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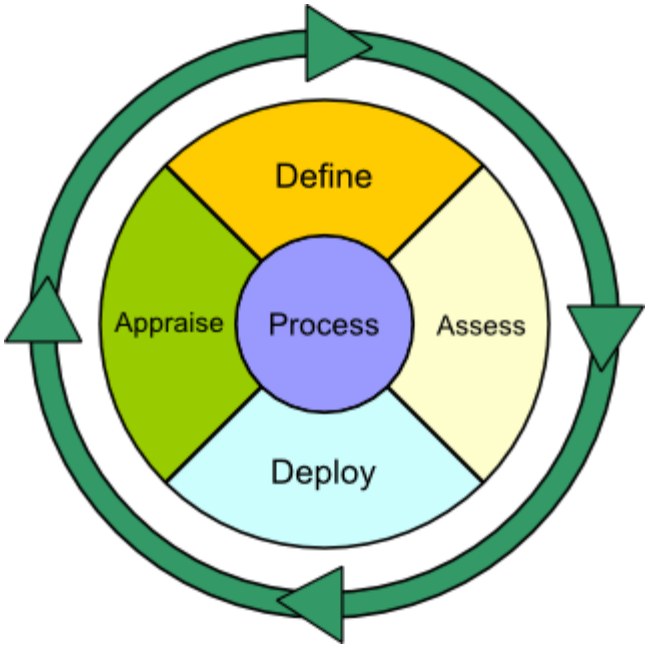
Server Consolidation of the US Army's Contract Writing System

Overview of the Methods and Benefits of Server Consolidation for the Standard Procurement System's Procurement Desktop/Defense



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Abstract

One of the best opportunities to achieve significant improvements in savings and service levels is server consolidation. Server consolidation refers to a reduction in the number of servers providing a given service or application to an organization.

This white paper examines a number of methods and benefits that could be implemented in order to reduce expenses associated with the current deployment of the United States Army's Contract Writing System.

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1 Concepts of Server Consolidation

After years of heavy investments in information technology, organizations are under increasing pressure to expand services and operate IT programs more efficiently. One of the best opportunities to achieve significant improvements in savings and service levels is server consolidation. Server consolidation refers to a reduction in the number of servers providing a given service or application to an organization. It can be implemented in different forms, depending on technology platforms, business rules, and budget. A successful server consolidation effort can provide significant benefits both in the direct costs to operate the program, as well as significant indirect benefits such as freeing up scarce IT resources, increasing satisfaction and productivity of end-users, and raising enterprise insight into collective data. Server consolidation is a means to simplify the system architecture and management, and enable or enhance such important system capabilities as scalability, security, disaster recovery, and more.

1.1 Server Consolidation Models

There are three types of server consolidation activities. Consider the following example a typical distributed computing environment:

