REPORT OF SURVEY CONDUCTED AT

ABC VIRTUAL COMMUNICATIONS, INC.
WEST DES MOINES, IA

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Best Manufacturing Practices

1998 Award Winner

INNOVATIONS IN AMERICAN GOVERNMENT

BEST MANUFACTURING PRACTICES CENTER OF EXCELLENCE
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Foreword

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

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

BMP identifies and documents best practices by conducting in-depth, voluntary surveys such as this one at ABC Virtual Communications, Inc., conducted during the week of June 2, 2003. Teams of BMP experts work hand-in-hand on-site with the company to examine existing practices, uncover best practices, and identify areas for even better practices

The final survey report, which details the findings, is distributed electronically and in hard copy to thousands of representatives from industry, government, and academia throughout the U.S. and Canada – *so the knowledge can be shared.* BMP also distributes this information through several interactive services which include CD-ROMs and a World Wide Web Home Page located on the Internet at http://www.bmpcoe.org. The actual exchange of detailed data is between companies at their discretion.

ABC Virtual Communications, Inc. has become a leading Internet software development and consulting company focusing its expertise, skill, and knowledge on e-Business products and services. The company is dedicated to excellence and committed to innovation. Among the best examples were ABC Virtual Communications, Inc.'s Software Development Methodology, Boot Camp Training Approach, and ECLoanPro Network.

The BMP Program is committed to strengthening the U.S. industrial base. Survey findings in reports such as this one on ABC Virtual Communications, Inc. expand BMP's contribution toward its goal of a stronger, more competitive, globally-minded, and environmentally-conscious American industrial program.

I encourage your participation and use of this unique resource.

Anne Marie T. SuPrise, Ph.D.
Director, Best Manufacturing Practices

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Section 1

Report Summary

Background

With the Web in its early stages and the insight for the potential of Internet technology, two software architects formed ABC Virtual Communications, Inc. (ABCV) in 1995. Located in West Des Moines, Iowa, ABCV has helped companies extend the reach of their enterprises through Web-Centric technologies, and has become the Internet software development and consulting company of choice focusing its expertise, skill, and knowledge on Internet-based e-Business products and services. ABCV targets medium- to large-sized companies where great demands for practical, cost-effective, and timely solutions are a reality. ABC Virtual is also involved with several regional trade associations such as the Mortgage Brokers Association of America and Software and Information Technology of Iowa.

ABCV's customers include several industries — financial, insurance, utilities, mortgage, medical manufacturing, and agriculture — which reflect the company's combined expertise and ability to produce solutions applicable to multiple industries. ABCV is a product development company recognized worldwide for its expertise in web-enabled application development using distributed computing and middleware technologies. In 2000, ABCV launched its flagship product, ECLoanPro, a comprehensive Web-based mortgage processing automation system. This was the first application built on ABCV's Internet Application Framework technology and provides essential productivity tools to manage and compress the complex loan origination process. Among the best practices documented were ABCV's Reusable Frameworks, Software Development Methodology, Business Process Collaboration, Boot Camp Training Approach, Unique Business Model, and Workforce Diversity Training. In 2001, ABCV was awarded the Economic Impact Award for creating jobs and contributing to a strong Greater Des Moines economy. The company has also been recognized as an "Outstanding Virtual Organization" during the Iowa Interactive Age Awards Program. These awards are designed to recognize and celebrate the achievements of Iowa companies and executives demonstrating leadership in developing or using electronic technologies on a local, national, or global scale to expand their business and communicate more effectively."

With a $500K Community Economic Betterment Account investment from the Iowa Department of Economic Development, ABCV plans to expand its workforce from 75 to 275. Dedicated to excellence and committed to innovation, ABCV has attracted and retained highly skilled employees in an extremely competitive market, enabling the company to help its customers extend the reach of their enterprises using the power of Internet technologies. The BMP survey team finds the practices in this report to be among the best in industry and government.

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Section 2

Best Practices

Design

Reusable Frameworks

ABC Virtual Communications, Inc. has developed several software frameworks that can be reused to facilitate more rapid development of robust software solutions. The development team builds new services by focusing on the high level architecture and designing the interface to interact with the low level, common architectural framework.

Accepted industry practices require the software developer of individual components to be responsible for an extensive amount of effort developing the low level architecture of an application. This type of development process resulted in limited deliverable functionality per unit time of production, while developing undesirable inconsistencies between separate developer's implementations that resulted in high maintenance costs.

Seeing the shortcomings of the accepted industry practices, ABC Virtual Communications, Inc. (ABVC) has implemented a new process that establishes a framework consisting of common components. These components are arranged in specified object repositories where applications can inherit the characteristics associated with the desired component. Using this process, developers can build solutions within the high level of the application architecture, and allow the use of the common components to provide the support on the lower architectural level. The development team builds new interfaces by focusing on the requisite data formats and any non-standard communication protocols.

One major challenge of a common, reusable framework is the process of client software updates. ABCV addresses this challenge by implementing an update process, which pushes the software applicable to the update to the clients' desktop when the client connects to the service. The client is notified when an update is available and has the choice of downloading the current updates. To prevent data being pushed from the client through the service in a format not supported by the update, the client is restricted from this process until the update has been downloaded. The client can make changes to the data currently residing on his/her local desktop. The data is then pushed through the service when the client has time to perform the required update.

The use of this framework provides many benefits, one of which eliminates the duplication of work effort. This factor and other issues on the use of previously developed components allow for predictable delivery schedules by developing maintainable and robust systems. It also provides the client with the functionality to operate the application on or off line. By using common components throughout all applications, the training required for developers new to the process is simplified by developers only understanding the common components that reside within the framework.

Software Development Methodology

ABC Virtual Communications, Inc. has implemented an industry-based process of organizing object-oriented design architecture using the Rational Rose Toolkit to incorporate the Rational Unified Process software development process. This process has provided a dynamic approach to documentation, requirements change, customer involvement, and communication of project progress.

ABC Virtual Communications, Inc.'s (ABCV's) previous method of paper-based processes was inefficient based on the manual maintenance required to support the incomplete and contradicting documentation it provided. Additional issues necessary for a better development process include the necessary time to maintain information, the inability to deal with changes in requirements, client expectations regarding tool proficiency, and the disconnection between implemented code and the associated documentation.

ABCV's Software Development Life Cycle is a tailored version of the Rational Unified Process (RUP), an industry-proven software development process for organizing object-oriented design architecture. RUP enables ABCV to select and deploy only the process components needed for each project

stage, using tools for configuring RUP to meet the specific project needs and developing internal knowledge into process components. RUP provides a graphical description of the solution design, displaying the relationships between components.

The implementation of this methodology has provided ABCV with a more efficient process that has become an instrumental asset to the business. This process, which gives a high-level description of the system, ensures the developers remain focused on the "big picture." With implementation of this process, ABCV began a method that involves an industry standard which provides a common vocabulary. This makes design decisions easier to communicate internally and with the customer. This methodology also provided ABCV with a more accurate process in establishing project estimates, and makes the process of requirements change easier to document and implement into the overall solution.

Uniform Mandated Build Configurations

Standardization of server build configurations and the addition of standardized build checklists have allowed ABC Virtual Communications, Inc. to significantly reduce the time required to install new systems in support of customer needs. This approach has also allowed the company to reduce its support personnel requirements and provide uniformity from system-to-system.

