Final Report

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FMS Final Report Table of Contents

1. Executive Summary
   1.1. Project Background
   1.2. Report Summary

2. Summary and Status of Work
   2.1 Overview
   2.2 Tools and Documentation Delivered

3. Recommendations for Continued Success
   3.1. Overview
   3.2. End Users and Business Operations
   3.3 AISD; Development and Computer Operations
   3.4 Software
   3.5 Technical Platform
   3.6 Control Procedures

4. Contract Deliverables and Client Satisfaction
   4.1. General
   4.2. Observations from Client Feedback
EXECUTIVE SUMMARY
1. **Executive Summary.**

1.1. **Project Background.** Over the past several years, Andersen Consulting has assisted Johnson Controls World Services Inc. (JCI) in the implementation of the Facilities Management System (FMS).

The project began by recognizing the need for and defining the facilities management system requirements. The major recommendations from this analysis included the following:

- Develop an integrated, on-line facility management system
- Use commercially available software as the foundation for new systems development

Following the completion of the system requirements' definition, the software selection process began. At the conclusion of this phase, the project team recommended the following primary application software vendors and package applications:

- Ross -- General Ledger system,
- Argonaut -- Payroll system (to be converted to DEC/ADABAS)
- Bonner & Moore -- Facilities Management system including the work management, equipment and preventive maintenance, and materials management applications (to be converted to DEC/ADABAS)

The development of the FMS system took approximately three years. Johnson Controls project members took responsibility for modifying and testing the General Ledger and Payroll applications, as well as the custom development of the Time (Labor Capture) system.

Andersen project team members accepted responsibility for modifying and testing the Bonner & Moore applications, as well as the custom development of the following applications:

- Work order interfaces with the LANL work order system
- Material interfaces to LANL
- Utility Billing,
- Cost Distribution -- internal general ledger interface.

The project team identified extensive functional enhancements required to meet the business needs of the Johnson Controls work management and materials management functions. The project team did not identify enhancements to the equipment/preventive maintenance sub-system.
The project team converted the existing work order, equipment, and purchase order data files the weekend preceding February 18, 1991. As of February 18, 1991, FMS became fully operational.

With the integration of virtually every application system at JCI, post production support activities focused on cross-application system reconciling and balancing. As well, the analyst and user groups joined efforts to identify and prioritize FMS modifications and enhancements. Some of the major enhancements begun during this time period include the following:

- Work order balancing with general ledger and LANL
- Payroll to general ledger interface
- Labor Capture prior period corrections
- Additional data deliverable reports
- Cost transaction displays
- Data base purge processing
- PREDICT data dictionary population
- Software AG recommendations
- Equipment/Preventive maintenance
- One-on-one, additional user training as required

SUMMARY AND STATUS OF WORK
1.2. Report Summary. The remainder of this report provides a detailed, final status of Andersen Consulting's participation in the FMS systems implementation project and offers suggestions for continued FMS improvements. The report presents the following topics of discussion:

- Summary and Status of Work
- Recommendations for Continued Success
- Contract Deliverables and Client Satisfaction

The Summary and Status of Work section presents a detailed, final status of the FMS project at the termination of Andersen's full-time participation. This section discusses the status of each FMS sub-system and of the Andersen major project deliverables.

The Recommendations section offers suggestions for continued FMS success. The topics discussed include recommendations for each of the following areas:

- End User and Business Operations
- AISD; Development and Computer Operations
- Software
- Technical Platform
- Control Procedures

The Contract Deliverables and Client Satisfaction section discusses feedback received from Johnson Controls management and FMS system users. The report also addresses Andersen's observations from the feedback.
2. **Summary and Status of Work**

2.1 **Overview** After the February 1991 conversion, the Facilities Management System (FMS) continued to evolve. As expected in any large system installation and conversion, the system encountered problems, but the development analysts and users reacted quickly to control and correct them. The AISD and Andersen Consulting project team developed a mechanism to record, prioritize, and track problem and enhancement requests. The user community committed themselves to participation in the evolving system by organizing a user-chaired FMS Steering Committee. Together the systems development team and the user community established the process and the tools necessary to effect progress in addressing FMS issues.

The system now operates in a relatively stable environment. Computer hardware functions more reliably, system data balances accurately, and many users recognize that FMS has delivered the following system objectives:

- daily, on-line cost detail requested
- separation of the JCI and LANL databases
- integration of all major JCI application systems

Other economic, administrative, and operational objectives will continue to be met as critical post production modifications and enhancements are completed.

