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Installing and Running AIM 2.3.1 in a Clustered Server Production Environment

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Abstract

High availability and redundancy were required for a 24/7 technical baseline at a nuclear production facility. Process engineering, operations, and maintenance all had to connect to the AIM workflow and data management system at the plant. 24-hour availability and 100% data integrity were requirements. AIM 2.3.1 satisfied these needs by running in a clustered environment, using shared RAID 5 data storage installed with Oracle Fail Safe on clustered WinNT 4.0 Servers. Order of installation was critical for successful operation. The system has been running in production for 12 months with minimal downtime, and zero loss of data.

Introduction

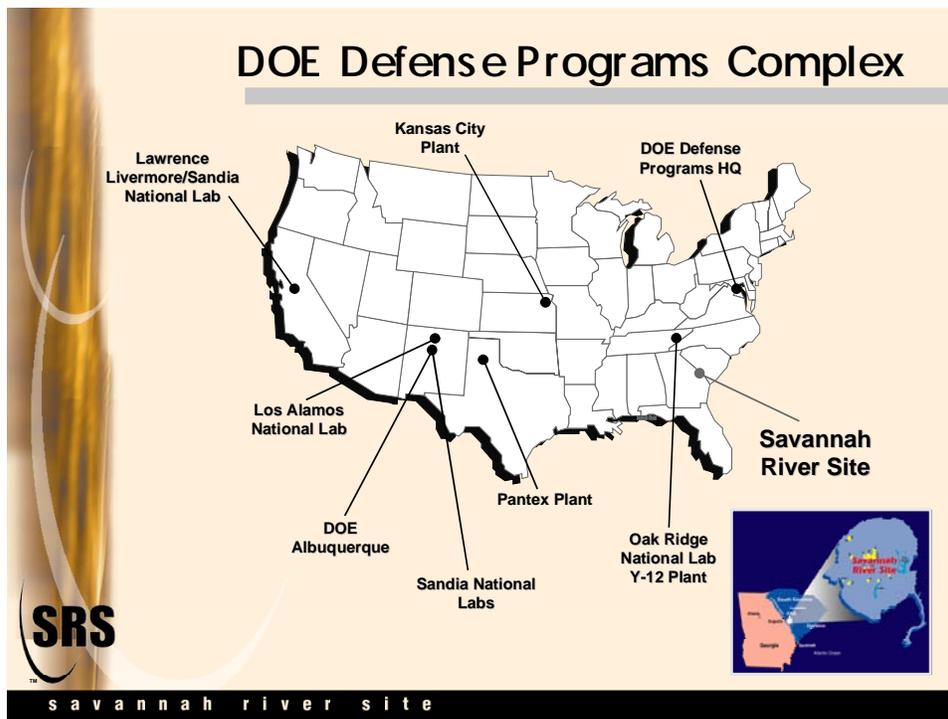
This paper will answer four questions about the Savannah River Site (SRS) and how AIM is installed and used here in a production environment. The four questions are:

- What is SRS and what do we do?
- How do I install AIM on Clustered Servers?
- What do I do after the Install?
- How can AIM improve my business processes?

1. What is the Savannah River Site?

The Savannah River Site (SRS) is part of the Department of Energy Defense Programs Complex, located on a 310-square mile tract near Aiken, South Carolina. (Fig. 1)

Figure 1



It was built in the 1950s to produce nuclear materials for the national defense. At one time there were five operating reactors on site. Current missions include maintaining the tritium stockpile and environmental management. SRS is owned by the Department of Energy and operated by Westinghouse Savannah River Company. There are approximately 15,000 employees at the site.

The site has five imperatives that govern all operations at SRS. They are:

- Safety
- Disciplined Operations
- Continuous Improvement
- Cost-Effectiveness

- Teamwork

The customers of SRS are the U.S. Department of Energy and the United States Strategic Command. Meeting the demands of those customers requires that all operations be conducted within the site's five imperatives. The installation of AIM and its operation has enabled the site to more effectively satisfy customer requirements within the boundaries of the imperatives.