Prior to late 1999, ABC Virtual Communications, Inc. (ABCV) managed the development and build of computer systems (servers) by allowing the installers to build the system as they thought it should be built. This practice led to large-scale, non-standardization in hardware and software for each system built. This approach also led to an increase in Help Desk calls, increased downtime due to reconfiguration requirements, increased troubleshooting times, and a general overloading of personnel supporting the different systems.

In an effort to support a growing number of servers and projects with a small support staff, ABCV developed a mandated system of build checklists for all new servers. The procedures listed in each checklist must be followed and signed off at each step of the build process. Once the system is built, the completed checklists are stored in a common area accessible by all implementation team staff. This process allows anyone on staff to know right away how a system is built and configured. In this way, the time to debug any problems is greatly reduced, and all administrators have the same information available to them whether or not they built the system. Scripts and programs on one system type will work the same on all other systems of that type.

Since incorporating standard processes and build configurations, ABCV has reduced the number of people supporting servers by a ratio of 6:1. This approach has also allowed the company to automate routine maintenance due to the system uniformity, improve installation consistency, reduce time spent to install new systems, reduce help desk calls, and reduce troubleshooting time by more than 50 percent.

Test

Shared Responsibilities of Help Desk and Quality Assurance

ABC Virtual Communications, Inc.'s Help Desk and Quality Assurance teams share responsibilities to meet the cyclical demands of both functions while minimizing the overall cost. The results are a continuously up-to-date Help Desk, increased knowledge of product features, and greater availability to customers.

Prior to ABC Virtual Communications, Inc.'s (ABCV's) implementation of its product, ECLoanPro, one test team was adequate. In 1999, ECLoanPro was rolled-out and customer support became necessary. A Help Desk was created to support the new customer base using the expertise resident in the test team. Today the company's Help Desk and Quality Assurance (QA) teams are collocated and share responsibilities.

Help Desk and QA workloads are cyclical in nature and revolve around the release of software packages. Both Help Desk and QA functions are very complex due to the many different state and county rules and regulations, which must be tested by QA and understood by the Help Desk. QA is extremely busy during the weeks prior to a software release, while the Help Desk workload is typically low at this time. QA tasks decrease after a software release, while Help Desk calls spike. Help Desk support covers both technical support of the software and implementation of market-specific functionality within the product. The Help Desk team assists with testing prior to software release, which reduces the QA workload and familiarizes

the Help Desk personnel with the new software release. After software release, QA personnel assist with the spike in Help Desk calls. QA personnel also have insight into the next software release, which answers some Help Desk calls.

The Help Desk receives between six and 18 calls per day from 50 clients with approximately 2,000 users. At its peak, there were five QA and four Help Desk personnel, which has leveled off to three in each team. Personnel track the types of calls and look for any trends or repetition. Statistics on Help Desk calls are distributed to the entire team by e-mail. Sharing resources between these two teams has minimized the overall cost for QA and Help Desk, while meeting the demands in call volume and testing.

Management

Boot Camp Training Approach

ABC Virtual Communications, Inc. responded to an urgent need to bring 20 software developers quickly up-to-speed in Java skills by developing an intensive five-week training Boot Camp in Java and related technologies. The solution was extremely successful as measured by public opinion, student evaluations, and final testing of students.

ABC Virtual Communications, Inc.(ABCV) faced a need for 20 additional Java developers in a short period of time. Software engineers in the U.S. are typically attracted to the East and West coasts or other large cities, and Iowa companies find it difficult to attract this talent. The company chose to develop this talent by enhancing the skills of its own developers. Unfortunately, sending them to software development classes would require multiple classes to cover the required topics at considerable cost in tuition and time. Travel expenses would be significant because classes in the required subjects were not available in Iowa at that time. Instead, ABCV chose to develop a specialized curriculum with a training consultant and deliver an intensive five-week training Boot Camp in Java and related technologies in Des Moines, IA.

Several senior technical staff met with their training coordinator to draft a curriculum to meet their needs. They then had to find trainers who would tailor their courses to meet the company's specific needs. This also allowed the incorporation of ABCV proprietary skills into the course. Conference interviews with training companies and trainers were used to find trainers with the appropriate background, education, and sense of humor to hold everyone's attention for five weeks. The five-week course covered 25 topics and was split into 30% classroom instruction and 70% hands-on lab experience. Table 2-1, Java Boot Camp Outline, shows the course outline for the Boot Camp. Homework was assigned on evenings and weekends. Weekly evaluations were completed by the students on what they learned and on the instructors. Students received tests and evaluations by the instructors followed by an individual in-house final project to gauge the results of the Boot Camp.

The cost to send 20 developers to publicly available software courses was estimated at $375,000. The Java Boot Camp provided more specialized training, in a shorter period of time, at a total cost

IJOD Introduction	Exception Handling	Serialization	Using Java JNDI	Introduction to JSP
OOD Overview	Java Syntax	Using RMI for Distributed Computing	Introduction to EJB	Security
Java Tools/Libraries Overview	Primitive Objects	Basic Threading	Stateless Session Beans	Entity Beans: Bean-Managed Persistence
Containment/Arrays	Using Java Servlets	Advanced Thread Control	Advanced Stateless Session Beans	Java Messaging Service
OOAD Introduction	Visual Programming with Java Beans	Using Java Servlets and JSPs	Introduction to Entity Beans	EJB Design Patterns
System Sequence Diagrams	Event Handling with Java Beans	J2EE Overview	Advanced Entity Beans – Container Managed Persistence	WebSphere
Collaboration Diagrams	Anonymous Inner Classes for Event Adaptors	UML Notation & Terminology	Transaction Management	VisualAge for Java
Design Class Diagram	Using Reflections to Invoke Methods	J2EE Applications	EJB Exceptions	
Mapping Interfaces	Accessing Relational Databases with JDBC	Layered Architecturres	EJB Environment	
Inheritance	Designing a Layered Architecture	Introduction/Patterns – Distributed Object Computing	Stateful Session Beans	

Table 2-1. Java Boot Camp Outline

of $140,000. In addition, a training grant from the State of Iowa covered half of this cost. ABCV received an unexpected promotional benefit from the unusual training provided to its employees, and received an influx of resumes from prospective developers interested in attending the Java Boot Camp. ABCV consultants gained the latest technological training in Java and related technologies, putting them ahead of their competitors.

Business Process Collaboration

In 1999, ABC Virtual Communications, Inc., in close collaboration with its mortgage and banking clients, created a first-of-its-kind Business Process Collaboration tool to support industries such as mortgage, banking, healthcare, and insurance.

In 1999, ABC Virtual Communications, Inc.(ABCV), in close collaboration with its mortgage and banking clients, noticed that existing collaboration methods did not integrate data at the application level. No one had developed tools that automated or assisted with the collaboration of business processes, which are labor-intensive. ABCV clients were using an array of disparate systems, traditional groupware, and a lot of e-mail to service its ever-growing client base. These paper intensive transactions, involving interactions between enterprises, financial institutions, marketplaces and other service providers, were ready for change and updating. Since no tools were available to provide this vital function, ABCV created a first-of-its-kind Business Process Collaboration (BPC) tool that automates and assists in the collaboration of these business processes.

Figure 2-1, BPC Current Method, shows how mortgage, banking, healthcare, and insurance industries utilize a team of employees working together to provide a service to the customer (i.e., processing a loan application). Most of the team members work as part of a business process workflow with a multistage pipeline structure consisting of lead generation, sales force automation, ordering, processing, and fulfillment. The lack of ability to share business process information among team members at different stages of the loan application processing makes these business processes extremely complex. For example, front office applications can be closely tied to back-office systems. What was traditionally a back-office function (i.e., underwriting in a service-oriented industry), can now be partially fulfilled by the front office applications if a collaborative environment is available.