Systems analysts and functional users need to continue to assess FMS operations and to modify and enhance the system as Johnson Controls World Services Inc.'s business grows and changes. The status of the system as it operated at the termination of Andersen Consulting's on-site and phone support activities is summarized by functional area below.

2.1.1 **Work Order** The work order software was modified extensively to meet JCI's specific processing requirements, and to incorporate NOS system features that work order system users desired. Approximately 80% of the work order system was modified and approximately one fourth of the enhancement requests presented by users were work order system related. Many of the high priority requests were completed. These requests included the following:

- Balanced work order costs -- reconciliation of work order costs to the general ledger and LANL work order system
- Purged closed work orders
• Enhanced cost displays to include dollars and cents on work order, cost display screens (WO08, WO09, WM32, WO04)
• Enhanced small job ticket and work ticket add screen defaults
• Corrected copy job plan for material requirements
• Implemented Software AG recommendations in custom programs

A number of high priority tasks remained incomplete. These included the following:

• Additional reporting requirements
• Small job ticket process simplification
• Work order closing process streamlining
• Work order field updating and front-end Work Order interface with LANL enhancements
• QuikNet Pro interface development

In addition, at the time of Andersen's on-site departure, over 100 Bonner & Moore User Report Form Requests (URF - Bonner & Moore mechanism for reporting software errors to vendor) existed. Many involved the work order function. Andersen Consulting fixed most of the problems so that JCI users felt little impact using the current version of the software.

If JCI installs version 6.2 of the Bonner & Moore software, AISD must ensure proper acceptance testing of the new release not only for the new, additional functionality but also for each URF documented previously.

Due to the extensive modifications to the work order system, Andersen Consulting has serious reservations concerning the installation of a new Bonner & Moore software release. We discuss our concerns in detail, along with recommendations in section 3.4.

2.1.2. Materials  Over 80% of the materials application software was modified to meet JCI's specific processing requirements. Many of the high priority requests completed include the following:

• Commodity Report
• LANL drop point
• Print goods receipt notices and pick lists
• Direct print to warehouse
• Software AG recommendations in custom programs
• Work order event counter update on ST14
A number of high priority tasks remained incomplete. These included the following:

- Additional reports
- Streamlining the purchase requisition process
- Simplifying the purchase order maintenance process
- Material purchase order interface with LANL
- System contracting
- Direct Issue Freight charges

2.1.3. Equipment/Preventive Maintenance  Virtually no modifications were made to the Bonner & Moore Equipment/PM application software prior to FMS implementation.

Since implementation, this system has posed several critical operational problems. Some of the obstacles encountered included the following:

- Limited functionality
- Vendor software bugs
- User training in use of system
- Production data bases populated with inappropriate conversion data

Users and analysts decided to further system test the modules in a test environment before proceeding with production usage. As of Andersen's departure, this system still had not functioned in the production environment.

Although JCI assigned a full time analyst to support this sub-system, Andersen Consulting completed several high priority requests. These included the following:

- Preventive Maintenance Work Order Generation Batch Program
- Prefix  Standard Jobs

During the months of February and March 1992, Andersen Consulting project team members implemented several modifications and enhancements to this sub-system. The tasks included the following:

- Preventive Maintenance Work Order List Report
- Preventive Maintenance Annual Plan Report
- Equipment Certificate Report
- Equipment Maintenance Costs Exceeding Installation Costs Report
- Equipment Cost by Class Report
2.1.4. **Utility Billing** This custom system has run in production mode since December 1991. Users have identified few opportunities to enhance the system. However, Andersen would like to communicate the concern that the system design and implementation efforts were based heavily on existing utilities contract arrangements. Should these contract arrangements change, the Utilities Billing programs may require modifications.

2.1.5. **General Ledger** The general ledger system has operated in production for close to two years. This system remains relatively modification free. Few requests for changes to the system have been received.

The General Ledger sub-system has operated smoothly. Users possess sound knowledge of the system's capabilities. One of the few obstacles encountered has been the contention recognized between General Ledger batch jobs submitted throughout the day with other on-line FMS functions (especially Materials receiving and issuing). The requests of these batch jobs should not pose a performance problem when the General Ledger and Payroll systems are transferred from the DEC 6420 to the DEC 4000 processor. We feel that this is a wise strategy, providing data access between subsystems and processors are addressed appropriately.

Immediately after conversion, costs did not reconcile amongst various sub-systems. The following major problems were identified: Cost Distribution received duplicate labor transactions from Labor Capture, material up-charge calculated at incorrect percentage, new material transaction cost type needed to be defined to system, and equipment and miscellaneous pre-processing of entered charges did not balance with actual charges.

