Columbia Gas Transmission Corporation Models Operational Excellence by Integrating RCM and Work Management

Don Crusan, Columbia Gas, Team Leader
John Pisanek, Columbia Gas, Sr. Engineer
Troy Harlow, Columbia Gas, Engineer
Desi Dundics, P.E., Equipment Links, Inc. Consultant

Overview

In an effort to achieve Operational Excellence, Columbia Gas Transmission Corporation (Columbia) felt it imperative to capture all of the financial and efficiency savings associated with an optimized maintenance process. The variability in their maintenance plans and procedures across seven states needed to be standardized. Columbia felt that an integrated implementation of Reliability Centered Maintenance (RCM) and Computerized Work Management (WM) would provide the tools and process to achieve these goals.

This paper describes the steps that led to program acceptance by top corporate management, and also the steps leading to implementation together with critical elements of personnel "buy-in" that will help ensure the success of these initiatives.

Who is Columbia Gas Transmission Corporation?

Columbia Gas Transmission Corporation is one of two natural gas pipeline subsidiaries of the Columbia Energy Group. Together with our sister company, Columbia Gulf Transmission, we operate an expanding 16,700-mile pipeline system that connects U.S. production areas to premium U.S. markets.

Columbia Gas Transmission's marketing headquarters is in Reston, VA. and the operational and commercial support headquarters is in Charleston, W V. The company has facilities in Delaware, Kentucky, Maryland, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Virginia and West Virginia. Columbia Gas Transmission's 2,000 employees provide gas transportation and storage services to 72 local distribution companies serving more than 7 million businesses and homes, as well as to hundreds of large-volume customers in the eastern half of the country. Company facilities include 140 compressor stations with more than 585,000 combined horsepower to move natural gas through the company's system of underground pipelines.

What does Columbia Gas Transmission Corporation Do?

Columbia Gas Transmission moves 3 billion cubic feet of natural gas per day to markets along a 12,500-mile pipeline network, which reaches across 10 Midwestern, Northeastern and Mid-Atlantic States. Columbia operates one of the largest natural gas storage systems in the country with 220 billion cubic feet (Bcf) of working capacity.

Steps Leading to the Adoption of the Maintain Program

On average, industry spends in excess of $400 billion annually on maintenance. It is estimated that 1/3 of this cost is unnecessary or is actually improper maintenance. Improper refers to the maintenance that does little to actually prevent failures of the equipment. Columbia feels that they can capture significant savings to their maintenance budget on the order of the national average.

Task group teams were mobilized, later called Operational Excellence Teams, that would recommend the projects that they believed would identify what is done right, and could be done better if standardized across all areas, districts and assets. The focus was on those things that are truly important and that provide value to the company.

The variability in maintenance plans and procedures needed to be eliminated or minimized in order to capture the financial and efficiency savings attributable to an Operation Excellent company. The focus of the new maintenance process should be to provide a cost effective, well documented and standardized maintenance plan. This would continue to assure the same level of safety and reliability that our customers and public have come to expect from Columbia.

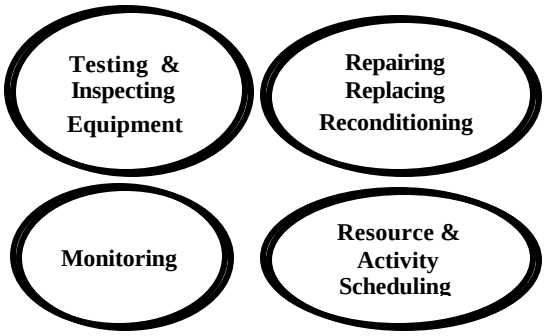
The projects that were determined to be of greatest value to the maintenance process were Reliability Centered Maintenance (RCM) and Work Management (WM). While each of these processes evaluated separately would provide improvement, it was viewed that both of these processes combined into a common project would achieve the greatest benefit.

In order to accomplish the projects and benefits, the overall project must be managed as a total Field Services organization. Duplication of effort must be eliminated. Resources will be allocated to ensure optimum efficiency of implementation. Successful completion of the project is extremely dependent upon buy-in from those ultimately responsible for implementing the maintenance plan. With that in mind, the project is being structured including all disciplines of facility personnel (maintenance mechanics, pipeliners and supervisors, etc.) to be involved in the development of these maintenance plans.