ABCV's Internet Application Framework supports business process collaboration among members in a team of authorized users as well as multiple installations for a given user. ABCV developed security policies that allow groups of people with different roles, possibly from multiple organizations, to work together, share information, and collaborate toward a workflow needed for specific service-oriented business processes. Multiple members of a team can share data using roles, permissions, and subscription. In order to share data, the roles of both members must permit such data movement; the owner of the data must give permission to the subscriber; and further, the subscriber must accept subscription from the owner. Figure 2-2, BPC Imple-

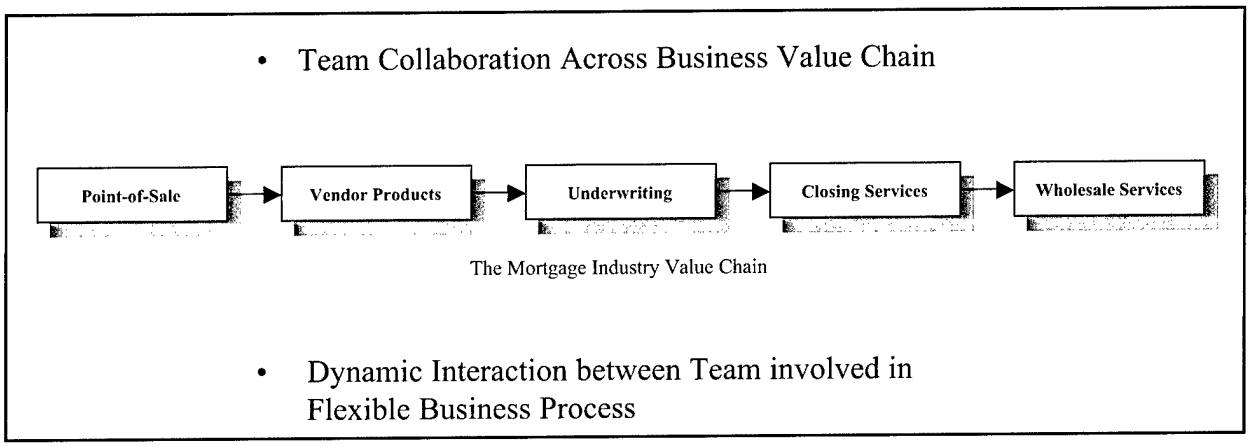


Figure 2-1. BPC Current Method

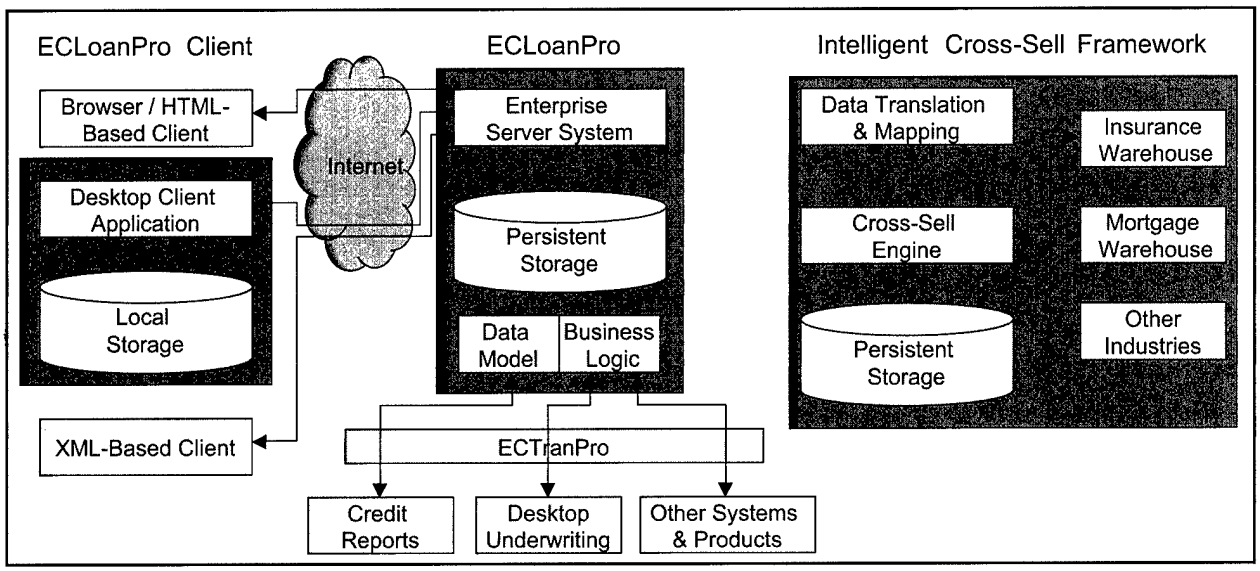


Figure 2-2. BPC Implementation

mentation, shows that once the authorized subscription is set-up, updates to data made in disconnected mode are also synchronized automatically without any user involvement.

Business Service Provider Strategy

In 1997, ABC Virtual Communications, Inc. created a Business Services Provider Strategy and began to provide small- and medium-sized companies comprehensive services to meet both the technology and business needs of service-oriented industries. ABC Virtual Communications, Inc. initially focused on the mortgage industry, and packaged the best practices of traditional consulting including software, hardware, infrastructure, hosting, and supporting services required by the mortgage industry.

In 1997, ABC Virtual Communications, Inc.(ABCV) saw a need to improve the Information Technology (IT) services to small- and medium-sized mortgage companies. To this end, ABCV developed a comprehensive Business Service Provider (BSP) Strategy and began to successfully provide end-to-end services to meet both the technology and business needs of service-oriented industries.

With the convergence of out-sourced business processing, hosted software, and open standards-based IT infrastructure, some companies are trying newer Internet-centric business models, such as Business-to-Consumer portals (Aggregators) or Application Service Providers (ASPs). Aggregators provide an interface to capture data from customers over the web, while ASPs provide web-based hosted business applications on a pay-based-on-use basis. None of these models address the need for automating comprehensive industry-specific business processes. ABCV's integrated business services link all the necessary elements for automating business processes in targeted vertical industries. ABCV offers mortgage companies Business-to-Business (B2B) enterprise portals for vertical industries that go beyond traditional product marketing, hosting, and technical consulting services.

ABCV's unique BSP strategy focuses on comprehensive services including in-house expertise which provides business and technical client support to its vertical industry. ABCV is Iowa's only small business, high end-to-end consulting, infrastructure, services, and hosting company. ABCV's core competencies are process re-engineering, consulting, hardware and software solutions, B2B interfaces and follow-on support services. The company uses streamlined, automated, straight-through processing to reduce cost and complexity. Customer data entry need only be entered once at the point-of-sale, requiring no further manual handling beyond the front office. Process or functionality changes (an inevitable result of regulation, legislation, product development or new market opportunities) need only be implemented once to become available throughout the entire end-to-end infrastructure.