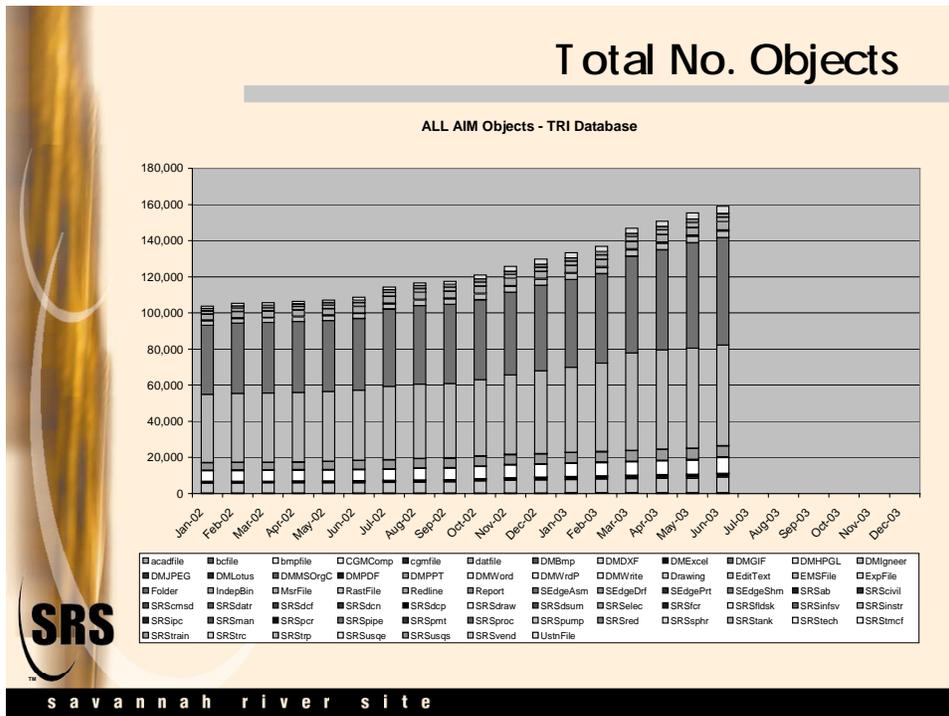
AIM provides site-wide access to the engineering technical baseline on a 24/7 basis. It manages engineering workflow and assures disciplined operations. AIM metrics are collected and analyzed to improve the engineering process. The bottom line is to share work and not re-do work.

AIM at SRS is installed at 20 facilities, including tritium operations, defense waste processing, site utilities, technology centers, and high level waste, among others. For the tritium facility the amount of information includes:

- 17,000 drawings
- 100,000 components
- 160,000 objects

Figure 2 shows how the use of AIM at the tritium facility has grown from January 2002 to July of 2003. The 160,000 total objects are divided among the 67 object classes at SRS.

Figure 2



2. How do I install AIM on Clustered Servers?

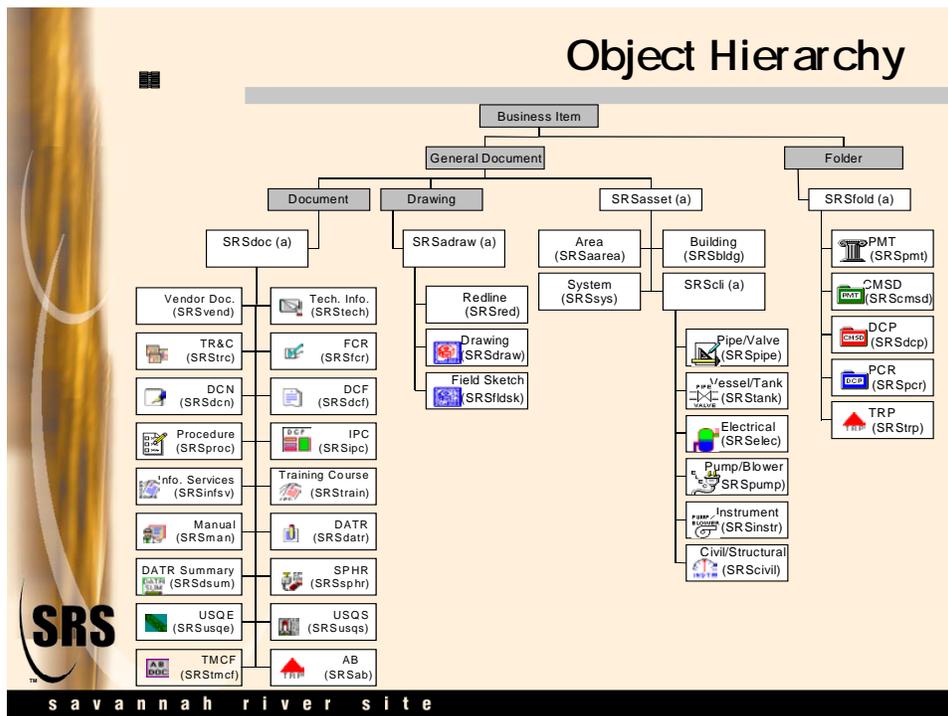
The current version of AIM installed at SRS is 2.3.1. (Fig. 3) An upgrade to SmartPlant Foundation is

Figure 3



currently in the requirements phase. AIM as run at SRS is a highly customized model with four site-specific object categories: Documents, Drawings, Assets, and Folders (Fig. 4).