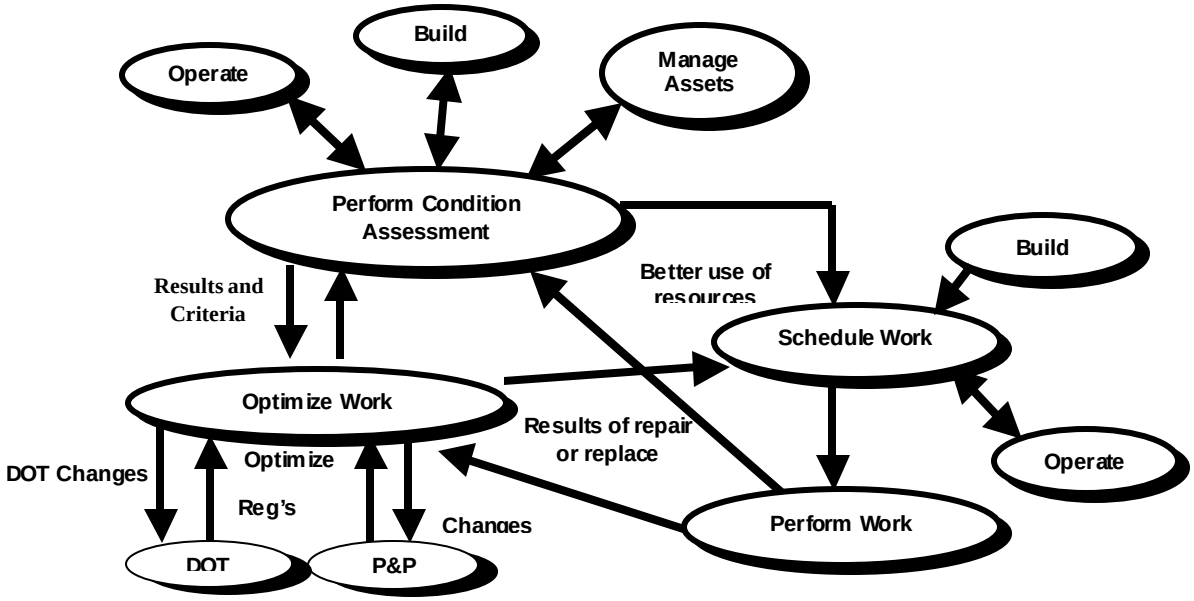
Columbia recognized that they were already performing good practices. They were already doing many of the tasks expected to be part of a "world-class" organization. Unfortunately, they were all being performed as independent actions that did not

contribute toward efficiently achieving their goal. The model depicting the current state, which illustrates this disconnected mode of operations, is shown on the following page as the "As-Is" Model. A model needed to be designed that would capture a state of integration that would ensure performance to be maximized. This future "To-Be" Model is also shown below.

AS-IS MODEL



TO-BE MODEL



Getting Buy-In At All Levels

History has shown that implementations of projects require not only a sound technical solution, but also must incorporate acceptance (buy-in) from the personnel responsible for executing the change of these projects.

Columbia is dedicated to the overriding principle of "do this with people and not to people." It takes the commitment of both time and people. It takes longer than just developing a program and sending it out to the field for use. Everyone in Columbia has a role in determining our future as a company. They will be part of the effort to create and instill a common understanding. Columbia will manage change by fostering a commitment to these principles and providing the support necessary to make it happen.

Management support and commitment, support by front line supervisors and input by field personnel are all critical to the success of the project. In order to achieve our goal, we must document and standardize our maintenance processes and procedures across all various assets and we must implement a work management system in a cost-effective manner. We must communicate and involve all employees in the process.

Columbia must capitalize on the expertise of their technical personnel. This is not only essential to facilitate the buy-in of the process, but also a means to capture their expert knowledge and experience. Most technical people will have been involved in the process, which would complete the cycle of "Do this with people, and not to people."

Selection of Consultants

A vendor scoring process was developed which allowed for a common evaluation of software and services. For evaluation of Work Management, an additional "scripting" process was developed so that all vendor demonstrations and functional aspects of the software were evaluated on equal footing.

For Work Management, Columbia selected MAXIMO by PSDI, and for RCM, Equipment Links, Inc. was selected for both services and their software, RCM Strategy Plus™.

Streamlined RCM

RCM is a process for determining the best maintenance for achieving reliability at minimum cost. It recognizes that some failures are preventable, some are predictable, and some are entirely random. It is not designed to eliminate all failures, but rather to significantly reduce the consequences of failure.

RCM requires an understanding of the mechanisms by which equipment fails, and then eliminating maintenance actions that do not address probable failure modes of that equipment. Unnecessary maintenance is eliminated, and new monitoring activities can be substituted for previously labor intensive inspections and servicing.

This approach confirmed tremendous benefit for organizations to move from a "reactive" maintenance nightmare to a "proactive" maintenance environment. Unfortunately, this process could be very labor intensive, time consuming, costly and often difficult to implement.