Because of ABCV's unique knowledge of the U.S. mortgage industry, the company was aware that

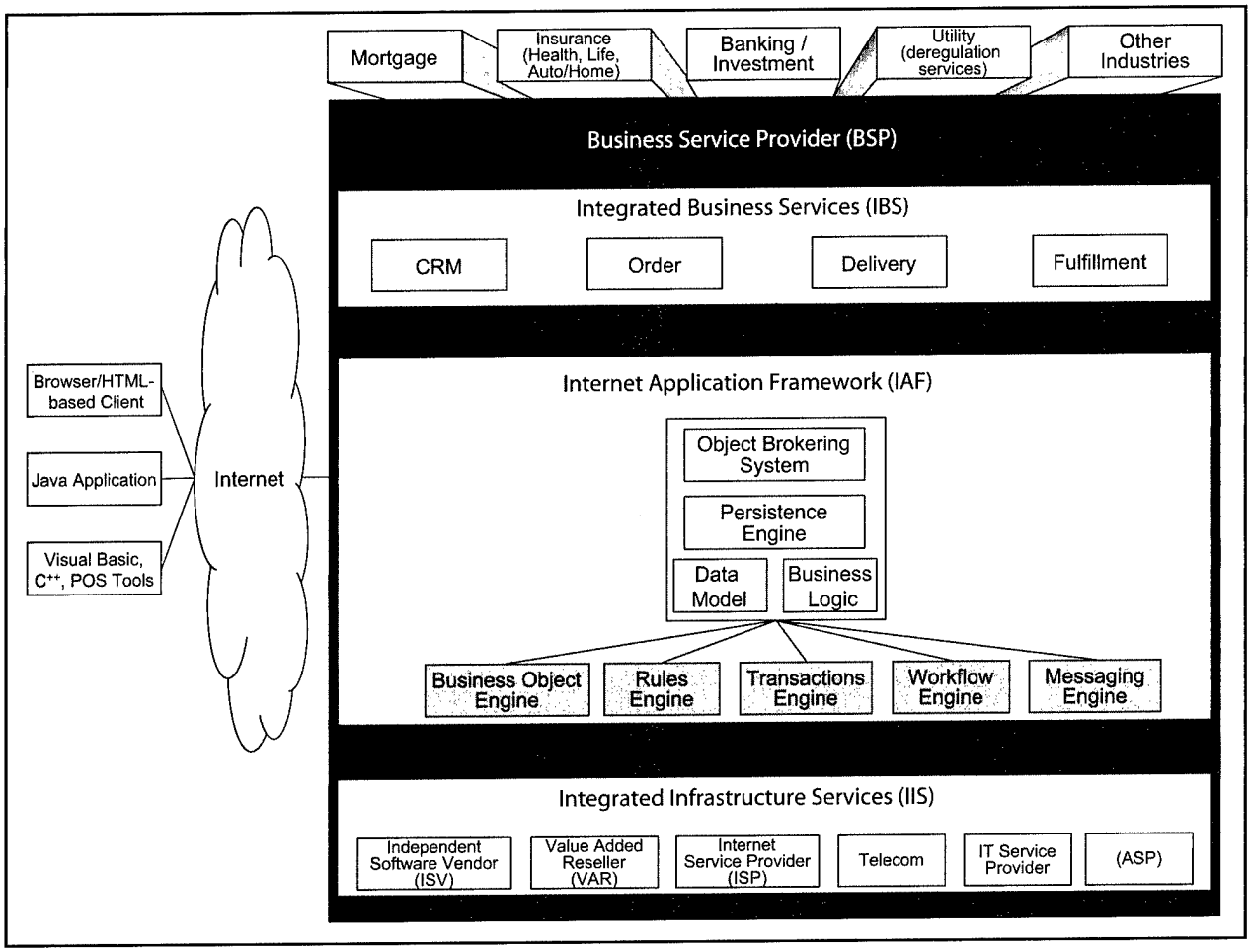


Figure 2-3. BSP Current Method

stove-pipe disparate systems clog front-office tasks (e.g., point of sale and origination, and stand-alone vendor product ordering system transactions). At the same time, back-office antiquated functional processes bogged down processing and underwriting, closing, funding, and account servicing.

An essential characteristic of ABCV's BSP strategy is to provide access to comprehensive services necessary for a given vertical industry using open standards and linking B2B transactions on the back end using a service-based architecture. Execution of the BSP model targeted the needs of both small companies as well as large corporations that needed one-stop access to integrated services in a given industry. The emphasis of ABCV's strategy is not in attempting to create a new marketplace or new ways to originate customer leads from the web; instead, ABCV's emphasis is on providing comprehensive services built on integrated infrastructure including hardware, software, and automated business processes and support services. This is an important consideration, because it means that the mature corporations with legacy applications can get access to web-based services faster than they can develop the services themselves. In addition, cost efficiency results by the sharing of infrastructure costs between multiple partners. Figure 2-3, BSP Current Method, shows how small companies can access state-of-the-art solutions at an affordable price.

ABCV is focusing initially toward the mortgage industry. Clients will interface their information systems with services over the Internet. The interface may occur at any stage in the sequence of the value chain. In the mortgage industry, a client may only use the companies' services to capture information for a loan application, and then transfer the information to a proprietary system, while another may also include services to obtain credit reports, desk top underwriting, etc. Over time, ABCV will

expand to other industries in which it has developed extensive know-how (e.g., insurance, banking, utilities) and eventually to others such as manufacturing and pharmaceuticals.

The BSP strategy is unique in providing a comprehensive set of services to meet both technology and business needs of service-oriented industries. ABCV has packaged the best practices of traditional consulting (both technical and business), software, hardware, infrastructure, hosting, and supporting services required by the mortgage industry. ABCV has built integrated frameworks to provide straight-through processing solutions at affordable prices that include all the components as a service.

ECLoanPro Network

ABC Virtual Communications, Inc's. shared cost model for its flagship product, ECLoanPro, enables small- to medium-sized companies to have the same advanced technology that many of the larger lending institutions use, without the large financial investment.

Small- and medium-sized mortgage companies and brokers need advanced technology to compete with larger companies. These smaller companies do not have the capital to invest in these technologies. ABC Virtual Communications, Inc.(ABCV) developed an affordable shared solution for these small companies. ABCV bundled multiple small mortgage and broker clients and hosted them jointly on one single server. By modifying its primary product deployment, ECLoanPro (ECLP), ABCV leveraged software, hardware, and applicable resources to provide small- and medium-sized clients a feature rich environment at considerable savings without sacrificing features.

ABCV's flagship product, ECLP, is three distinct product offerings: ECLP Network for small- to medium-sized companies that share a hosted environment; ECLP Service Bureau for clients who want the product hosted in ABCV's facility; and the licensed product that can be managed by the clients in their environment. The ECLP Network is designed for very small mortgage companies and brokers. Customers' transactions flow through and are stored on ABCV's servers in a secure, state-of-the-the-art facility to ensure security and reliability of the customers' data. The concept of smaller companies sharing software, hardware, and services to enable them to compete with the biggest and the best, is truly an advantage only the Internet can offer. Members of the ECLP Network are instantly connected to a network of other mortgage professionals, giving them the opportunity to develop prosperous business relationships and increase revenue potential.

By implementing this unique shared cost model, ABCV provides small- to medium-sized mortgage companies and brokers the same advanced technology that many of the larger lending institutions use, without the prohibitive financial investment. Currently, approximately 10% of ABCV's user base takes advantage of this solution.

Identify and Plan for Risk

ABC Virtual Communications, Inc. manages software development risk by identifying risks early, developing mitigation and contingency plans for those risks, and building time into the project schedule to monitor and deal with those risks. The result is that ABC Virtual Communications, Inc. prevents costly overruns associated with late risk realization, and projects are completed on time and within budget.

