ORGANIZATIONAL RELIABILTY ASSESSMENT
For
XYZ Corporation

Alidade MER, Inc.
Providing insight, advice and support

(321) 773-3356
info@alidade-mer.com

JUNE
17-22
2007

XYZ Corporation

Organizational Reliability Assessment Report

Executive Summary

An assessment was performed at the XYZ Corporation plant between June 18th and June 22nd, 2007 by ALIDADE Reliability Solutions. The Assessment Team completed the assessment and provided an interim briefing before departing the site. The assessment covered four areas; foundation, work management processes, focus & execution and proactive reliability. In addition, the Assessment Team was asked to evaluate the turn around management program and to perform an analysis of the XYZ Corporation Reliability Self Assessment score sheet.

The overall findings were that the plant has excellent leadership, environmental, health and safety performance and an engaged management team and workforce. Some work needs to be done in the foundation and work management process areas to enable the proactive reliability elements. Focus & execution elements appear to be in good order. Generally, the wrench time and the average number of work request completed are in the upper quartile of performance. Environmental, health and safety performance is exemplary. The computerized maintenance management system is capable and there is a noteworthy Asset Utilization (AU) measurement system. All of these items point to a mature organization that is well positioned for a more substantial reliability focus.

Recommended improvements in the foundation area are primarily related to improving the penetration of the governing principles (Asset Utilization and the impact of reliability practices on AU), correcting asset hierarchical structure within the CMMS, and establishing a criticality ranking system with three significant figures of resolution for plant assets. Increased understanding of AU and reliability will increase buy-in and participation in achieving goals. The Plant Hazard Analysis process can be leveraged for criticality ranking. Hierarchy in the CMMS needs to be aligned to support cost analysis, mean time between failure analysis and general best practices; typically five levels of hierarchy. Standardizing the CMMS hierarchy allows enhanced data-mining capability and ease of measurement and report generation.

The establishment of criticality for all plant assets is considered an imperative. It will allow establishment of common practice business rules. These business rules will allow a precedence to be set among priority 3 work requests, proper assignment of priority 1 and priority 2 items and standards for when to call in off-shift maintenance support. Correcting these foundation areas will contribute to improved plant reliability.

Recommended improvements in the work management process area are related to work control guidance. Work control guidance includes refining the existing work flows and documentation to more completely describe the work management process. In addition, behavior and process performance measures need to be established to manage the work management and backlog processes. Behavior measures are used by supervisors to trend how well process stakeholders are executing the required work control steps. Process performance measures are the expected outcomes of well run work management processes; such as schedule compliance and percent of planned and unplanned work.

In the area of focus & execution, the assessment team was unable to collect sufficient data from the two surveys; the Workplace Climate Survey, and the Motivation & Coaching Survey. These were not completed because of an unanticipated problem with workforce access to internet enabled computers. These, or similar surveys, provide insight into the how employees view their work environment. This insight is important for designing professional development training; empowering leadership, communication, building trust, setting goals and expectations, etc.

The assessment team found significant opportunity to improve in the proactive reliability area. With the aforementioned improvements in foundation and work management process areas XYZ Corporation will be generating good, actionable information. This actionable information will provide data for reliability improvement processes. It is recommended that a substantial operator care program be established, with asset condition assessments and a streamlined permitting process. Operator care, operator performed asset condition assessments and a streamlined permitting process will allow the reallocation of craftsmen resources to proactive reliability activities. Specifically, it is recommended that the Houston plant:

1. Establish a preventive maintenance (PM) optimization program.
2. Improve the predictive maintenance (PdM) program.
3. Improve the Root Cause Analysis (RCA) program.
4. Institute a Reliability Centered Maintenance (RCM) program.

It is strongly recommended that the lubrication program is rejuvenated. This would include general housekeeping practices for lubricant storage, lubrication practices and management training (through an independent, qualified consultant), improved cleanliness of grease fittings and obtaining one or more filter carts (five to ten micron filters) for new oil filtering and sump recirculation to improve lubricant quality. It is also strongly recommended that XYZ Corporation locate an independent oil analysis laboratory for its oil analysis program and consider an ultrasound grease gun tool for proper application of grease.

Overall, XYZ Corporation is well positioned to leverage its current performance to improve AU and reduce working capital. Our estimation is that a sustainable ten percent improvement in AU and a reduction of working capital in the order of ten to fifteen percent is achievable within twelve to eighteen months. These estimates assume a well structured action plan executed through self-help projects and facilitated support. Based on data obtained during the assessment the value of these improvements are estimated to be between $984K to $1.1M per year; derived from 15% to 17.5% improvements in overtime, outside services, plant machinery, equipment/supplies cost categories.

Overview of the Organizational Reliability Model

Organizational reliability is the strategic model that relates the importance of control and stability of processes with proactive reliability. Data generated from consistent processes becomes actionable information and is used for continuous improvement through proactive reliability tools. The results that are achieved from organizational reliability include improved production capacity at the lowest cost.