In order to achieve the benefit of the traditional RCM approach and reduce the costs of development, Columbia adopted a "standards" based methodology to streamline the entire process.

It was recognized that every time that the traditional RCM approach generated a "top-down" strategy, the end result was a set of tasks to be performed at the "component" level. This would happen over and over and over again. The resultant tasks for similar equipment would often be extremely alike.

This entire process could be streamlined if a "standard" was generated for every component, and rather than develop that strategy every time within every system, why not generate an extremely comprehensive strategy that could be used and referenced repeatedly throughout the organization?

Columbia's Current Plan for RCM

The current plan for RCM incorporates the streamlined approach of using standardized component strategies across the entire corporation. This would be done in three phases.

- Phase I is to identify common systems and equipment groups and to identify the common component standards that must be developed.

- Phase II is to generate comprehensive standards for each of the components comprising the systems identified in Phase I, and then to "scrub" those standards to ensure that operational context and environmental and safety factors are taken into account. This phase produces "templates" of complete systems and equipment groups.

- Phase III migrates the generic system templates into actual equipment strategies. This phase recognizes specific characteristics of the equipment, such as age, previous history, unique operating behavior, operating context, and allows a final customization of the standards to adapt to the "criticality" of the equipment functions and subsequent consequences should that equipment fail.

Work Management

The work management system is a computerized tool that will be used to execute the maintenance strategies generated in RCM. This system will allow Columbia to continuously improve the process and to optimize performance. By including maintenance plans and procedures, Columbia will be able to implement "best practices" and to consistently deploy business processes across all assets.

At a more detailed level, work management will enable us to:

1. Standardize work management processes across the corporation
2. Establish a single source data repository for tracking the maintenance and failure of components
3. Eliminate the concept of using forms to collect data and promote the concept of collecting information about assets that will be used later for analyzing and reporting
4. Eliminate redundant data entry by utilizing on-line and remote data collection in conjunction with system interfaces to disseminate information to the appropriate systems
5. Support the creation and maintenance of the maintenance plan
6. Facilitate work planning so that resources, such as people, materials, and tools, can be used more efficiently
7. Reduce time spent looking for information, i.e. manufacturer specifications, schematics, policy and procedures, etc., necessary for performing work by organizing the information and associating it with the asset or job plan

8. Institute automatic work identification by monitoring operating conditions to predict when maintenance is required ***before*** failure occurs
9. Facilitate alarm center processing by utilizing the asset and maintenance repository to diagnose problems and avoid callout, or, when callout is necessary, to determine who is responsible and how to get in touch with them
10. Track costs (labor, materials, and tools) associated with maintaining assets so that informed life cycle decisions can be made.

Integrating RCM and Work Management

From the extensive interviews conducted by Columbia prior to embarking on this project, it was obvious that RCM would provide considerable benefit, but by itself it would not provide the total benefit desired of the goal. The same could be said of Work Management. To achieve maximum benefit requires that the two be combined into one cohesive unit.

If RCM is the element that defines the strategy (i.e. what and how should the equipment be maintained), then work management is the element that executes this strategy.

There are tremendous benefits associated with this integration:

- RCM can collect specific equipment nameplate data which will help populate WM with maximum data entry efficiency
- RCM defines all of the predefined tasks that will be performed on equipment, and again will help to populate the WM system.
- As WM collects historical data, analysis of this data will support continual improvement to the maintenance strategies generated and contained in RCM through failure trending and root cause analysis.
- The WM historical data will provide justification and details that can be used to influence Regulatory Agencies to consider allowing "right maintenance" versus "broad policy requirements."

Establishing a measurement benefit program

Fast results are not expected. Columbia has adopted the philosophy to "go slow to go fast," so that more time is spent in up-front planning and organizing for the long term. Short-term gains are being sacrificed for larger long-term gains.

The RCM implementation schedule is designed to complete the analysis of a large number of facilities in a relatively short time frame of two years. Considerable time is spent early in the program to generate comprehensive component standards so that the strategies can be rolled out to specific equipment very quickly later on. Again, by spending more time early on will increase the rewards later and will definitely reduce or eliminate rework that is typical of projects of this nature.

Work Management is taking time up-front to review important business processes to determine if changes can be made to improve the business process rather than using the current processes and putting them into a work management system "as-is".

Establishing a meaningful measurement benefit program will be an extremely difficult task due to a lack of data that can be used to make comparisons. The benchmarks for tracking maintenance performance will be different tomorrow that they were yesterday, and therefore accurate data for evaluation will be difficult to generate. This measurement program must evolve as the program implementation proceeds. This measurement program is considered to be one of the most important aspects of the project. It will not only validate the current efforts and support future improvement, but it will also provide justification to the hundreds of employees involved in this work. The results will help to increase the buy-in, which will additionally fuel motivation and enthusiasm for continued improvement.