One of the keys to ABC Virtual Communications, Inc.'s (ABCV's) success in meeting contractual deadlines is a robust risk management strategy. In the company's early years, risk management was largely ignored, and problems and issues would be dealt with as they arose over the course of a project. Responding to these issues required significant resources (both time and personnel), causing projects to fall behind schedule, and requiring "heroic" efforts from the developers to get the product to the customer on time.

The company realized that in order to succeed, it had to identify and document risks early, and establish appropriate mitigation strategies. ABCV's approach to handling software development risk begins by allocating time at the beginning of each software development. The program manager and project architect define the boundaries of the system and identify potential impacts to project success. These are all recorded in a database. The next step is to develop mitigation (prevention) and contingency (reaction) plans for all identified risks. Time can then be built into the project's schedule for the following phase to deal with these risks.

One of the significant factors in ABCV's success in this area is the emphasis on the importance of

risk management. The company is totally committed to the risk management process, from the very top of its corporate structure down to the individual developers. The risk management program is considered a critical part of its process, and resources are allocated accordingly. Managers review the current risk status of their programs as often as twice a week to "stay on top of things."

While this appears to be a lot of effort at first glance, ABCV's experience has proven that the benefits (and payoffs) of this approach are significant. The amount of effort spent on mitigating risks and/or resolving them early is less than a tenth of the effort that was expended resolving problems after they surfaced on their own. In addition, since the time spent on risk mitigation is more consistent, the overall project schedule is easier to predict and can be calculated with much greater accuracy and confidence.

Iterative Development

The adoption of an iterative development methodology by ABC Virtual Communications, Inc. enabled the company to more accurately predict the time and effort needed to develop software projects. This methodology also allows the company to deal well with changing requirements and minimize the effect of change on the progress of the project.

Previously, ABC Virtual Communications, Inc. (ABCV) used the Waterfall model of software development as its development methodology. This methodology made it very difficult to accurately estimate the time needed to develop software projects, and made it expensive to handle requirement changes late in the project. When using the Waterfall methodology, it is common to discover software defects later in the development process. The later in the software development process a software defect is discovered, the more time it takes to fix that defect.

ABCV adopted an iterative development methodology to address the shortcomings of the Waterfall methodology. The iterative development methodology is composed of two phases: the first phase comprises scope and risk identification, high-level requirements gathering, functional screen designs, high-level architecture design, and phase two estimates; the second phase comprises finalization of requirements, finalization of architecture and design, development, and testing. Phase two activities are iterated a predefined number of times. Each iteration will produce a complete deliverable that implements a subset of the project's functionality.

By using an iterative development methodology, ABCV can more accurately estimate project development time and avoid cost overrun. ABCV's clients have been very satisfied with projects managed with the iterative development methodology. ABCV delivers projects closer to estimated schedules, and the development process is more amenable to the changes in project requirements that occur during the software development lifecycle. Additionally, ABCV improved employee morale by creating more accurate labor estimates and schedules.

Partnership to Reuse and Refine an IT Framework

ABC Virtual Communications, Inc. partnered with subject matter experts to create a flexible and reusable information technology framework. This framework enables the company to deliver proven solutions to its partners in a timely and cost-effective manner.

Previously, ABC Virtual Communications, Inc.(ABCV) was a typical information technology (IT) consulting company. The company performed consulting tasks such as web site design and hosting, server and middleware configuration, and custom software development. While performing these consulting tasks, ABCV identified the opportunity to partner with subject matter experts in specific industries to create a generic IT framework that could be applied across several industries.

The generic framework consists of several important features. It is designed to be easily expandable and flexible allowing rapid adaptability for new requirements. The generic framework is designed to support thin (web browsers) and thick (standalone applications) clients. It also supports connected and disconnected modes of operation using asynchronous groupware features. The generic framework has built-in software, content, and metadata updates. Design patterns are used in the implementation of the generic framework, which makes it possible to reuse business objects on both the thin and thick clients.

The close working relationship between ABCV and its partners enables the company to clearly focus on requirements. This relationship has two

benefits: first, it allows ABCV to focus on its core IT competencies; and second, its partners focus on their competencies. ABCV was able to adapt its partners' requirements into a generic framework that could be easily applied to other industries.

By applying its generic framework to new industries, ABCV reduced the development costs, and the time it took to market and provide a proven solution to its partners. In addition, by creating a generic framework that can be applied to new partners, ABCV delivers a proven solution and reduces the risk of failure. It has been estimated that 30% of an IT project cost is in infrastructure. ABCV's generic framework implements this infrastructure, thereby reducing development costs for new projects that use the generic framework.

Technical Due Diligence

ABC Virtual Communications, Inc. identified the need to be a rapid adopter of new technologies to differentiate itself from its competitors. At the same time, the company needed to continue delivering successful solutions with low to moderate risk to its clients. To satisfy these conflicting requirements, ABC Virtual Communications, Inc. developed and implemented a technical due diligence process, allowing the evaluation and use of new technologies as they become viable and reducing risk to projects using this new technology.

ABC Virtual Communications, Inc.(ABCV) identified the need to be a rapid adopter of new technologies to differentiate itself from its competitors. Previously, only the following options were available to use new and unknown technologies: hire someone with experience in this new technology; partner with a firm that had experience with this new technology; or use the new technology and accept the risk of working with an unknown and unproven technology.

To reap the benefits of being an early adopter of new technologies and still reduce risk to its clients, ABCV developed a technical due diligence process. When ABCV identifies a new and viable technology that it wants to use, several steps are taken to evaluate that technology. First, viable products that implement that technology must be identified and then evaluated. Evaluation consists of performing the following tasks: comparing product-specific features, determining compliance with open standards, understanding the product's relationship to the existing infrastructure, and examining the performance of each product. After a product is selected, a prototype is built to gather hands-on experience, and then team training is done to share the new knowledge. ABCV can then safely benefit from the use of new technologies and use the experience gained in this process as a differentiator when competing for new contracts.

By implementing the technical due diligence process, ABCV can quickly adopt new technologies without hiring new staff or risking costly mistakes in the development process. Using new technologies has several benefits including: increasing the performance of new or existing software projects (by increasing the load the project can handle and/or the speed in which it can handle a load); decreasing the development time to deliver a new project; and adding new functionality that did not previously exist.

Unique Business Model

ABC Virtual Communications, Inc. established a process of rotating personnel between consulting and product involvement to provide an opportunity for every employee to contribute to the company's bottom line between consulting opportunities. This has created a workforce of consultants who are directly in touch with the products they support.

ABC Virtual Communications, Inc.'s (ABCV's) business consists of 70% consulting and 30% product development. Often weeks may pass between engagements in the consultation business. This is known as the "bench," and providing funding for the consultants during this time period was a problem. Previously, ABCV focused on service provider development, which resulted in minimal flexibility to revisit phases once completed. The company also wanted to focus on the development of its employees' core skill sets.

ABCV established a process that allocates resources to both sides of the business — consultation and product development. Weekly meetings are conducted to compare estimated work efforts to the available resources. Employees are then rotated between consulting and product development, based on their previous task and the area in need of more resources. While most consultants gather experience in both areas, 25% of the workforce re-

mains full-time in product development to ensure continuity in the product life cycle. Keeping consultants on staff between consulting engagements provides a unique advantage by involving the consultants with the technical knowledge of the work product and keeping the core company skills in continuous use. ABCV's focus continues to emphasize the project work, which allows the development of more product features in a shorter period of time.