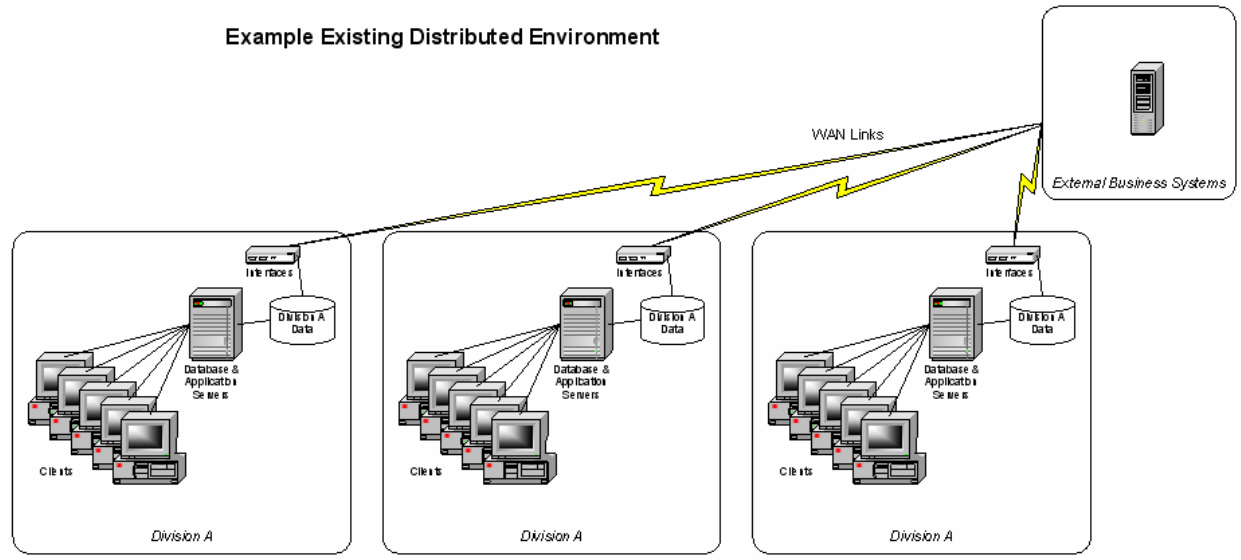

Figure 1: Distributed Computing – SPS / PD2

Each organization maintains and supports applications, databases and client programs for only its users and businesses. Data may be sent or exchanged with external systems, often times using costly point-to-point interfaces. Each organizations pays for support labor, hardware and software upgrade costs. Sharing of data between organizations or headquarters is clumsy and expensive.

This is the environment in which the present day PD2 application resides. Each installation has its own set of PD2 servers and administrators, interface concerns and client support tasks. The

basic architecture of this application suits the high bandwidth, low latency of a robust local area network typical of standalone installations.

1.1.1 Server Collocation

Servers previously located at many individual sites are housed in a central network operations center. This relocation does not reduce the number of servers, but reduces administration costs via the reduction of the number of sites and the pooling of administration resources. Some deployment savings are gained from the common location of the servers. This solution is not technically viable for the current client server version of PD2.

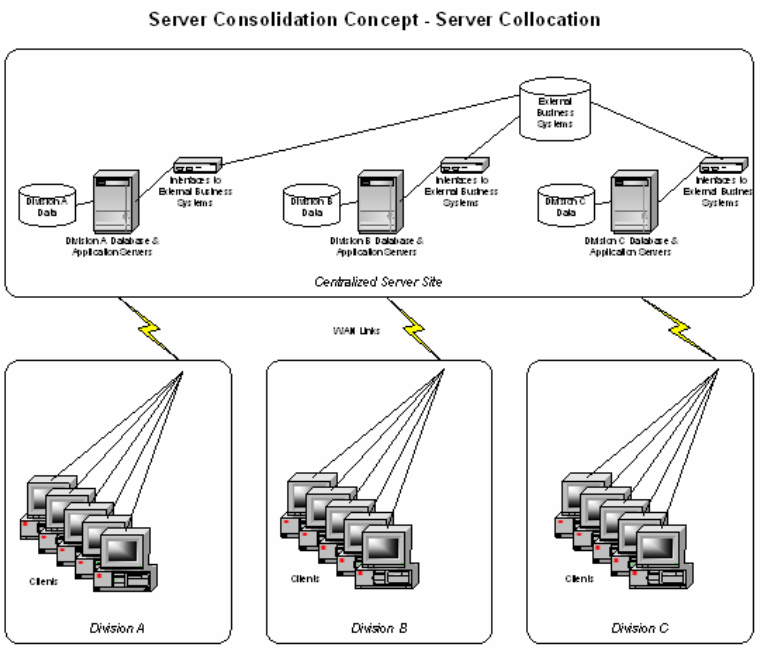

Figure 2: Server Collocation - N/A to PD2

Server collocation seeks to reduce administrative costs by reducing the number of sites that must maintain the application's servers and having clients communicate over WAN's. This is not a viable solution for the current version of PD2 because of how the application behaves over a WAN with its inherent latencies due to firewalls, routers, switches and the like. The application's performance becomes unsatisfactory and its network traffic load is a burden.

