College Park, MD 20740  
Attn: Rebecca Clayton, Director  
Phone: 1-800-789-4267  
FAX: (301) 403-8180  
rebecca@bmpcoe.org

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<th>Company Name and Location</th>
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<tbody>
<tr>
<td>1985</td>
<td>Litton Guidance &amp; Control Systems Division - Woodland Hills, CA (now Northrop Grumman Navigation Systems)</td>
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| 1986 | Honeywell, Incorporated Undersea Systems Division - Hopkins, MN (now Alliant TechSystems, Inc.)  
Texas Instruments Defense Systems & Electronics Group - Lewisville, TX  
General Dynamics Pomona Division - Pomona, CA  
Harris Corporation Government Support Systems Division - Syosset, NY  
IBM Corporation Federal Systems Division - Owego, NY  
Control Data Corporation Government Systems Division - Minneapolis, MN |
| 1987 | Hughes Aircraft Company Radar Systems Group - Los Angeles, CA  
ITT Avionics Division - Clifton, NJ  
Rockwell International Corporation Collins Defense Communications - Cedar Rapids, IA (now Rockwell Collins)  
UNISYS Computer Systems Division - St. Paul, MN |
| 1988 | Motorola Government Electronics Group - Scottsdale, AZ  
General Dynamics Fort Worth Division - Fort Worth, TX  
Texas Instruments Defense Systems & Electronics Group - Dallas, TX  
Hughes Aircraft Company Missile Systems Group - Tucson, AZ  
Bell Helicopter Textron, Inc. - Fort Worth, TX  
Litton Data Systems Division - Van Nuys, CA  
GTE C 2 Systems Sector - Needham Heights, MA |
| 1989 | McDonnell Douglas Corporation McDonnell Aircraft Company - St. Louis, MO  
Northrop Corporation Aircraft Division - Hawthorne, CA  
Litton Applied Technology Division - San Jose, CA  
Litton Amecom Division - College Park, MD (now Northrop Grumman Electronic Systems Division)  
Standard Industries - LaMirada, CA (now SI Manufacturing)  
Engineered Circuit Research, Incorporated - Milpitas, CA  
Teledyne Industries Incorporated Electronics Division - Newbury Park, CA  
Lockheed Aeronautical Systems Company - Marietta, GA  
Lockheed Missile Systems Division - Sunnyvale, CA (now Lockheed Martin Missiles and Space)  
Westinghouse Electronic Systems Group - Baltimore, MD (now Northrop Grumman Corporation)  
General Electric Naval & Drive Turbine Systems - Fitchburg, MA  
Rockwell Autonetics Electronics Systems - Anaheim, CA (now Boeing North American A&MSD)  
TRICOR Systems, Incorporated - Elgin, IL |
| 1990 | Hughes Aircraft Company Ground Systems Group - Fullerton, CA  
TRW Military Electronics and Avionics Division - San Diego, CA  
MechTronics of Arizona, Inc. - Phoenix, AZ  
Boeing Aerospace & Electronics - Corinth, TX  
Technology Matrix Consortium - Traverse City, MI  
Textron Lycoming - Stratford, CT |
1991
Resurvey of Litton Guidance & Control Systems Division - Woodland Hills, CA
Norden Systems, Inc. - Norwalk, CT (now Northrop Grumman Norden Systems)
Naval Avionics Center - Indianapolis, IN
United Electric Controls - Watertown, MA
Kurt Manufacturing Company - Minneapolis, MN
MagneTek Defense Systems - Anaheim, CA (now Power Paragon, Inc.)
Raytheon Missile Systems Division - Andover, MA (now Raytheon Integrated Air Defense Center)
AT&T Federal Systems Advanced Technologies and AT&T Bell Laboratories - Greensboro, NC and Whippany, NJ
Resurvey of Texas Instruments Defense Systems & Electronics Group - Lewisville, TX