Lessons Learned

Even though Columbia still has a very large journey still ahead, there are a number of lessons learned that may be helpful to others embarking on similar endeavors.

- Don't underestimate the need for buy-in.
- Don't succumb to the pressures to reduce the buy-in aspects of the project by the technical personnel
- Communicate your intentions constantly and consistently to all levels of the organization
- Perform stakeholder analyses to identify personnel that could potentially become obstacles, and to make extreme efforts to convert these individuals if possible. If not possible to convert, develop a plan to keep them from influencing others
- Be prepared to support project goals with accurate industry achievements
- Perform as many on-site visits as possible to confirm the success and failures of others in similar endeavors
- Perform on-site visits to check references to confirm that consultant selections are consistent with goals and industry practices
- Plan for contingencies. Prepare for obstacles before they occur so that the organization can react quickly if needed.
- Expect everything to take longer than originally scheduled
- Try to perform small "pilots" to prove new concepts before embarking on large-scale implementations

- Implement as early as possible. Don't wait to implement until a large amount of strategies are available, but rather recognize that there could be a tremendous learning opportunity by trying to implement on a small s cale before spending too much time in development. This will identify problem areas where small adjustments will keep the program on track
- Implement on "low hanging fruit", and get rapid benefit before waiting to roll out large amounts of strategies

Successes

To date, Columbia has enjoyed many successes both tangible and intangible. They include:

- The selection of the CMMS tool - Maximo
- The implemented Phase 1 on time and within budget
- A better understanding of the work we do
- A better awareness of components (assets)
- Increased PC literacy of all users
- Helped new supervisors learn facilities & tasks
- Consistent terminology
- Consistent task frequency
- Quantified work against facilities
- Understanding of why we do tasks
- Standardized naming conventions, tasks anddesign standards
- Scheduling based on pre-determined criteria
- Established new Business Rules
- Smooth rollout
- Phase 1 Workshop
- Developed customized training for Phase 1
- Implemented Net-Meeting - remote data sharing
- Use Terminal Server/MetaFrame

Next Steps

Develop business case for Phase 3 - remote data collection

A business case is currently being developed to implement remote data collection. The purpose of this phase of Work Management is the empowerment of a truly mobile workforce, with superior communications and compliance capabilities, through handheld device and electronic data capture implementation.

The scope of this project will include providing remote data collection capability to the entire Field Services workforce. This will include the identification of data requirements for mandatory work and prioritized non-mandatory work. It will also include putting the infrastructure in place to support the communication of the data to and from the Maximo application. We will be looking at different types of hardware devices, such as: laptops, PDA's, ruggedized handhelds, etc. depending on the employee's work requirements. The majority of the users are anticipated to be hourly mobile field personnel who require ruggedized handheld devices. Initial estimates indicate there are 580 of these types of employees who are performing mandated work away from an office PC.

A pilot encompassing all different types of work and devices will be in place by October 1, 2000 and completed by November 1, 2000. Implementation to the mobile workforce using this technology would be completed by the end of the 1st quarter of 2001.

Develop procedures to be incorporated into Job Plans

A team was initiated to document and write procedures for all work tasks. These procedures are written in MS Word and assigned an exclusive file number, then stored in the Document Management System (Domino.doc). The exclusive file number will becomes the Maximo Job Plan number. At this time the plan is to incorporate the procedures into the Maximo Job Plan by copying and pasting them from Domino.doc. We are currently investigating importing the data directly from an embedded document in Domino.doc. The Job Plans will be associated to Mandatory PM's. As the PM's are generated into Work Orders, the procedures will be automatically attached.

Incorporate RCM Failure Codes into Maximo

Plans are being developed to incorporate the "generic" component Failure Modes and Effects Analysis (FMEA) information into Maximo for the purpose of classifying failures. Component types will have their own series of failure codes. For example, a valve (component) could have the following functional failure: fails to control flow of product. The failure mode (problem) codes could be 1) failure to open, 2) failure to close or 3) leaking around the stem. The code failure to open could have the following failure cause: A) valve corroded or B) operator malfunction. Tasks (remedies) for the cause "valve corroded" could be one of the following: a) replace valve or b) overhaul valve.

The generic Failure Code/Info will be migrated from the RCM Standard database into Maximo for Failure Classification as follows:

RCM	Maximo
Component	Class
Function	Additional Level (to be added to Maximo - Called Function)
Mode	Problem
Cause	Cause
Task	Remedy

This will provide a standardized method for tracking failures, thereby allowing us to capture information that may drive changes to task frequencies.