1.1.2 Server Centralization

Larger servers at a centralized location are used to replace a number of smaller servers previously located at many individual sites. Individual sites continue to utilize separate databases. The reduction in the number of servers reduces administration costs and some increased deployment savings are gained from reduction in servers. Hardware costs are reduced through more efficient hardware utilization achieved via the economies of scale.

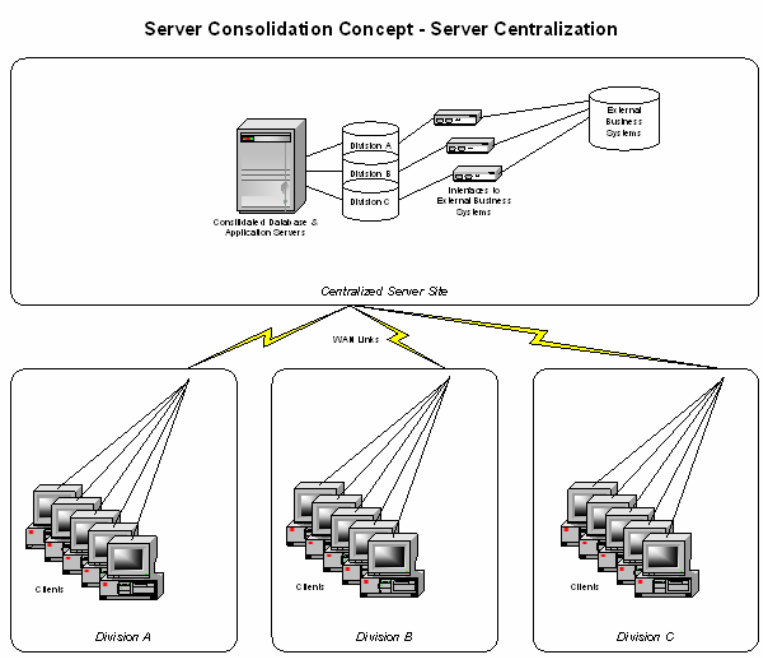

Figure 3: Server Centralization - PDe

The biggest share of the expense of the Army's current contract writing system is in administrative labor at the technical and functional level. A server centralization effort has the maximum potential for reducing those costs. By concentrating the need for administrative personnel to just a few sites instead of dozens labor costs incurred for managing the CWS could be reduced significantly. A web-enabled replacement application for PD2 opens up that possibility.

1.1.3 Data Centralization

A large single enterprise server (or cluster) at a centralized location replaces all independent server and database instances. The most efficient of the consolidation options, significant cost savings can be realized from lower administrative costs, reduced hardware and storage, and improved backup/recovery capabilities. Also provides the greatest single-point-of-failure risks, requiring redundancy data redundancy procedures to protect.