Workforce Diversity Training

ABC Virtual Communications, Inc. developed a means of recruiting and retaining highly skilled software engineers while expanding its client base. The training and employees' development process has given the company a diverse workforce, allowing growth and providing customers with leading-edge skills.

Shortly after its founding in 1995, ABC Virtual Communications, Inc.(ABCV) began a steady path of growth. By early 1998, the company was experiencing a phenomenon faced by many other companies in the Midwest — a shortage of qualified personnel in Iowa to help design and build the products and provide the services ABCV was targeting. The shortage was so severe that companies were taking talent from one another. Recruiting new graduates from the Iowa universities and colleges was difficult as the newly graduated students were mostly moving to the coastal areas where they could demand higher salaries and sign-on bonuses.

In order to alleviate this shortage of qualified personnel, ABCV decided to take advantage of the tremendous talent offered by foreign-born individuals. As more and more of these individuals were hired, the company realized that, to be successful in this endeavor, it must design and implement a very aggressive training program, policies, and activities for a diverse workforce. ABCV turned to Iowa State University and the Iowa Department of Economic Development for help. Training guides and curricula for in-house training were developed. One of the first courses developed was "The American Workculture." This training was specifically designed for the company's workforce comprising 14 different nations. Expansion of the training for this multi-cultural workforce now includes a mandatory eight-hour orientation overview for new employees and an "Effective Communications" training course for all employees. Conversational English and Accent Reduction classes for employees and their families are also offered via the acclaimed Rosetta Stone language learning software. Other efforts at ABCV include teaming with the Des Moines Area Community College to create specialized classes for individual needs. The company pays for training and encourages employee participation. Private tutoring in accent reduction and language classes is also offered to the employees.

The understanding and facilitation of the needs of a multi-cultural workforce have greatly benefited ABCV. The company has employed personnel from as many as 15 different countries and 45 ethnic groups within those countries. This diversity has allowed the company to grow, provide its customers with leading-edge skills, and expand its customer base to other countries as well as local and regional markets. ABCV found that the cultural exchange of ideas and ways of thinking about solutions to problems have given the company an edge in its business goals. ABCV has gone from struggling to hire and retain qualified employees to being a leader in recruiting and retention, boasting a 99% retention rate between 1998 and 2002. Through investment in the needs of its workforce and its excellent support system, ABCV hires and retains new employees.

Transition Plan

ECLoanPro Implementation Process

ABC Virtual Communications, Inc. created a dedicated implementation team to work with its customers, from initial planning through deployment and training. By maintaining a single team throughout the process, ABC Virtual Communications, Inc. fosters better communication between the customer and the developers, which results in smoother and faster system roll-outs, better user training, and increased customer satisfaction.

Prior to 2003, ABC Virtual Communications, Inc.(ABCV) used many different teams to handle various customer-related functions. The sales team collected customer requirements and data, a build team created customized software modules, a Quality Assurance (QA) Team verified the setup when the product was delivered, and a separate support team provided follow-up support. Because of in-

sufficient communication between the teams, installations suffered from slower-than-anticipated customer acceptance. ABCV's solution was to create a dedicated implementation team.

The implementation team works with the customer to establish requirements for the target environment and the deployment, collects customer data, and identifies any needed specific customization. Before the software is ready to be deployed, the implementation team begins working with the customer's own people to "train the trainers," including providing demo environments for the customer to begin learning. When the software is ready for delivery, the implementation team remains on-site to help users learn the new software and acclimate to new ways of doing things. Ordinarily, the implementation team remains with the customer for 120 days. During the first 30 days, the team provides the users with "tips and tricks" to help them get the most out of their new software. From 30-60 days, the implementation team focuses on mitigating any function gaps; and during the last 60 days, works on prioritizing additional customization. Since implementing this process, software roll-out times are measured in days rather than weeks and customer satisfaction has increased, which is reflected in greater system usage and fewer help desk calls.

Section 3

Information

Design

Creative Object-Oriented Design

ABC Virtual Communications, Inc. makes extensive use of object-oriented software design principles to design and develop code more efficiently. As a result of good object design, code that is developed comes together more quickly, is more reliable, and easier to maintain.

Since its inception, ABC Virtual Communications, Inc. (ABCV) has relied on object-oriented design techniques to leverage the efforts of its developers. Object-oriented programming allows developers to create an "abstract" object once, and then derive minor variations of that base object as needed. Instead of having to write code for each different case, the codes can access the methods defined in the base class, and the object itself handles the specific details making code development more efficient.

One of the major examples of ABCV's success with this technique is the ABCVIOTableBean object, which is designed to display a list of "summary objects." The ABCVIOTableBean does not need to know what kind of data it is displaying, and can reconfigure its display based on the information passed to it. Additionally, this component automatically handles requests to edit any displayed item, as well as handling data-persistent tasks specific to the objects being listed. The ECLoanPro (ECLP) software (ABCV's flagship product) contains approximately 100 uses of ABCVIOTableBean.

Another example of ABCV's creative use of object-oriented software design is in its use of the Rational Rose™ software product. ABCV uses Rational Rose™ to create, store, and implement the business objects used in ECLP. Rational Rose™ provides perfect correspondence of the implementations and their associated class diagrams. Unfortunately, each time a new version of the business object is generated, developer-added code is overwritten and lost. ABCV's innovative solution to this is to use Rational Rose™ to generate base classes of the business objects. If a specific modification is necessary, the developer creates a child-object with any necessary extensions to the base class. As a result, the base class can be regenerated at will, without losing any of the modifications in the derived classes.

By adopting the object-oriented design philosophy as a significant part of its corporate culture, ABCV efficiently develops code and successfully leverages existing bodies of code.

Search and Destroy Software Bug Resolution Process

During development and testing, ABC Virtual Communications, Inc. immediately assigns responsibility to a developer to address a software defect after that defect is discovered. The developer immediately repairs the defect or the defect is entered into the issue tracking system. This methodology allows ABC Virtual Communications, Inc. to find and repair software defects earlier in the development process, thereby improving the quality of the software, reducing the labor involved in managing the issue tracking database, and allowing ABC Virtual Communications, Inc. to be more responsive to new software defects as they are discovered.

Previously, ABC Virtual Communications, Inc.(ABCV) utilized a simple method for tracking software defects. As software defects were discovered, they were entered into an issue tracking database. Over time, the issue tracking database became too large and unwieldy to be useful. It was very difficult to prioritize a long list of defects and to fully understand what, if any, relationships existed between defects. As the issue tracking database grew larger, it also became difficult to respond to customer complaints, and overall quality suffered. ABCV defined and implemented a process to find and address any defects early in the development process and to only record defects that were not immediately resolved.

By using this methodology, the development and testing groups work together to resolve all software

defects as soon as they are discovered. When a defect is discovered, it is immediately brought to the attention of a developer. Only if the issue is not resolved is it recorded in the issue tracking system. Additionally, the software is developed in stages and goes through a testing phase after each development stage is completed, allowing many software defects to be discovered early in the development process.

Since the introduction of the Search and Destroy methodology of software defect resolution, customer support calls and the cost of resolving software defects have decreased, since this methodology creates fewer issues to manage in the issue tracking database. ABCV is also more responsive to its clients and provides quicker customer issue resolution. Additionally, the quality of the software is higher at release time since more issues have been handled before release.

Management

Business-to-Business Interfacing

ABC Virtual Communications, Inc. takes a unique approach to offsetting the costs associated with initial software development by seeking to partner with vendors to offset these costs.