Since 1991 year-end processing, the work order and utility data bases have continued to reconcile costs transferred to the GL on a monthly basis.

As Andersen completed on-site support efforts, the Payroll sub-system interface to the GL has continued to be a problem. The inability of the Payroll software vendor to interface payroll transactions to the appropriate GL accounts and cost centers has resulted in weekly manual adjusting entries to the GL.

2.1.6. **Labor Capture** This custom subsystem has run in production mode since February 18, 1991. This system has allowed effective recording and reporting of productive and non-productive labor hours for all JCI personnel. The primary requests for enhancements have related to additional reports and corrections to time reported in previous pay periods. To effectively address the approach and implementation of
Labor Capture enhancements, an additional subcommittee of users, analysts, and department managers has been formed to address the issues.

2.1.7. Payroll  The payroll subsystem has been operational since the first pay period of 1991. The major enhancement requests have focused on additional reports and reconciliation of the general ledger interface accounts. As of the Andersen departure, the interface to the general ledger still required manual adjustments to reconcile general ledger cost center and account balances.

2.1.8. Cost Distribution  This custom subsystem has run in production mode since February 18, 1991. Although relatively few service requests have been submitted, those identified have been of high priority. Most of the cost distribution enhancement requests have dealt with auditability and procedural control issues. Much of Andersen's on-site support and off-site continuing support have been dedicated to addressing these issues. AISD analysts have praised the modularity and ease of maintaining the key programs in this subsystem.

High priority enhancements completed include the following:

- Additional audit trail reports (transactions with invalid FQAs, transactions with invalid work order status, fuel transfer report, and summary of general ledger totals) created for Cost Distribution to General Ledger interface
- Cost display enhancements
- Increase size of miscellaneous transaction file
- Year-end purge of transactions associated with closed standing work orders
- Reconciliation of work order, general ledger, and LANL data bases. The reconciliation problems appear under control, as the only remaining out-of-balance situations identified have resulted from computer crashes.
2.1.9. **WOS Interfaces** The FMS work order system supports two electronic data transfers with the LANL work order system (WOS). The front-end interface populates the FMS work order data bases with new, authorized work orders from the LANL WOS System. The back-end interface reports daily work order status and cost information to the LANL WOS System. The back-end interface currently operates in a production mode and has been transmitting data successfully since October 1991.

While the front-end interface operated successfully during an integration test with the lab, users and analysts decided that the system should be supplemented with additional audit trails and internal controls before being placed in production. Work was underway to complete these requirements at the time of Andersen's departure.
2.2 Tools and Documentation Delivered  Throughout the development and implementation phases, Andersen has been responsible for creating the tools and documentation necessary for JCI analysts to support the system. While significant work remains to implement existing user enhancement requests, it is important to recognize that modifying and enhancing the system is a continuous process. Managing that change from system and user perspectives is the key to success. The tools and documentation created by Andersen Consulting include the following:

2.2.1. The "Guide to FMS: A Programmer's Handbook" A Programmer's Handbook was delivered in January 1992. This manual was created to provide a central source of documentation pertaining to the maintenance of the FMS system. While thorough in its content, it was not intended to document every situation a programmer may encounter. Rather, it was intended to provide guidance and direction to beginning programmers. The handbook explained technical environment maintenance procedures, year-end processing and work order purge processing considerations, and data dictionary documentation format and update procedures.

2.2.2. PREDICT Data Dictionary The documentation portion of the PREDICT data dictionary was populated with all relevant program information. All vendor and custom on-line and batch programs were entered. The relevant program information added for each on-line or batch program included all called modules, screen maps, job stream steps, files accessed, and reports generated.

2.2.3. Technical Environment Documentation Before Andersen Consulting completed on-site support, the technical environment maintenance procedures were documented and the AISD Work Management team leader was trained in the maintaining of the development, system test, and production environment source code, object code, executable code, job streams, and on-line screen definitions. The necessary compiling, linking, and migration procedures were also discussed in the documentation. A copy of the technical environment documentation was included in the "Guide to FMS: A Programmer's Handbook."

2.2.4. Vendor Code Modifications Log and Procedures Until April 1991, Andersen Consulting maintained a set of 5 binders containing the detail of each modification Andersen Consulting made to the COMPASS system software. This documentation included modifications made to temporarily fix Bonner & Moore software to make it production ready, as well as modifications made for enhancements specific to Johnson Controls Inc.'s special operating requirements. This documentation included a hard copy of program code before and after the modifications were made. In addition, brief descriptions of the purpose of the modification were included.
After April 1991, lead development analysts determined that this documentation process should not be continued. Therefore, this documentation does not include modifications made to the COMPASS system after this date.