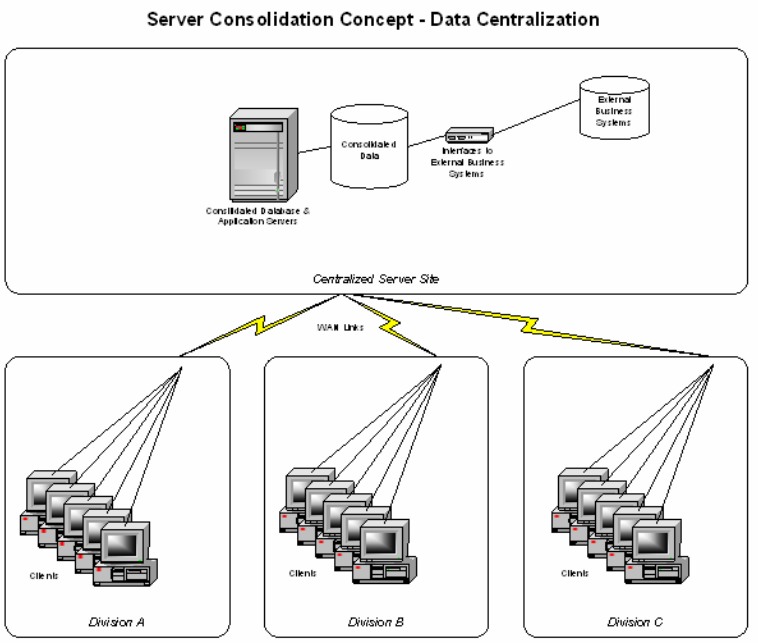

Figure 4: Data Centralization - PDe

The ultimate benefit from a consolidation effort may not be in labor savings and increased efficiency. It may actually come from the analysis of the collective business knowledge contained in a consolidated data space. The ability to, at one time and place, to analyze buying habits and pricing trends opens up the opportunity to produce large scale savings on acquisitions of goods and services.

The consolidation options presented above stand in increasing order of efficiency. While an organization may maximize savings by employing the third instead of the first, they are not necessarily mutually exclusive. Indeed, an organization seeking the most efficient data centralization option, could use all three in a sequential process if funding, culture, and business rules required it. Consolidation of servers from LAN-connected sites to remote sites via a WAN requires an application capable of executing across that infrastructure. In combination with an analysis of the operational environment, organizations must also perform an analysis of their infrastructure to determine if an application is capable of performing adequately across it. Many client/server applications are not capable of traversing a WAN for communication between the client and the server. In these cases, server-based computing provides the important bridge between the centralized server paradigm and the client-side processing paradigm of client/server computing.

2 Server Consolidation of the US Army's Contract Writing System

2.1 Background

The US Army currently performs more than 180,000 contract actions per year[1] using an installation-based, client/server (C/S) application, American Management Systems' Procurement Desktop-Defense (AMS, PD2.) The design of this system, when first deployed, suited the existing Army network infrastructure. Client/server applications rely on robust local area networks (LANs) to handle the high level of network traffic between the central database and the client-side application. Army installations were able to host local versions of the application and database. As a result of the design of the product and its technical limitations Army commands created dozens of unique networks and databases.

The reliance of the PD2 application on a C/S architecture in even its most recent version (4.2 Increment 2) does not allow the Army to take advantage of emergence of a pervasive Internet Protocol (IP) enterprise network. Client server applications require substantial bandwidth to handle the heavy packet traffic created by the client side application. In tests conducted for the US Naval Air Command (NAVAIR) in the year 2000, Alterion engineers discovered that the PD2product was unsuitable for operation over wide area networks (WANs). The application performed slowly because of network saturation and latency as a result of the need to move many, small packets on a constant basis to perform even minor contract actions.

NAVAIR had commissioned the above referenced study to assess the viability of consolidating its PD2 servers from a number of installation sites to one central site in order to reduce hardware and support labor costs. The conclusion of the study was that the C/S architecture of PD2 is not suited to task of consolidating contracting activity. The database construction of the PD2 product also presented barriers to a consolidation effort. Databases could not be combined so any consolidation effort would require that the central server(s) run multiple databases and perhaps multiple instances of the database software. The end result of the study was that the NAVAIR command decided against consolidation.

There have been other, more successful efforts towards PD2 server consolidation. Two commands within the Army, Corps of Engineers (USACE) and the National Guard Bureau (NGB) have implemented solutions using so called "thin client" technology. Both commands have placed multiple PD2 databases in central sites (two for USACE, one for the NGB). Users access their respective databases using technology that places the client application on one or more terminal servers. Users connect to the terminal server across a LAN or WAN and manipulate the PD2 application in a user session on the terminal server. In this operation only screen data is passed across the network. This approach significantly reduces network traffic as compared to a "thick" client as found in the standard C/S deployment.