Figure 4



Prior to the installation of AIM on clustered servers, it was running on a single 4-processor server for a single facility. As AIM was moved out across the site to other facilities the data access and availability requirements were re-evaluated. For the tritium facility a server upgrade and a Microsoft NT Cluster were selected. The configuration consisted of:

- Two HP NetServer LH 6000r servers
- Each with 6 processors (700+ MHz)
- Network adapter teams on each server
- Redundant power
- Clustered database
- 31 External RAID drives
- 400 GB storage
- Separate license server

Since AIM 2.3.1 was not cluster-ready, it was decided that only the Oracle databases would be made fail safe on the clustered servers. AIM would be installed as separate installations on each server. In the event one node of the cluster failed, the database would automatically fail-over and all that would be required would be to point clients to the running node.

The installation took place in a Windows NT 4.0 Enterprise environment with Oracle 8.0.6. This operating system and application were fairly early versions of their type for implementation in the clustered server world. They required a very specific installation order of several software packages with nearly two hundred steps, some determined by trial and error (Microsoft, 2000), (Oracle, 2001).

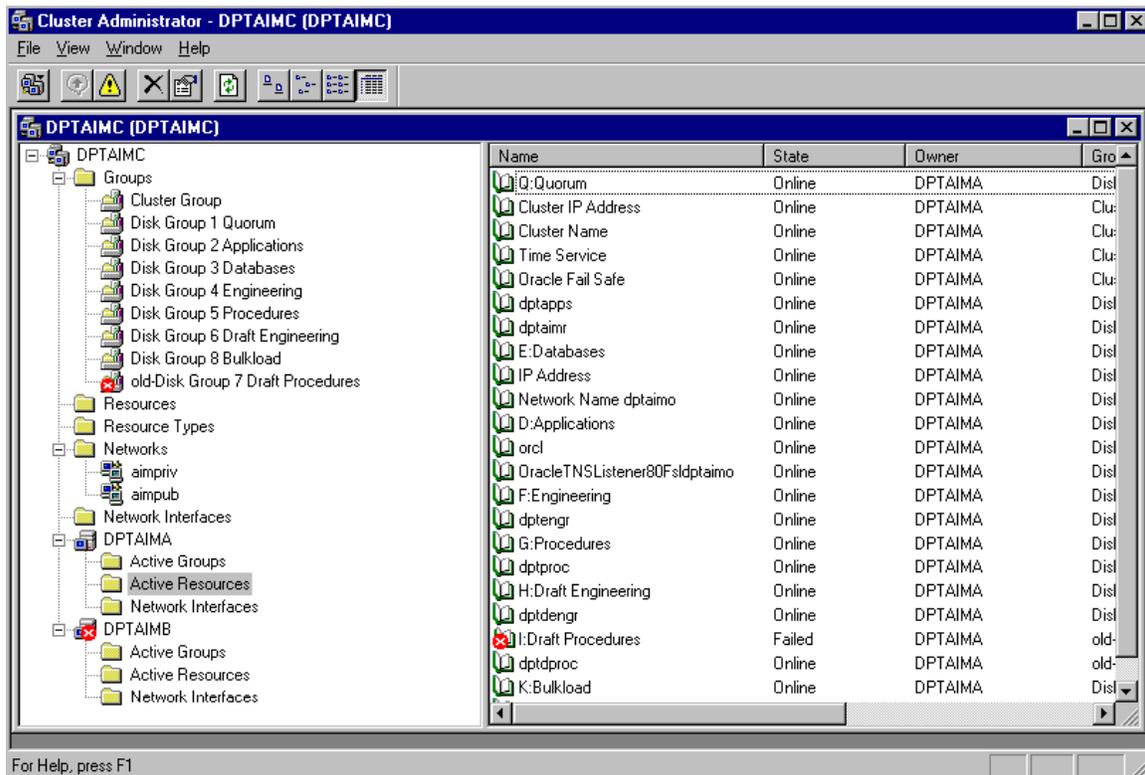
The basic order of installation was:

- WinNT Server Enterprise Edition
- Microsoft Cluster Server
- Oracle
- Oracle Fail Safe
- AIM

The Microsoft Cluster Server (MSCS) was a two-node cluster with each node running a copy of WinNT Server Enterprise. Each server had to belong to the same NT domain and be member servers, not domain controllers. This first stage of the installation took 80 steps.