2.2.5. **Computer Operations Batch Processing Manual** This manual describes all custom and COMPASS program job streams in the required sequence of operation. This documentation includes the sequence of operation for job streams that need to be executed on a daily, week-end, month-end, quarter-end and year-end basis. Also included within this binder is a description of the appropriate action to be taken in the event an error occurs. Finally, we updated COMPASS job stream documentation to coincide with modifications made to the packaged software and Johnson Controls Inc.'s mode of operation.

2.2.6. **Systems Test Model** Systems test model documentation consisted of 31 binders that coincided with our testing cycles for each business function tested. Each binder contained the following:

- Test conditions for the business function
- Data used to test the conditions
- Detailed test result expectations
- Cross references to required program correction reports (Bonner & Moore URFs or Andersen Consulting SIR's)

This documentation is normally used to verify which functions were tested and the level of detail at which they were tested and to serve as a guideline for conducting systems testing activities related to future FMS modifications.

While this documentation was created and left for use by the AISD analyst team, apparently it was later considered non-useful and therefore may not be available for reference.

2.2.7. **Training Manuals** The training manuals consist of thirteen binders for each of the major business functions performed when using the Bonner & Moore COMPASS and Cost Distribution applications. These manuals are broken into three parts. They include the following:

- Instructor-led screen instruction -- This section highlights fields of importance on each of the screens used in carrying out the function, and describes the valid input values accepted in each of the fields.
Instructor led case -- This section builds a scenario around realistic work transactions and data that the instructor walks participants through.

Self-study case -- This section also builds a scenario around realistic work transactions and data, but in this example the information about the scenario is communicated in the case text, and the participants are expected to attempt to solve the scenario themselves.

These manuals accompanied a training database that was stored on tape. This tape was placed in AISD operations custody so that training data could be refreshed as necessary to support new and ongoing training.

2.2.8. User Procedures Guides. Besides the user manuals provided with the COMPASS software system, the development team prepared User Procedure Guides. These guides described the manual and automated procedures required in carrying out each of the operations supported by the work management, materials management, and cost distribution functions. They have been developed in a matrix format that reduces the amount of text and increases the accessibility and portability of the information. Included in these matrices are the screens, decision points, forms and controls required to perform the procedure, presented in the sequence appropriate for proper completion of the functional.

2.2.9. Screen and Report Definition Manual The Andersen Consulting team spent several weeks updating the screen and report definition manual during on-site support efforts. This manual contained a hard copy example of each custom developed screen and report in the work management, materials management, cost distribution and utility billing areas along with a description of the data they contain and when used.

2.2.10. FMS System Flows A Guide for on-line program flow was produced. A section of the guide was dedicated to each of the functional applications. These sections described the desirable program flow required to complete a specific work task. This guide was created to supplement the existing User Procedure Guides and the Screen and Reports Definition Manual.

2.2.11. Project Status Reporting Until November 22, 1991, FMS status reporting to JCI management and JCI user groups was completed on a weekly basis by Andersen Consulting using an automated PC spreadsheet. On November 22, 1991, the AISD Systems Development Supervisor, assumed responsibility for the weekly updates, and expressed intentions to transfer the PC spreadsheet to QuikNet Pro within a reasonable time frame.
RECOMMENDATIONS FOR CONTINUED SUCCESS
3. Recommendations for Continued Success

3.1 Overview During the course of our work in designing and installing the FMS system, we faced several obstacles in the following areas:

- End Users and Business Operations
- AISD: Development and Computer Operations
- Software
- Technical Platform
- Control Procedures

We depended heavily on our methodology, management techniques, and quality assurance program to aid in minimizing the risks of these obstacles. We gained valuable experience applying this approach. We would like to share some recommendations in each of these areas with AISD to help the department minimize risks they may face in their continued development of FMS.
3.2 **End Users and Business Operations** There were five major difficulties facing the FMS development team that may be categorized as user or business operations related. These are:

- Wide spread acceptance of existing systems.
- Field users had little or no previous exposure to computers.
- Packaged software application processing flow differed from existing business operations flow.
- Even though more cost information was available on-line with FMS, the data entry efforts required to capture the information for some business processes were cumbersome.
- Centralized, common user reference materials were unavailable

The result was mixed acceptance of the FMS system. In order to better manage these obstacles in the future, we make the following recommendations:

- Develop training programs for ongoing and new employee training requirements
- Continue FMS Steering committee meetings involving system users, management and AISD analysts
- Adequately set user expectations of software modifications, and foster acceptance of change
- Develop a centralized user library

These are described in more detail below:

3.2.1. **Training Programs** No formal training programs have been established for either new system enhancements training or new hire basic system training. This appears extremely ironic since training was one of the strongest complaints aired by users early in the system's conversion.