Most businesses seek ways to reduce initial development costs. ABC Virtual Communications, Inc.'s (ABCV's) approach to this challenge resulted in the development of a unique decision-based process. Some companies absorb the initial costs in hopes that the return on investment will compensate for the work effort. This, however, can result in a high risk to the company based on uncertainties, such as the economy. Since this risk was too high for ABCV, the company found another process to support its initial development costs.

ABCV implemented a cost-sharing process to develop an interface with each business partner, which has resulted in an increase in revenue. By negotiating a lower-per-transaction cost for each new business partner, ABCV realized an improvement of its return on investment as well as greater customer satisfaction.

ABCV's Business-to-Business (B2B) process continues to improve, while the company's initial development costs are being reduced. This is a win-win situation for ABCV and its clients.

Appendix A

Table of Acronyms

ACRONYM	DEFINITION
ABCV	ABC Virtual Communications, Inc.
ASP	Application Service Provider
B2B	Business-to-Business
BPC	Business Process Collaboration
BSP	Business Service Provider
ECLP	ECLoanPro
IT	Information Technology
QA	Quality Assurance
RUP	Rational Unified Process

Appendix B

BMP Survey Team

Team Member	Activity	Function
Larry Halbig 317-891-9901	**BMP Field Office-Indianapolis** Indianapolis, IN	**Team Chairman**
Nicole Frome 301-405-9990	**BMP Center of Excellence** College Park, MD	**Technical Writer**
	Team A	
Don Hill 317-849-3202	**BMP Field Office-Indianapolis** Indianapolis, IN	**Team Leader**
Todd Brandt 909-273-5552	**Naval Surface Warfare Center – Corona** Corona, CA	
Ralph Sickinger 301-405-9990	**BMP Center of Excellence** College Park, MD	
	Team B	
Rick Buentello 301-405-9990	**BMP Center of Excellence** College Park, MD	**Team Leader**
Jonathon Maddock 909-273-5202	**Naval Surface Warfare Center – Corona** Corona, CA	
Lloyd Meinholz 301-405-9990	**BMP Center of Excellence** College Park, MD	

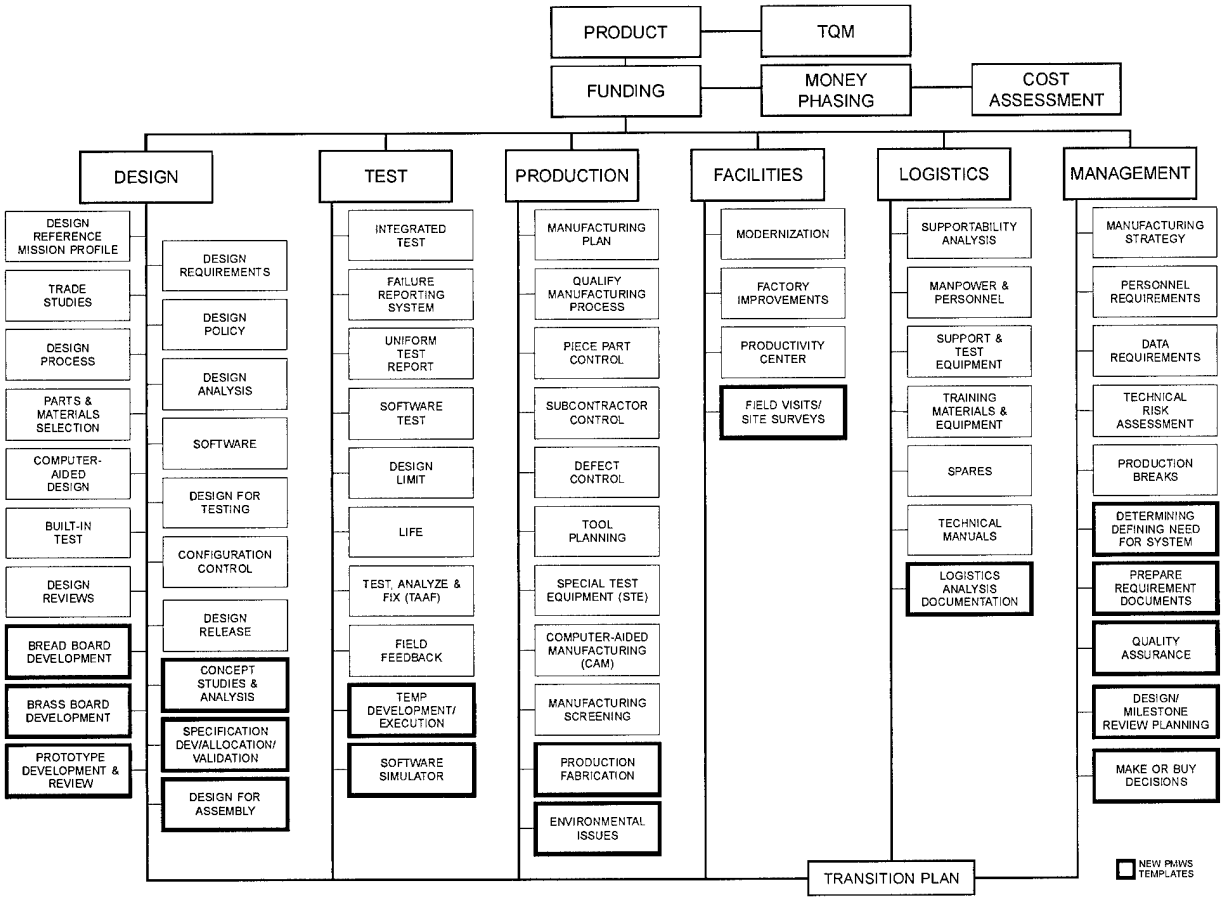
Appendix C

Critical Path Templates and BMP Templates

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

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

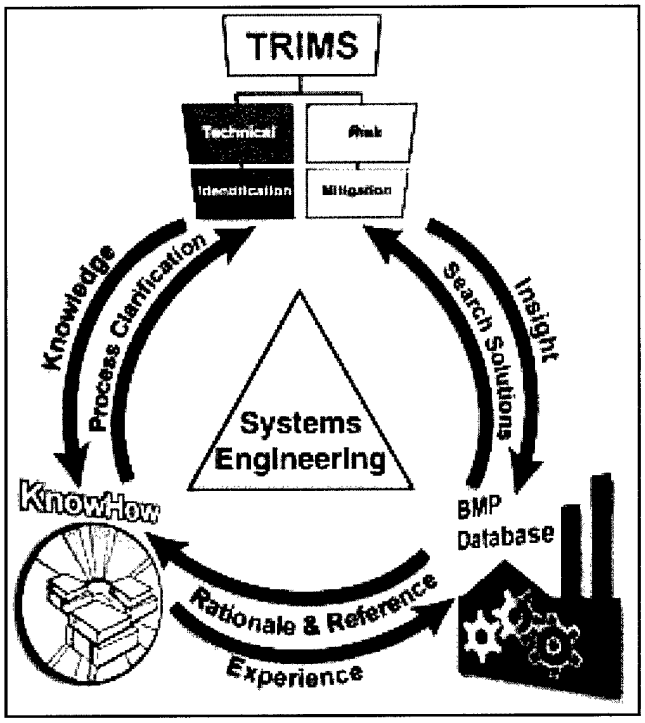
"CRITICAL PATH TEMPLATES FOR TRANSITION FROM DEVELOPMENT TO PRODUCTION"



Appendix D

The Program Manager's WorkStation

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



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

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

The **BMP Database** provides experience as a unique, one-of-a-kind resource. This database contains more than 2,500 best practices that have been verified and documented by an independent team of experts during BMP surveys. BMP publishes its findings in survey reports and provides the user with basic background, process descriptions, metrics and lessons learned, and a Point of Contact for further information. The BMP Database features a searching capability so users can locate specific topics by typing in keywords. Users can either view the results on screen or print them as individual abstracts, a single report, or a series of reports. The database can also be downloaded, run on-line, or purchased on CD-ROM from the BMP Center of Excellence. The BMP Database continues to grow as new surveys are completed. Additionally, the database is reviewed every other year by a BMP core team of experts to ensure the information remains current.