Develop Multi -skills/Operator Qualification

It's Columbia Gas Transmission's vision is to empower its hourly employees to perform needed tasks in a safe, reliable and cost efficient manner in areas outside their normal areas of expertise. This will be accomplished through the implementation of a Multi-Skill Program that will provid e the needed training and verification of skills to each hourly employee. Multi-skill is a management system and a cultural change agent to promote the success of the future organization. This process will enable each hourly employee to more effectively leverage his/her skills and knowledge. It will provide the Company with a skilled labor force enabling greater cost efficiencies and enhanced competitive position in the marketplace while still maintaining safe and reliable customer services.

The objective is to provide employees greater flexibility in completing tasks required at their facilities, foster employee educational and personal development and to remove functional boundaries. Employees will be challenged to enhance their skills, gain a sense of pride in ownership of the facilities that they support and ensure that our workforce is comprised of broadly skilled and trained individuals. This will help to ensure safe, reliable and cost effective services.

The Department of Transportation (DOT) is requiring that employee's be qualified to perform certain tasks. The competencies required for Operator Qualification (Op Qual) and Multi-Skill will be housed in People Soft and brought into Maximo as competencies. The qualification process includes entering time associated with the Op Qual task in the Job Plan. Competencies will be maintained People Soft and transferred to Maximo. Any Interfaces between Maximo and People Soft will be defined and developed in later phases.

Complete RCM Site Specific Strategies

Columbia currently is in the process of developing RCM site specific strategies on all facilities. A streamlined RCM analysis will be performed on all facilities. A risk analysis will be performed to determine criticality as part of the assessment. The risk analysis will take into account the criticality of the equipment in relation to maintenance (repair) cost; operations or lost revenues; safety, health or environmental liability and the likelihood of occurrence. Tasks to prevent failures will be identified and their frequency established based on that criticality. The tasks will then be imported into Maximo and maintenance will be scheduled accordingly.

Author Biographies

Mr. Don Crusan

RCM Team Leader, Columbia Gas Transmission Corporation

Senio r Engineer in the Technical Services Group within the Operations process, at Columbia Gas Operation Headquarters in Charleston WV. Don has been with Columbia for 11 years and has been instrumental in bringing not only RCM initiatives to Columbia, but also a number of technical projects that will encourage standardization and optimization. Currently, he is the Team Leader for the RCM / Standardization project. Don graduated with a BS. in Physics and Mathematics from Elmira College and a degree in Mechanic al Engineering from SUNY at Alfred. Don is a US Navy veteran, and has worked for Corning, Dresser Industries and Ingersoll-Rand in various engineering capacities.

Telephone: (304) 357-2980
email: dcrusan@columbiaenergygroup.com

Mr. Desi G. Dundics, P.E.,

President, Equipment Links, Inc.

RCM and Executive Consultant for all maintenance optimization initiatives. A US Naval Academy graduate with 25 years experience in RCM, plant operations and maintenance. Qualified as Chief Engineer for navy nuclear propulsion plants, and served on nuclear power Mobile Training Team (MTT) staff to prepare nuclear ships to ensure acceptance by the Operating Reactor Safeguards Examining Board. Desi was an integral member of US Navy's advanced research and development team to develop a state-of-the-art integrated condition assessment technology. Has trained hundreds of personnel in RCM principles and regularly speaks at technical conferences and reliability conferences.

Telephone: (702) 454-1939
email: ddundics@equipment-links.com

Mr. John Pisanek

Sr. Engineer, Columbia Gas Transmission Corporation

Senior Engineer in Technical Services & Support within the Operations process, at the Ohio area office in Sugar Grove, Ohio. John has been with Columbia for 18 years. Currently, he is assisting with the implementation of Maximo. John graduated with a B.S. in Petroleum Engineering from Marietta College, Marietta, Ohio. John has worked with two independent oil companies and Columbia Gas Transmission Corporation in various engineering and supervisory capacities.

Telephone: (740) 746-2221
email: jpisanek@columbiaenergygroup.com

Mr. Troy Harlow

Engineer, Columbia Gas Transmission Corporation

Engineer in Technical Services & Support within the Operations process, at Bickers Compressor Station in Standardsville, Virginia. Troy has been with Columbia for 7 years and has been an integral part in the Work Management implementation for Columbia Gas. Troy has an MBA from James Madison University and a BS in Mechanical Engineering from Old Dominion University.

Telephone: (804) 985-2158
email: tharlow@columbiaenergygroup.com