We recommend that AISD work closely with Human Resources to develop a training plan that identifies:

- Training requirements for the user population.
- Methods of delivery (Instructor Lead, Computer Based, Self Study Manuals) for required training topics.
• Materials to be developed based on topics and methods of delivery.

• Maintenance requirements for the computer system's training environment including program versions, data and hardware.

• Training facilities.

In the current changing data processing environment that Johnson Controls finds itself operating, the importance of a formal training program becomes more important. We recommend that an ongoing training process be formalized and included as a primary step in the enhancement turnover process for each modification made to the system.

The pre-conversion training manuals and materials provide JCI with an excellent foundation for developing an ongoing training program. The development of the training program will require a large resource commitment. Therefore, we recommend that a member from AISD and Human Resources be specifically assigned to work part-time on the task until the programs are firmly established.

3.2.2. FMS Steering Committee  The FMS Steering Committee existed throughout the design and installation of the system development process. Consistent attendance at the regularly scheduled meetings from users, management, and AISD, was difficult to achieve. The renewed interest and active participation by these groups have contributed greatly to the speed and quality with which the post production enhancements have been implemented.

This level of commitment must continue. We suggest that JCI provide an incentive for involvement such as highlighting FMS accomplishments reported at steering committee meetings in the JCI paper and training the elected System Application Administrators for each application.

3.2.3. User Expectations and Change  Managing user expectations will play a key role in the success of continued FMS system enhancements. Four major subsystems have yet to be fully integrated in the production environment: equipment/preventive maintenance; work order front-end interface, labor capture prior period corrections and electronic ordering of materials.
Mechanisms to help manage user expectations include the following:

- Ensure user participation and involvement throughout the complete change process including sign-offs at design, testing, and roll-out phases.
- Require key user input throughout enhancement testing. If possible, have users develop test conditions and expected results as well as execute test cycles and verify test results.
- Ensure adequate training is provided for all users affected by the enhancements.

3.2.4. **Centralized Library** Johnson Controls has not established a centralized repository of FMS system user documentation. A centralized library has the potential to serve as a reference center for users and analysts. The library should contain at least the following reference materials:

- Updated Screen and Report Definition Manual
- Updated User Procedure Guides
- Updated On-line System Flows
- Updated Training Manuals
3.3 AISD; Development and Computer Operations  The primary development and computer operation challenges faced during the FMS system development efforts included:

- Standard development methodology and approach not established or adopted
- High development team turnover
- The number and magnitude of systems implemented could not be absorbed by operations in the short time given
- Centralized, common technical reference materials were unavailable

As AISD continues to build a strong development team, we feel that the department should apply the following recommendations:

- Establish a procedure for maintaining and enforcing methodology standards
- Develop professional education training for development and operations teams (TQM adopted at JCI)
- Establish a centralized technical library for development and operations teams
- Assign a documentation coordinator and establish a procedure for keeping documentation up to date

3.3.1. Establishing and Maintaining Methodology Standards  Not only does the Johnson Controls AISD department need to establish a systems development methodology, but also the standards to enforce the process. Some necessary mechanisms already placed into practice include the following:

- Limit access to Natural until Natural Security is received and installed

Other mechanisms to enforce methodology standards include the following:

- Adhere to program, screen, and job stream naming standards established during FMS development phase
• Establish and maintain a system test model, which includes mandatory test conditions and expected results for system modifications

• Develop standardized checklists for steps to be taken and sign-off to be received for system modifications

It will be important that the standards developed at Johnson Controls promote acceptance of the new methodology.

3.3.2. **Professional Education Training**  Johnson Controls has adopted the Total Quality Management program. The analyst and operations staff would benefit from other in-depth training as well. Some of these include the following training topics:

• Train Operations in reading job stream logs

• Establish checklist for reviewing job stream execution

• Develop technical expertise in DECforms

• Provide Operators with the tools needed to adequately monitor job stream reports for errors

• Provide advanced Natural training courses

3.3.3. **Centralized Technical Library**  A centralized resource area for technical system documentation does not exist at Johnson Controls. References to include in a technical library include the following:

• Programs, screens, data base management system, job streams, operating system, programming language, and hardware documentation

• File layouts

• System test model

• Department standards

• Vendor technical system operations manuals

3.3.4. **Documentation Coordinator and Documentation Updates**  The FMS system continues to experience considerable change. Historically, keeping documentation up to date with the system changes has been difficult. We suggest that Johnson Controls assign a documentation coordinator to be responsible for updating documentation (system, programming, training).
In light of recent natural disaster system recovery tragedies across the country, Johnson Controls should not overlook documentation requirements in a disaster recovery plan.
3.4 **Software** The system and application software presented most of the complications the project team faced. These complications consisted of:

- Extensive software bugs in the COMPASS software application
- Complex interfaces with new systems being developed at the Lab
- Extensive application software modifications to COMPASS software

The project team has recovered from the impact of many of these obstacles; however, in moving forward the following recommendations should be considered.