Since all the databases and servers reside at a central location the commands have a lower cost for server administration than if they had to provide servers at each of several dozen locations (NGB has offices in all 50 states.) Application upgrade costs are lower for the same reason.

[1] Total solicitation, awards and modifications for FY02 as reported in the FY02 Metrics Master statistics provided by SEC-LEE.

The terminal server solution is not without costs. Sites must maintain, in addition to the normal PD2 server set (database, application, interface agents), a separate set of terminal servers. The terminal server license costs are significant and support for the terminal server software requires administrators with additional sets of skills on which they must be trained.

For a fuller explanation of the terminal server solution see appendix A of the BCA report.

Use of a server computing solution such as used by NGB and USACE does meet, in principal, the goals of consolidated server version of a contract writing system. Those goals include:

- Reducing the labor costs necessary to support multiple server installations
- Reducing the costs of application upgrades by eliminating the need to "touch" large numbers of servers
- Speeding the process of upgrades to days or weeks instead of months

What is not clear is if such a solution offers cost savings, customer satisfaction (performance can be an issue with such a solution) and flexibility.

2.2 A Notional Army CWS – the Idealized Vision

The balance of this discussion will focus on an idealized Army Contract Writing System (CWS) that supports a regionalized server infrastructure. The following notional structure presupposes a number of situations. The first is the existence and/or acquisition of a CWS application that does not reside in a client/server environment. The principal recommendation would be that the Army, in particular, and DoD in general move to web-enabled application. Web-enabled means a application that relies not on a client-side application communicating with a central server but rather uses a simple web browser interface to a centrally hosted application. All application actions and database transactions occur at a central site and virtually no processing takes place on the client side.

This approach has a number of advantages over the current C/S implementation of PD2. First is the ability to house databases not on an installation basis, but in regionally located server sites. Severing the connection to local installation servers reduces the need for local servers and local server support. Reducing the number of servers needed to house Army contract actions lowers hardware costs modestly (the centralized servers tend to be more expensive) but offers large reductions in the cost of labor to support local servers.

A second advantage is the potential costs savings in cost of application upgrades[2]. In the current situation each time the vendor makes available a major revision to PD2 there is a large cost associated with upgrading each of the more than 100 PD2 servers. There is also an indirect cost, as each of the more than 7,000 users must have their local client applications upgraded. Having support personnel "touch" 7,000 PCs is a large, if not easily calculated, expense. Using a web-enabled application with a diminished number of servers reduces the number of devices that must be attended to by either AMS or Army support staff. Web applications do not require any changes to the users' client machines whatsoever. That alone saves 7,000 "touches".

[2] The term "potential" is used here as the current labor charges for data migration and systems updates may change in any future contract with the CWS supplier. However, the reduction in the number of sites is so substantial as to be certain that cost savings would result.

The third advantage is the speed of the upgrade process. Rollouts of new versions of the application would be completed in a matter of a few weeks instead of some months. Since only a relatively small number of servers would need upgrading the total time to complete the upgrade process is much reduced. If proper use is made of the ability to off load users to another server location (easily done in a web environment) sites would see little if any user downtime during the upgrade process, a real boost to productivity.

A fourth advantage would be the near universal access users would have to the CWS. Contract actions could occur wherever the user has a computer with connectivity to a proper network. Such access allows those personnel supporting war-fighters to operate both near the site of operations and in near real time to the needs.

There are costs in moving to a web enabled CWS. The costs for new, more powerful servers able to handle the increased loads of centralized systems are high. To handle user traffic, communications networks must be robust and redundant. The cost for the re-training of support staff and perhaps for users is not trivial. Then there is the cost of the application itself and for the migration of the data from existing installation servers to regional ones.