1992
Tandem Computers - Cupertino, CA
Charleston Naval Shipyard - Charleston, SC
Conax Florida Corporation - St. Petersburg, FL
Texas Instruments Semiconductor Group Military Products - Midland, TX
Hewlett-Packard Palo Alto Fabrication Center - Palo Alto, CA
Watervliet U.S. Army Arsenal - Watervliet, NY
Digital Equipment Company Enclosures Business - Westfield, MA and Maynard, MA
Computing Devices International - Minneapolis, MN (now General Dynamics Information Systems)
(Resurvey of Control Data Corporation Government Systems Division)
Naval Aviation Depot Naval Air Station - Pensacola, FL

1993
NASA Marshall Space Flight Center - Huntsville, AL
Naval Aviation Depot Naval Air Station - Jacksonville, FL
Department of Energy Oak Ridge Facilities (Operated by Martin Marietta Energy Systems, Inc.) - Oak Ridge, TN
(National Nuclear Security Administration)
McDonnell Douglas Aerospace - Huntington Beach, CA (now Boeing Space Systems)
Naval Surface Warfare Center Crane Division - Crane, IN and Louisville, KY
Philadelphia Naval Shipyard - Philadelphia, PA
R. J. Reynolds Tobacco Company - Winston-Salem, NC
Crystal Gateway Marriott Hotel - Arlington, VA
Hamilton Standard Electronic Manufacturing Facility - Farmington, CT (now Hamilton Sundstrand)
Alpha Industries, Inc. - Methuen, MA

1994
Harris Semiconductor - Palm Bay, FL (now Intersil Corporation)
United Defense, L.P. Ground Systems Division - San Jose, CA
Naval Undersea Warfare Center Division Keyport - Keyport, WA
Mason & Hanger - Silas Mason Co., Inc. - Middletown, IA (now American Ordnance LLC)
Kaiser Electronics - San Jose, CA
U.S. Army Combat Systems Test Activity - Aberdeen, MD (now Aberdeen Test Center)
Stafford County Public Schools - Stafford County, VA

1995
Sandia National Laboratories - Albuquerque, NM
Rockwell Collins Avionics & Communications Division - Cedar Rapids, IA (now Rockwell Collins, Inc.)
(Resurvey of Rockwell International Corporation Collins Defense Communications)
Lockheed Martin Electronics & Missiles - Orlando, FL
McDonnell Douglas Aerospace (St. Louis) - St. Louis, MO (now Boeing Integrated Defense Systems)
(Resurvey of McDonnell Douglas Corporation - McDonnell Aircraft Company)
Dayton Parts, Inc. - Harrisburg, PA
Wainwright Industries - St. Peters, MO
Lockheed Martin Tactical Aircraft Systems - Fort Worth, TX (now Lockheed Martin Aeronautics Company)
(Resurvey of General Dynamics Fort Worth Division)
Lockheed Martin Government Electronic Systems - Moorestown, NJ
Sacramento Manufacturing and Services Division - Sacramento, CA
JLG Industries, Inc. - McConnellsburg, PA

1996
City of Chattanooga - Chattanooga, TN
Mason & Hanger Corporation - Pantex Plant - Amarillo, TX
Nascote Industries, Inc. - Nashville, IL
Weirton Steel Corporation - Weirton, WV
NASA Kennedy Space Center - Cape Canaveral, FL
Resurvey of Department of Energy Oak Ridge Operations - Oak Ridge, TN (now National Nuclear Security Administration)

G-2
1997

- Headquarters, U.S. Army Industrial Operations Command - Rock Island, IL (now Operational Support Command)
- SAE International and Performance Review Institute - Warrendale, PA
- Polaroid Corporation - Waltham, MA
- Cincinnati Milacron, Inc. - Cincinnati, OH (now Cincinnati Machine, LLC)
- Lawrence Livermore National Laboratory - Livermore, CA
- Sharretts Plating Company, Inc. - Emigsville, PA
- Thermacore, Inc. - Lancaster, PA
- Rock Island Arsenal - Rock Island, IL
- Northrop Grumman Corporation - El Segundo, CA
  (Resurvey of Northrop Corporation Aircraft Division)
- Letterkenny Army Depot - Chambersburg, PA
- Elizabethtown College - Elizabethtown, PA
- Tooele Army Depot - Tooele, UT