- Build stronger relationships with systems and application software vendors
- Formalize and enforce application software modification process
- Avoid migration to new software versions without updated modification documentation

3.4.1. **Vendor Relationships** The major applications within the FMS system were installed from a vendor’s base package. Many of the applications have been modified extensively which makes vendor support a more difficult issue. Johnson Controls should foster vendor relationships for which the vendors can be held accountable.

3.4.2. **Application Software Modification Process** The AISD department at Johnson Controls has not established or maintained a process by which vendor software should be modified and tested. Such a process would allow Johnson Controls to better manage vendor relationships by tracking, recording, and documenting modifications to the vendor software.

3.4.3. **Migration to New Software Versions** In the recent past, Johnson Controls has discussed migrating to the newest release of the Bonner & Moore software package. In making such an important decision, we present the following considerations:

- Some of the Bonner & Moore software functions have been modified in excess of 80%. On average, 50% of the package has been modified.
- Historically, new Bonner & Moore releases have required thorough testing.
The software enhancement documentation established by Andersen Consulting has not been kept current.

At this point, a new release migration would virtually require a full implementation work plan.
3.5 Technical Platform  The technical platform implemented added the following difficulties to the FMS development efforts:

- Required computer processing power was greatly underestimated
- Unstable communications network
- Fatal software bug in the ADABAS Database Management System's buffer control
- Application software packages converted from IBM/VSAM to DEC/ADABAS platforms did not take advantage of the benefits offered by the DEC/ADABAS architecture

These issues were responsible for the limited user access to the system and slow system performance.

AISD has acted readily to address these problems by developing a new hardware upgrade strategy. In addition, we feel the following recommendations should be examined:

- Follow through with the hardware upgrade strategy
- Follow through with software vendors' performance enhancements

3.5.1. Hardware Upgrade Strategy  Shortly after implementation of the FMS system, the Johnson Controls systems resource planners began work on a hardware upgrade plan. The plan consisted of the purchase of the following hardware upgrades:

- CPU processor upgrade to a 6420
- One additional DEC 4000 (total of 2 on-site)
- New tape backup and storage device
- Additional disk storage
- Operating system upgrade

These components have been requisitioned and in process of implementation since August 1991. We believe the hardware upgrade strategy implementation to be crucial to continued FMS improvement success.
3.5.2. **Vendors' Performance Enhancements** Some enhancements that Johnson Controls requested but were not complete at the time of Andersen's contract termination include the following:

- Software AG "patch" to fix random fatal buffer error
- New DBI with Software AG recommendations from Bonner & Moore
- Over 100 identified and documented Bonner & Moore program bugs
- Payroll to general ledger interface from Argonaut
3.6. **Control Procedures**  Control procedures exist to ensure the accuracy and completeness of system processing. Controls seek to maximize data integrity, reliability, and security. The FMS system encountered the following six major obstacles throughout the implementation and post-implementation support activities that relate to control procedures' concepts:

- Corrupt data appeared in the production environment
- Inconsistent display of similar data across screens
- Data balancing and reconciliation problems occurred between interfaced subsystems (cost distribution to general ledger, cost distribution to work order, general ledger to LANL, and payroll to general ledger)
- Varying versions of programs existed in the system test and production environments (production should always mirror system test under the current migration procedures)
- Programmers have privileges to the production data environment
- Continuation of batch processing

The project team has worked to correct many of these problems as they occurred. We offer the following additional recommendations:

- Establish more and better audit trails and reconciliation reports
- Enforce security procedures

3.6.1. **Audit trails and reconciliation reports** Throughout the post implementation support efforts, additional audit trail and reconciliation reports were identified that would assist in detecting system data problems more readily. These reports include the following:

- Equipment and miscellaneous charges entry reconciliation -- verify the transactions entered in with the transactions processed. This reconciliation was in process at the time Andersen's contract terminated.
- Reconciliation for LANL charges by account.
- Detailed daily transactions report by account and work order.
- Work order balance reports. These reports were completed by Andersen and were available for request on a monthly or life to date basis.
Add statistics reports to all batch update and interface programs (counters for records read, written, updated, in error, etc.).