Determining exact costs involved in installing and supporting a web-enabled application is not possible, as the application has yet to be selected, nor are its operational characteristics known at this time. By operational characteristics it is meant the requirements for load handling, transactional scaling and bandwidth usage. One potential candidate, AMS' PDe, is still under development at this time and the developer has yet to conduct large-scale performance and load testing.

2.3 Notional Design

An idealized CWS architecture would operate on the principles of centralizing of data, reduction in the required number of support personnel, redundancy of operation and full access to an enterprise network. It also presupposes the existence of a capable, web-enabled application, and a corporate commitment by the MACOMs to give up "ownership" of the existing CWS.

The proposed CWS architecture would employ two regional server centers to be located in geographically separated areas. Each site would have sufficient processing power, data storage capacity and network connectivity to handle 90% of both centers' peak loads. The centers would have near real time data mirroring so that the failure of either system would not prevent users from either region from performing tasks. The connectivity between the centers would need to support the mirroring activity; and the connectivity to the enterprise network would need to handle 100% of user traffic with perhaps some performance degradation.

The server configuration would consist of a large and powerful database server with sufficient, redundant storage to handle the maximum data needs. Current estimates, based on information provided by SEC LEE, indicate a total Army requirement of 6 terabytes of data storage[3]. Whatever that amount is, the proposed system provides for on-site data redundancy (using RAID technology) and off-site data mirroring to the other regional center.

[3] The current CWS system consumes massive amounts of storage because of its use of Microsoft Word documents to hold contract information. Each contract is stored in a binary large object (BLOB) attached to the database. As disclosed by AMS, its PDe product separates contract data from contract documents, storing documents in the standard .pdf format. This development may greatly reduce data storage needs.

Each site would employ multiple web servers to receive and direct user requests against the application and database. Multiple servers provide greater redundancy (if one fails the load is automatically shared among the others). The proposed design would also include use of IP round robin tools to distribute user requests to available web servers. This design is very common in distributed computing systems. It provides both flexibility and enhanced performance.

Between the web servers and the database sits the application or middleware server. The application server basically does what the client application does in a C/S system. It performs the data manipulation, i.e., the contract transactions. In this type of architecture the user is sending HTML requests through the web sever front end to the middleware server. The middleware sever translates the HTML requests into SQL queries against the database (this is a very high level explanation.) The middleware server, or application server does most of the heavy lifting in terms of processing. For the sake of efficiency, the system may operate with more than one application server linking with more than one database.

Large databases raise the question of co-mingled data. The notional architecture has as its basic principle the consolidation of data. Instead of the C/S model of single databases for individual installations, the consolidated architecture relies on one or more large databases housing multiple installations', indeed multiple commands', data in shared data space with segregated access. Users may access only the data sets permitted by the security policies of their respective organizations. This arrangement provides the benefits on single point maintenance with the continued separation of information as commands warrant.

2.4 Investment Requirements

To quantify the costs of such a solution analysts reviewed data on the current contract transactional data. The data included numbers of contracts, modifications, purchase requests and other relevant information. Engineers also examined certain audit tables of key current installations to gauge the level of hardware activity profile of the current CWS application. This included analysis of disk and random memory I/O. When combined with relevant date and time of day information, analysts produced a profile of a system that combines the workloads of individual systems into a consolidated platform. That profile is the basis of the cost structure of the notional architecture.

2.5 Economic Advantages

In the current architecture 80% of annual operating costs, or $13 million dollars, falls into the classification of labor, training and management. There are over 300 individuals involved in the administration of the CWS working with more than 190 individual databases.

In the notional, two regional site CWS the staffing costs are lowered by 88% to approximately $1.6 million. Lowered costs do not translate directly into savings in the command's overall budgets, as not all concerned personnel will leave the service or employ of the Army. Of the $13 million in labor costs, personnel with 110x job series account for $5.7 million of the total. The potential for overall savings, however is considerable whether there is a reduction in force or re-assignment of personnel to other valuable tasks.