For the installation a Domain User account had to be first created for the cluster under which it would run. Next, WinNT Enterprise was installed on cleanly formatted drives. The server nodes were configured to share the 31 external RAID drives. Then the cluster was tested with the Microsoft supplied Cluster Administrator to verify that the cluster was formed properly and the nodes were online. (Fig. 5)

Figure 5



After the cluster was installed and running, Oracle and Oracle Fail Safe had to be installed. Correct installation took approximately 100 steps. The major steps included:

- Create a local user with administrative privileges on both nodes
- Create or edit system variables, as specified in Oracle and AIM installation guides
- Install Oracle on the first node without a database
- Install Oracle on the second node without a database
- Create and verify a database on the first node
- Install Oracle Fail Safe on the first node without restarting the server
- Install Oracle Fail Safe on the second node
- Restart the first node
- Restart the second node
- Run Oracle Fail Safe again to put the database into MSCS
- Test installation of database by running Oracle Fail Safe Manager

After Oracle and Oracle Fail Safe are running on the cluster, the AIM installation proceeds normally.

3. What do I do after the Install?

After AIM is up and running on the cluster, the system administrator's time is spent primarily in three areas: on-going upgrades, user issues, and daily operations. According to Stephen R Schach's "Object-Oriented and Classical Software Engineering," (Schack, 2002), 67% of the life cycle costs of software are spent on maintenance. Of that cost, 20% is spent fixing bugs and 80% is spent adding new features.

The SRS AIM development team has created 13 upgrades or fixes for the SRS installation of AIM in the 26 months since Version 1.0 was installed in May of 2001. That is approximately an upgrade or fix every two months (Fig. 6).

Figure 6



Users have the usual password, user name, and renamed computer issues, but what they really want to know is, “What is AIM going to do for me?” As an evangelist for AIM I usually tell them, it:

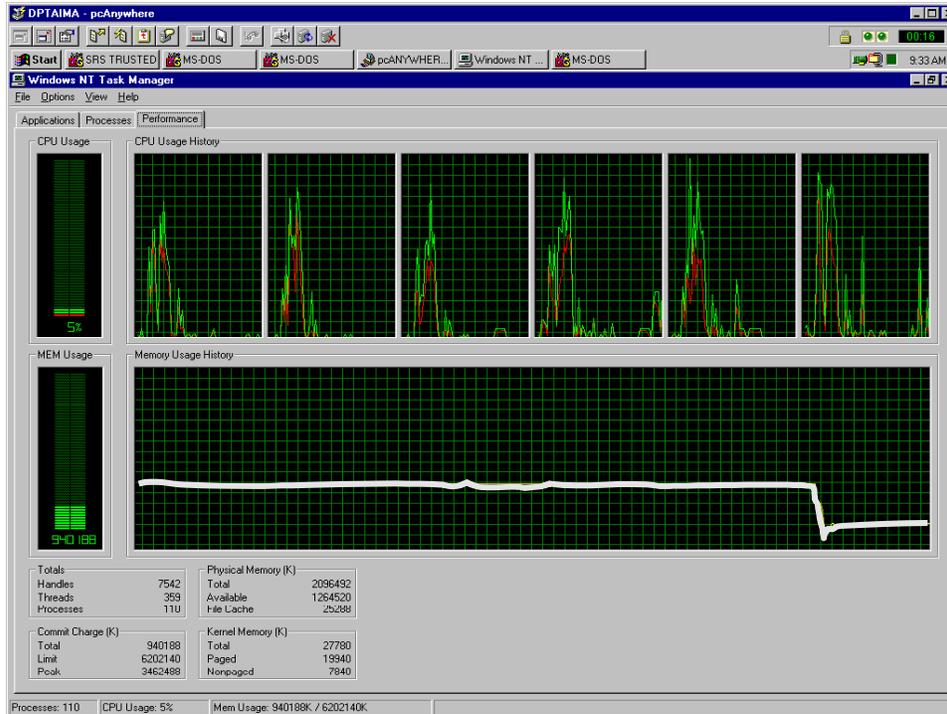
- Provides a computerized work space
- Eliminates carrying a document or drawing around for review and signatures (workflow)
- Manages your work
- Tracks and maintains component information
- Retrieves and displays the latest drawing for review or updating
- Tells you when you have work that must be done

The actual workflow for different objects can get complicated quickly for a 50-year old facility with highly specified approval processes. A draft workflow is show in Fig. 7 and the resulting AIM computerized workflow in Fig. 8.