1998

- United Electric Controls - Watertown, MA
- Strite Industries Limited - Cambridge, Ontario, Canada
- Northrop Grumman Corporation - El Segundo, CA
- Corpus Christi Army Depot - Corpus Christi, TX
- Anniston Army Depot - Anniston, AL
- Naval Air Warfare Center, Lakehurst - Lakehurst, NJ
- Sierra Army Depot - Herlong, CA
- ITT Industries Aerospace/Communications Division - Fort Wayne, IN
- Raytheon Missile Systems Company - Tucson, AZ
- Naval Aviation Depot North Island - San Diego, CA
- U.S.S. Carl Vinson (CVN-70) - Commander Naval Air Force, U.S. Pacific Fleet
- Tobyhanna Army Depot - Tobyhanna, PA

1999

- Wilton Armetale - Mount Joy, PA
- Applied Research Laboratory, Pennsylvania State University - State College, PA
- Electric Boat Corporation, Quonset Point Facility - North Kingstown, RI
- Resurvey of NASA Marshall Space Flight Center - Huntsville, AL
- Orenda Turbines, Division of Magellan Aerospace Corporation - Mississauga, Ontario, Canada (now Orenda Turbines, Repair, Overhaul and Industrial - Division of Magellan Aerospace Corporation)

2000

- Northrop Grumman, Defensive Systems Division - Rolling Meadows, IL
- Crane Army Ammunition Activity - Crane, IN
- Naval Sea Logistics Center, Detachment Portsmouth - Portsmouth, NH
- Stryker Howmedica Osteonics - Allendale, NJ (now Stryker Orthopaedics)

2001

- The Tri-Cities Tennessee/Virginia Region - Johnson City, TN
- General Dynamics Armament Systems - Burlington, VT (now General Dynamics Armament and Technical Products)
- Lockheed Martin Naval Electronics & Surveillance Systems-Surface Systems - Moorestown, NJ (now Lockheed Martin MS-2)
- Frontier Electronic Systems - Stillwater, OK

2002

- U.S. Coast Guard, Maintenance and Logistics Command-Atlantic - Norfolk, VA
- U.S. Coast Guard, Maintenance and Logistics Command-Pacific - Alameda, CA
- Directorate for Missiles and Surface Launchers (PEO TSC-M/L) - Arlington, VA (now Surface Ship Weapons & Launchers - PEO IWS 3.0)
- General Tool Company - Cincinnati, OH

2003

- University of New Orleans, College of Engineering - New Orleans, LA
- Bender Shipbuilding and Repair Company, Inc. - Mobile, AL
- In Tolerance - Cedar Rapids, IA
- ABC Virtual Communications, Inc. - West Des Moines, IA
- Resurvey of Electric Boat Corporation, Quonset Point Facility - North Kingstown, RI
- United Defense, L.P. Ground Systems Division - Aiken, SC
- Auto-Valve, Inc. - Dayton, OH
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TOMAK Precision - Lebanon, OH  
RB Tool & Manufacturing Company - Cincinnati, OH  
Forest City Gear - Roscoe, IL  
CALCE Electronic Products and Systems Center - College Park, MD (now Center for Advanced Life Cycle Engineering - CALCE)  
U.S. Army Aviation & Missile Command, Automation Division-Integrated Materiel Management Center - Redstone Arsenal, AL | |
| 2005 | Northrop Grumman Electronic Systems - Baltimore, MD  
Raytheon Integrated Air Defense Center - Andover, MA | |
| 2006 | Raytheon-Louisville - Louisville, KY  
Midwest Metal Products - Cedar Rapids, IA  
Rockwell Collins - Cedar Rapids, IA  
Resurvey of Tobyhanna Army Depot - Tobyhanna, PA | |
| 2007 | Raytheon Network Centric Systems Manufacturing Center - Largo, FL | |