Costs for training of Server Administrators would also likely be lower if current vendor charges remain the same. The notional CWS would include four SA's and eight functional support personnel per regional site.

A second area of savings is in the cost of application upgrades. In FY03 the Army budgeted $928,000 to the upgrade the current CWS program from PD2 version 4.1e to 4.2 Increment One. That cost was principally for labor and travel by vendor staff to visit each server site and upgrade applications and databases. In a two site, regional architecture that cost should diminish by nearly 90%. Since upgrades would occur at only two server installations, costs on an annual basis should be less than $100,000.

Also greatly reduced is the cost for data migration as commands upgrade server hardware. In the current system a five-year replacement model requires the upgrade of approximately 20 PD2 database servers per year at an average cost of over $20,000. With the notional plan upgrades occur only twice in 10 years (once for each site at the 5 year replacement cycle).

Indirect costs are also greatly reduced when it is no longer necessary to physically upgrade each user's computer to the latest version of the application. In the notional architecture users employ a standard web browser to operate within the CWS. There is no need to upgrade the user stations for the more than 7000 licensed users. If, as an example, it takes 2 hours to upgrade each user machine that would require 14,000 hours of labor. At an hourly rate of $15.00 that's a savings of $210,000.

The Army already has experience with server computing in its use of PRweb. The web enabled purchase requisition system provides some of the same benefits as the notional architecture in the server-centric computing and use of a web browser for client entry. PRweb functionality would be a component of the next generation of the CWS. While this would eliminate the need for current set of PRweb servers, the hardware costs have been accounted for in the stated cost of hardware required for the notional system. According to a recent study of PRweb conducted for the Army, most labor associated with the administration of PRweb flows from the same community of PD2 SA's so no large savings in SA labor are projected because of the inclusion of PRweb functionality into the new CWS.[4]

2.6 Technical Features

The notional CWS physical requirements are considerable. The two regional sites would replace more than 300 servers and 800 CPU's. Database requirements may top 6 terabytes. Each site would be able to process all Army users in case one site failed[5]. The two sites would each contain mirrored data images of the other. In the case of an environmental disaster (for example a weather event that disrupts power or telecommunications), users of the affected site would be directed across the network to the mirrored site with little or no loss of productivity.

The mirroring of data would be near-real time. How near to real time is not as much a technical issue as an economic and business decision. The Army would need to analyze the costs/benefits of providing near instantaneous failover as opposed to several hours. A suggested interval would be four hours to synchronize databases, re-target DNS servers and re-direct users from the failed site to the operational site.

Failover, or the ability to switch more or less automatically from a non-working site to an operational one, is a requirement of a fully consolidated CWS. The efficacy of having all of the Army's contracting data concentrated in one space is balanced by the vulnerability of that data.

[4] Information provided by AMS personnel indicates that PDe will include PRweb functionality in its base configuration.

[5] Each site would be able to handle, with some performance degradation, 90% of total system peak workload, i.e., the last week of the fiscal year.

A single server site is a technical possibility but not practical. The notional CWS places the data in two, geographically separated sites for the specific reason of reducing the risk of one natural disaster affecting both sites. Of course, in light of the increased awareness of terrorist activity, separate sites with data redundancy reduce the risk that an attack would bring down the Army's ability to contract goods and services.

The architecture of redundant sites is common in both industry and the government. The DEBX system has four sites (two run by DISA and two by DLA.) All four sites have the capacity to handle the entire existing load for all users. This investment provides for both continuity of operation and security of data.

Key to the operation of a two site consolidated system is the communications links between them. Again, the cost associated with these links depends, to some degree, on the nearness of the failover scheme to real time. Links that would allow instantaneous mirroring of data (all database writes are mirrored to both sites simultaneously) would likely need to be dedicated fiber optic connections. Less than real time failover would get by with slower, narrower links. The links would need to be secure, dedicated and redundant.