Daily operations for AIM consist of:

- Reviewing objects in the workflow to make sure they are flowing and engineers are processing assignments
- Checking the workflow queue for blockages
- Clearing normal error messages on the server (e.g., users attempting to modify out-of-date objects)
- Checking memory usage and freeing up memory when needed (Fig. 9)
- Checking processor usage to validate server configuration

Figure 9



Finally, the AIM configuration settings in the config.cfg file can be reviewed to optimize server response and user satisfaction.

4. How can AIM improve my business processes?

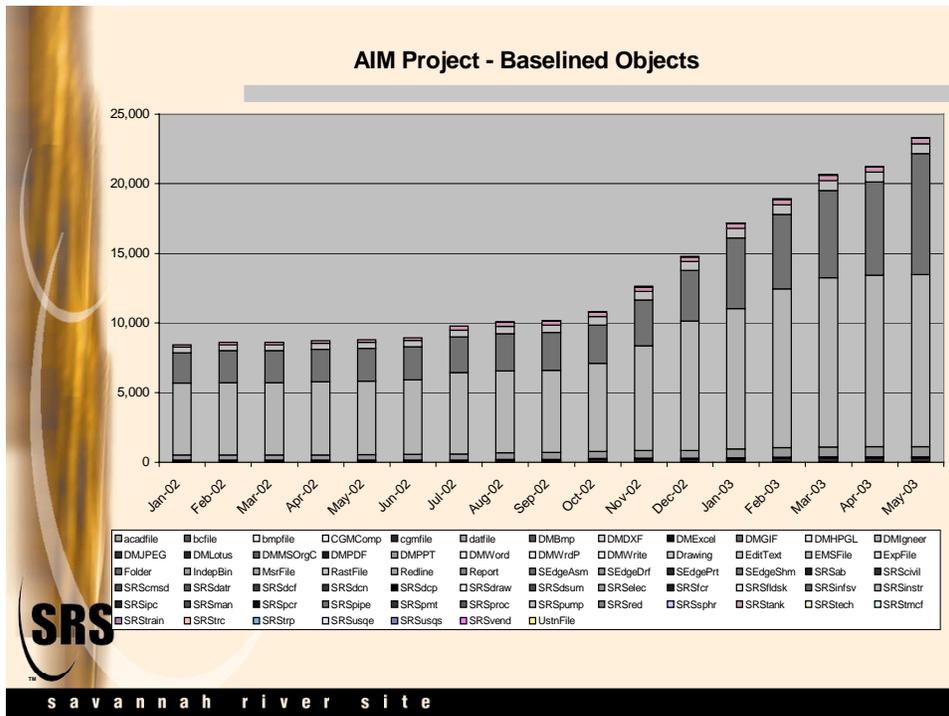
AIM is more than a software-enhanced method of conducting business, in SRS's case, the engineering practice. We are collecting historical data to review the way we do business and look for ways to improve safety, efficiency, and productivity. We collect workflow data, email data, and item count data toward this end. Workflow data consists of:

- Item Identifier
- SRS Object No
- Object Title
- Facility/Project
- Workflow
- Workflow Revision
- Process Name

- Time Stamp In
- Time Stamp Out
- Exit Status
- Elapsed Days
- Assignment Message
- Original Assigned User
- Actual Assigned User
- Action
- Comments

The Elapsed Days item can tell us the average time to review and approve a particular type of object, such as an instrument or drawing. We can determine which items were rejected by a reviewer and why, and apply this information to our continuous improvement program. There are 67 different types of objects we manage in AIM, some, such as components and drawings, consume the bulk of AIM resources. By graphing the throughput per month we can track projects and ongoing operations. (Fig. 9)

Figure 9



Conclusion

AIM is an integral part of the way we do business at SRS. In just two years when it emerged from its pilot stage it has grown from managing one facility to managing 20. In one facility, tritium operations, AIM is coordinating the work of 400 users, managing 160,000 objects, and keeping track of 17,000 drawings. AIM is used to provide engineers their workspace. It is synchronized with our Passport maintenance database to ensure that operators and maintenance staff have the most up-to-date information and drawings to perform their work safely and efficiently. Finally, the wealth of metric data in AIM is being used to further improve the way we do business at SRS.

References

Microsoft Corporation. "Installing the Windows NT Option Pack on Microsoft Cluster Server (MSCS)" Microsoft Corporation, January 2000.

Oracle Corporation. "Oracle Fail Safe Installation Guide," Oracle Corporation, January 2001.

Schack, Stephen R.. "Object-Oriented and Classical Software Engineering," McGraw Hill, Boston, 2002.

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