3.6.2. **Enforce security procedures** The implementation of the following recommendations will help Johnson Controls alleviate some of the data problems resulting from the batch transaction processing routines and system development life cycle process.

- Allow computer operators to check nightly job streams to ensure successful batch processing. Require the responsible functional analyst to check all batch job stream logs the morning following the batch run. Require that users verify processing from daily statistic reports.

- Develop procedure and checklist to follow when a batch job fails to ensure processing doesn't continue when data bases require a restore.

- Enforce procedures prohibiting programmers from modifying production data.

- Establish responsibilities for processing rejected transactions in a timely manner.
CONTRACT DELIVERABLES AND CLIENT SATISFACTION

4.1. General. Prior to January 3, 1992, Andersen Consulting requested a formalized sign-off memo from Johnson Controls. On February 3, 1992, Andersen received a copy of the requested memo from Barry Hull. The memo listed Andersen Consulting's major contractual obligations and Johnson Controls level of satisfaction with the services. (Copy attached)

On February 7, 1991, the Andersen Consulting team management participated in a post contract, follow-up steering committee meeting. Part of the meeting was dedicated to providing Andersen with project performance feedback. The following list summarizes the major feedback received:

4.1.1. User involvement. Most users did not feel adequately involved in the FMS development process.

4.1.2. Training. Most users did not feel that the training adequately prepared the user community for the day-to-day operational changes the FMS system would require.

4.1.3. System complexity. The complexity of the integration of all the administrative and operational systems was grossly underestimated.

4.1.4. Documentation. Adequate user and system documentation was not provided.

4.1.5. Design. The design of the work scheduling and labor capture modules did not meet Johnson Controls business objectives.
4.2. Observations from Client Feedback.

4.2.1. User involvement. Throughout the design and installation process, project programmers and analysts met with users individually. The weekly user steering committee meeting became the major vehicle for user coordination and resolution of design and installation issues.

4.2.2. Training. The Andersen project team provided two months (December 1990 and January 1991) training to field users. Andersen brought in firm training and change management experts to assist the training team. For consistency, all training courses followed the same format and provided multiple, hands on case examples and activities.

4.2.3. Design. The intent of using vendor software requires that the organization modify the way business it does business. That has not happened at Johnson Controls. The uniqueness of operations was underestimated by all parties involved.

Work scheduling is a function of the Bonner & Moore software package. Andersen Consulting did not modify the established package process for work scheduling.

As for the design of the Labor Capture system, Andersen Consulting did complete the preliminary system design. The design was to be used as a basis, not as a complete, detailed design. All other functional areas used a similar approach. The preliminary system design for cost distribution and utilities billing was used as a basis to complete the design and continue to the programming and testing phases for these systems.
APPENDIX
MEMORANDUM

TO: James M. Fritz, Andersen Consulting

TO: Norma Miller, Andersen Consulting

THRU: MANAGER, INFORMATION SERVICES, JCWS/AISD

THRU: SUPERVISOR, SYSTEM DEVELOPMENT, JCWS/AISD

FROM: PROJECT LEADER, SYSTEM DEVELOPMENT/WORK MANAGEMENT, JCWS/AISD

DATE: FEBRUARY 03, 1992

MEMO NO. AISD-92.045

SUBJECT: Andersen Consulting Contract Close Out

Andersen Consulting Contract with Johnson Controls World Services, Los Alamos, New Mexico has ended and Andersen Consulting has requested sign-off on their project team tasks to be completed on or before the end of the contract. Any project of this size needs information to both Andersen Consulting and JCWS on performance and contract deliverables. I have only been with JCWS since January 1991, and most of the implementation phase was in-progress by Andersen team.

The ratings given are based on other major projects where I have been a major team member and other Consulting/Contractors deliverables. The March 26, 1991 letter from James M. Fritz on Andersen close out for April 12, 1991 (Attached) was used for deliverables.