External connectivity to the sites is also of concern. Analysis of contracting activity, however, indicates that the connection from the server sites to an Internet backbone need not be extreme. Even at end of fiscal year peak periods the number of contract activities per hour for all of the Army is less than 300[6]. The exact determination of the bandwidth required is not possible since no performance information is available about the web-enabled application. What is of concern is that all users regardless of command or location have access to common network so that they may connect to the servers.

Universal access to the system by users, regardless of time or location is a benefit of the notional architecture. Granting that access to users within certain logical domains does pose administrative and security challenges. Coordination of access rights to the server domains will be the task of site administrators and their counterparts at each command. The current Army enterprise infrastructure is in flux. The proposed solution would function best in a unified network where all users have common, secure access to the server site domains.

[6] Data provide by the Army did not provide 100% coverage of all Army contracting activities. However sites that did not provide data were not perceived as heavy contract writing sites, therefore minimizing the impact on the accuracy of the analysis.

3 Risks of Consolidation

There are risks involved in the implementation and deployment of such a large-scale system. The primary, physical risk is putting all Army contracting information and data in just two physical locations. However, that risk can be mitigated through the site mirroring design, site security plans and the proper continuing operation contingency planning.

A secondary, but more likely risk is the loss of data and/or productivity during the transition between the current "as-is" and the notional "to-be" systems. Data migration will be a complex and potentially costly process. Maintaining currency of data and user productivity while transitioning databases is a major technical and procedural challenge. If the decision is to merge all contracting data into a common database there will be questions of ownership, control and access to answer.

The most pressing technical question is how does the Army migrate historical data from the existing system to the new, web-enabled application. If the selected product's developer is the same as the current system the answer may be straightforward. The transformation to a true consolidated database is not a simple matter, however, and the costs for achieving the transformation may be considerable.

If the selected vendor is the not the current one, care must be taken in the acquisition process to ensure that data transformation requirements are fully stated and understood by both the government and the vendor. An incomplete understanding of the task would make any transformation virtually useless. The same level of understanding of the requirements should be integral to the process regardless of which contractor performs the task.

A third area of risk is removal of technical and functional support personnel from local installations. Centralized support systems are economically superior but may break the personal link between user and support staff. The support staff must receive the proper training to handle questions and procedures from a variety of commands. Installations may still rely on their "super users" to provide support for local CONOPS questions but central help desk operations will provide users access to staff with the best training and knowledge of the system. Single sources of support also can be used to promote consistent application of contracting practices throughout the Army.

4 Conclusion

The current Army, indeed, DoD's contract writing system is a cost inefficient system by today's standards. While it has continued to evolve functionally to better support the contracting community, its piecemeal organization requires too much labor and far too high costs to maintain. Moving away from this client/server application to web-enabled system makes economic sense at most any level of data/server consolidation.

The maximum benefit in terms of savings and efficiency to the Army comes with a CWS architecture that brings data and support together at two regional centers. The two-center approach provides the best combination of economics and security.

1. The requirements for a successful implementation of this notional architecture are:
2. A web enabled application that meets the functional requirements of a CWS
3. The establishment of comprehensive and detailed requirements governing the transition
4. An investment in modern data processing and storage technology
5. A unified, interconnected Army network infrastructure
6. The resolve to work out issues of data ownership throughout the Army
7. A commitment by all leadership groups within the Army to make the task successful

About Alterion

Alterion was founded in March, 2000 with the goal of becoming a premier provider of IT Program IV&V Management and Support services. Headquartered in suburban Philadelphia, Alterion has since been successfully involved in numerous programs for corporate and government organizations.

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About Alterion SharpThought™

The Alterion SharpThought™ methodology is a cost-effective method of assuring successful IT system acquisition and deployment through the verification of requirements and the minimization of risks. SharpThought minimizes risk during all phases of a program's life cycle by identifying problems early, allowing corrective actions to be taken at the lowest cost to the program.

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