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

Appendix E

Best Manufacturing Practices Satellite Centers

There are currently ten Best Manufacturing Practices (BMP) satellite centers that provide representation for and awareness of the BMP Program to regional industry, government and academic institutions. The centers also promote the use of BMP with regional Manufacturing Technology Centers. Regional manufacturers can take advantage of the BMP satellite centers to help resolve problems, as the centers host informative, one-day regional workshops that focus on specific technical issues.

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

The ten BMP satellite centers include:

California

Chris Matzke
BMP Satellite Center Manager
Naval Surface Warfare Center, Corona Division
Code QA-21, P.O. Box 5000
Corona, CA 92878-5000
(909) 273-4992
FAX: (909) 273-4123
matzkecj@corona.navy.mil

District of Columbia

Geoffrey Gauthier
BMP Satellite Center Manager
U.S. Department of Commerce
Bureau of Industry & Security
14th Street & Constitution Avenue, NW
H3876
Washington, DC 20230
(202) 482-9105
FAX: (202) 482-5650
ggauthie@bis.doc.gov

Illinois

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BMP Satellite Center Manager
Rock Valley College
3301 North Mulford Road
Rockford, IL 61114-5699
(815) 921-2073
FAX: (815) 654-4343
r.lindstrom@rvc.cc.il.us

Iowa

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Iowa Procurement Outreach Center
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DAU Program Director, Manufacturing Manager
Defense Acquisition University
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FAX: (703) 805-3721
bill.motley@dau.mil

Appendix F

Navy Manufacturing Technology Centers of Excellence

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

Best Manufacturing Practices Center of Excellence

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

Point of Contact:
Dr. Anne Marie T. SuPrise
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: annemari@bmpcoe.org

Institute for Manufacturing and Sustainment Technologies

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

Point of Contact:
Mr. Robert Cook
Institute for Manufacturing and Sustainment Technologies
ARL Penn State
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 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

National Center for Excellence in Metalworking Technology (Operated by Concurrent Technologies Corporation)

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

Point of Contact:
Mr. Richard Henry, P.E.
National Center for Excellence in Metalworking Technology
c/o Concurrent Technologies Corporation
100 CTC Drive
Johnstown, PA 15904-1935
Phone: (814) 269-2532
FAX: (814) 269-2501
E-mail: henry@ctcgsc.com

Energetics Manufacturing Technology Center

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

Point of Contact:
Mr. John Brough
Naval Surface Warfare Center
Indian Head Division
101 Strauss Avenue
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 technologies; benefits that will accrue not only to the Navy, but to industry as well. CNST is operated and managed by ATI in Charleston, South Carolina.

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

Gulf Coast Region Maritime Technology Center (Operated by University of New Orleans, College of Engineering)

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

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

Best Manufacturing Practices Program
4321 Hartwick Rd., Suite 400
College Park, MD 20740
Attn: Anne Marie T. SuPrise, Ph.D., Director
Telephone: 1-800-789-4267
FAX: (301) 403-8180
annemari@bmpcoe.org

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

1991	Resurvey of Litton Guidance & Control Systems Division - Woodland Hills, CA Norden Systems, Inc. - Norwalk, CT (now Northrop Grumman Norden Systems) Naval Avionics Center - Indianapolis, IN United Electric Controls - Watertown, MA Kurt Manufacturing Co. - Minneapolis, MN MagneTek Defense Systems - Anaheim, CA (now Power Paragon, Inc.) Raytheon Missile Systems Division - Andover, MA AT&T Federal Systems Advanced Technologies and AT&T Bell Laboratories - Greensboro, NC and Whippany, NJ Resurvey of Texas Instruments Defense Systems & Electronics Group - Lewisville, TX
1992	Tandem Computers - Cupertino, CA Charleston Naval Shipyard - Charleston, SC Conax Florida Corporation - St. Petersburg, FL Texas Instruments Semiconductor Group Military Products - Midland, TX Hewlett-Packard Palo Alto Fabrication Center - Palo Alto, CA Watervliet U.S. Army Arsenal - Watervliet, NY Digital Equipment Company Enclosures Business - Westfield, MA and Maynard, MA Computing Devices International - Minneapolis, MN (now General Dynamics Information Systems) (Resurvey of Control Data Corporation Government Systems Division) Naval Aviation Depot Naval Air Station - Pensacola, FL
1993	NASA Marshall Space Flight Center - Huntsville, AL Naval Aviation Depot Naval Air Station - Jacksonville, FL Department of Energy Oak Ridge Facilities (Operated by Martin Marietta Energy Systems, Inc.) - Oak Ridge, TN McDonnell Douglas Aerospace - Huntington Beach, CA (now Boeing Space Systems) Crane Division Naval Surface Warfare Center - Crane, IN and Louisville, KY Philadelphia Naval Shipyard - Philadelphia, PA R. J. Reynolds Tobacco Company - Winston-Salem, NC Crystal Gateway Marriott Hotel - Arlington, VA Hamilton Standard Electronic Manufacturing Facility - Farmington, CT (now Hamilton Sundstrand) Alpha Industries, Inc. - Methuen, MA
1994	Harris Semiconductor - Palm Bay, FL (now Intersil Corporation) United Defense, L.P. Ground Systems Division - San Jose, CA Naval Undersea Warfare Center Division Keyport - Keyport, WA Mason & Hanger - Silas Mason Co., Inc. - Middletown, IA Kaiser Electronics - San Jose, CA U.S. Army Combat Systems Test Activity - Aberdeen, MD (now Aberdeen Test Center) Stafford County Public Schools - Stafford County, VA
1995	Sandia National Laboratories - Albuquerque, NM Rockwell Collins Avionics & Communications Division - Cedar Rapids, IA (now Rockwell Collins, Inc.) (Resurvey of Rockwell International Corporation Collins Defense Communications) Lockheed Martin Electronics & Missiles - Orlando, FL McDonnell Douglas Aerospace (St. Louis) - St. Louis, MO (now Boeing Aircraft and Missiles) (Resurvey of McDonnell-Douglas Corporation McDonnell Aircraft Company) Dayton Parts, Inc. - Harrisburg, PA Wainwright Industries - St. Peters, MO Lockheed Martin Tactical Aircraft Systems - Fort Worth, TX (Resurvey of General Dynamics Fort Worth Division) Lockheed Martin Government Electronic Systems - Moorestown, NJ Sacramento Manufacturing and Services Division - Sacramento, CA JLG Industries, Inc. - McConnellsburg, PA
1996	City of Chattanooga - Chattanooga, TN Mason & Hanger Corporation - Pantex Plant - Amarillo, TX Nascote Industries, Inc. - Nashville, IL Weirton Steel Corporation - Weirton, WV NASA Kennedy Space Center - Cape Canaveral, FL Resurvey of Department of Energy, Oak Ridge Operations - Oak Ridge, TN

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