Andersen Consulting post-implementation support team did an outstanding job of supporting and transitioning the FMS system to JCWS personnel and AISD staff. The following are ratings by major contract deliverables:

<table>
<thead>
<tr>
<th>DELIVERABLES</th>
<th>RATINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirement Definitions</td>
<td>Exceed</td>
</tr>
<tr>
<td>Basic System Design by Major Systems</td>
<td>Unsatisfactory</td>
</tr>
<tr>
<td>Labor Capture</td>
<td>Unsatisfactory</td>
</tr>
<tr>
<td>Work Scheduling</td>
<td>Marginal</td>
</tr>
<tr>
<td>Equipment/Preventive Maintenance</td>
<td>Marginal/Satisfactory</td>
</tr>
<tr>
<td>Cost Distribution</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Work Order Processing</td>
<td>Satisfactory/Exceed</td>
</tr>
<tr>
<td>LANL/FMS Work Order(WOS)</td>
<td>Marginal/Satisfactory</td>
</tr>
<tr>
<td>Materials</td>
<td>Marginal</td>
</tr>
<tr>
<td>Utilities</td>
<td>Exceed</td>
</tr>
<tr>
<td>Technical System Design</td>
<td>Outstanding</td>
</tr>
<tr>
<td>Bonner &amp; Moore Mods/Control</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Development</td>
<td>Exceed</td>
</tr>
<tr>
<td>Unit Testing</td>
<td>Marginal</td>
</tr>
<tr>
<td>Parallel Testing</td>
<td>Marginal/Satisfactory</td>
</tr>
<tr>
<td>Conversions</td>
<td></td>
</tr>
<tr>
<td>DELIVERABLES</td>
<td>RATINGS</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Start-up Training</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Post implementation Training</td>
<td>Marginal</td>
</tr>
<tr>
<td>Audit/Controls</td>
<td>Marginal</td>
</tr>
<tr>
<td>Implementation</td>
<td>Marginal/Satisfactory</td>
</tr>
<tr>
<td>User Documentation</td>
<td>Unsatisfactory/Marginal</td>
</tr>
<tr>
<td>ADABAS/Natural</td>
<td>Marginal</td>
</tr>
<tr>
<td>NATURAL PREDICT Documentation</td>
<td>Marginal</td>
</tr>
<tr>
<td>Technical Documentation</td>
<td>Excellent</td>
</tr>
<tr>
<td>Post implementation support</td>
<td>Marginal</td>
</tr>
<tr>
<td>Implementation by Major systems</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Equipment/Preventive Maintenance</td>
<td>Marginal</td>
</tr>
<tr>
<td>Cost Distribution</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Work Order Processing</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>LANL/FMS Work Order (NOS)</td>
<td>Excellent</td>
</tr>
<tr>
<td>LANL/FMS Work Order (WOS)</td>
<td>Marginal/Satisfactory</td>
</tr>
<tr>
<td>Materials processing</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Utilities</td>
<td>Satisfactory</td>
</tr>
</tbody>
</table>

The Andersen Consulting tasks sign-off July 1991 thru end of contract (not dated, Attached). I rated or noted deliverables.

<table>
<thead>
<tr>
<th>DELIVERABLES</th>
<th>RATINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiscal year end closing and balancing:</td>
<td></td>
</tr>
<tr>
<td>Work Order Balancing with CD History</td>
<td>Exceed</td>
</tr>
<tr>
<td>Plan Year End Schedule</td>
<td>Exceed</td>
</tr>
<tr>
<td>Execute Year End Schedule</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Document Year End Schedule</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Purge Work Order and CD History</td>
<td>Marginal/Satisfactory</td>
</tr>
<tr>
<td>Document Work Order and CD Hist. purge</td>
<td>Satisfactory</td>
</tr>
</tbody>
</table>

Cost Display Enhancements:
- WO08 - Work Order Cost Inquiry       | Exceed                   |
- WM32 - Work Order Cost Inquiry       | Exceed                   |
- CD05 - Work Order History Inquiry    | Marginal/Satisfactory    |
  Marginal user involvement and technical performance problems.
  Satisfactory final testing and user requested updates.
- CD06 - Accounting History Inquiry   | Not Started              |

LANL Work Order Interface:
- Complete parallel testing           | Marginal/Satisfactory    |
- Marginal user involvement, "front end" testing, and work order conversion.

Monitor Production                    | Satisfactory/Exceed      |
Reconcile cost differences             | Satisfactory             |
Document interface procedure           | Satisfactory             |
Technical programmer notes, not formal documentation | Marginal |
Train users on front-end               | Not Started              |
Train new AISD Analyst                 | Excellent                |
DELIVERABLES
FMS Documentation:
- System Overview
- Marginal user involvement, need source disk and software product used. Satisfactory beginning.
- Predict Data Dictionary
- Technical Environment
- Guide to FMS/Special Procedures
- Marginal formal documentation

Project Status Reporting:
- Weekly status
- Transition

Programming:
- ST14
- ST24
- PH150PA

RATINGS
Marginal/Satisfactory

Outstanding
Marginal

Satisfactory
Satisfactory
Satisfactory/Exceed