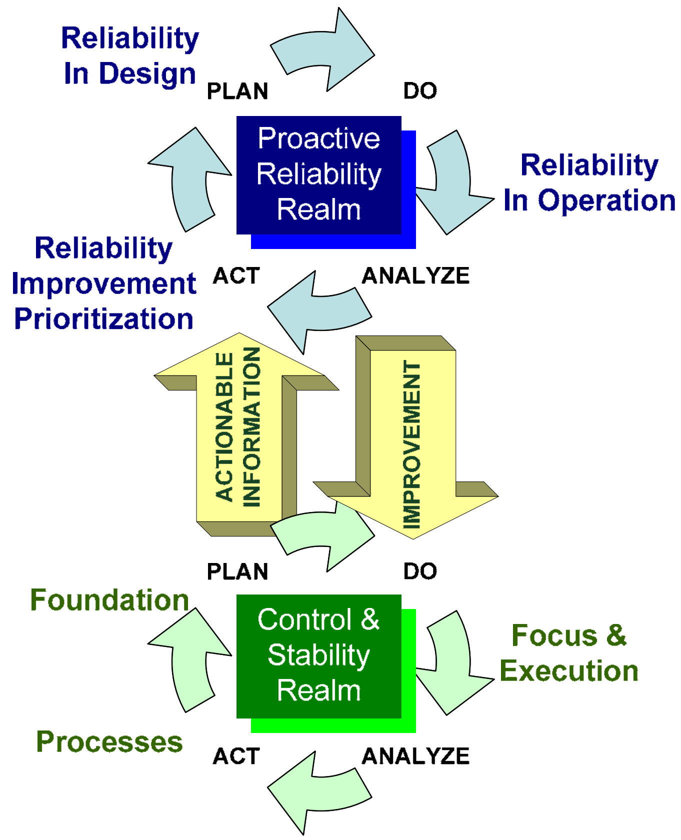


Figure 1 Organizational Reliability Model

Figure 1 is a graphical representation of the Organizational Reliability Model. Both the control and stability realm and the proactive reliability realm are based on the Shewhart Cycle (popularized by Demming) and known as the "plan-do-check-act" or PDCA cycle.

The bottom loop, the control & stability realm, is the foundation for a reliability based program. Many reliability initiatives fail because they are focused on reliability tools such as Reliability Centered Maintenance (RCM), predictive maintenance (PdM) or other devices instead of being focused on the quality of information. The control & stability realm must be functioning to an acceptable level before an organization can expect good return on investment from proactive reliability.

The control & stability realm is comprised of foundation elements, work management process elements and focus & execution elements. ALIDADE's experience is that, within our assessment tool, each element must be functioning at or above 85% in order for the organization to have sufficient control & stability to benefit fully from proactive reliability.

Proactive reliability is comprised of three sub-elements; reliability in design (RID), reliability in operations (RIO) and reliability improvement processes (RIP). RID uses tools such as RCM and reliability modeling to identify failure modes in new systems, and after sufficient operating history is accumulated, re-evaluation of existing systems. After identifying the failure modes, mitigating strategies can be employed through configuration changes, material changes, PM/PdM monitoring techniques, etc. to minimize the impact of failures on the system.

RIO is the collection of activities that make best use of workforce skill sets and information to most effectively use plant resources. Activities in this sub-element include actual PM and PdM tasks, start-up, shut-down and commissioning standards, stationary system condition monitoring, precision maintenance, lubrication program, operator care strategies and asset condition assessment. These are the activities that work management processes act through, and which is the focus of continuous improvement activities.

RIP activities are the application of tools to sift through the actionable information (data) in order to identify trends and improvement opportunities. The tools in this sub-element include opportunity identification, life cycle cost analysis, Pareto analysis and reliability performance measures. It is the consistent use of screening tools based on analysis standards that allows the organization to identify reliability improvement targets.

The target opportunities are then processed using the RID tools and improvements are then processed through a management of change (MOC) process. MOC activities include updating documentation, training stakeholders in new procedures and instituting behavior change measures that confirm the adaptation to the new processes or procedures.

With this basic understanding of the Organizational Reliability Model, the assessment results can now be presented. Each of the following sections include a summary score sheet and detailed explanations of the findings in each of the four assessment elements.

Foundation Elements

Foundation Elements		
1	Governing Principles	72.00
2	Objectives & Goals	86.67
3	Master Plan	85.33
4	Organizational Structure	94.67
5	Functional Alignment	86.67
6	Budget & Cost Control	93.33
7	Configuration Management	73.33
8	Asset Definitions, Hierarchy & Criticality	49.33
9	Management Reporting	81.33
10	Facilities & Tools	94.67
	Overall Element Score	**81.7**

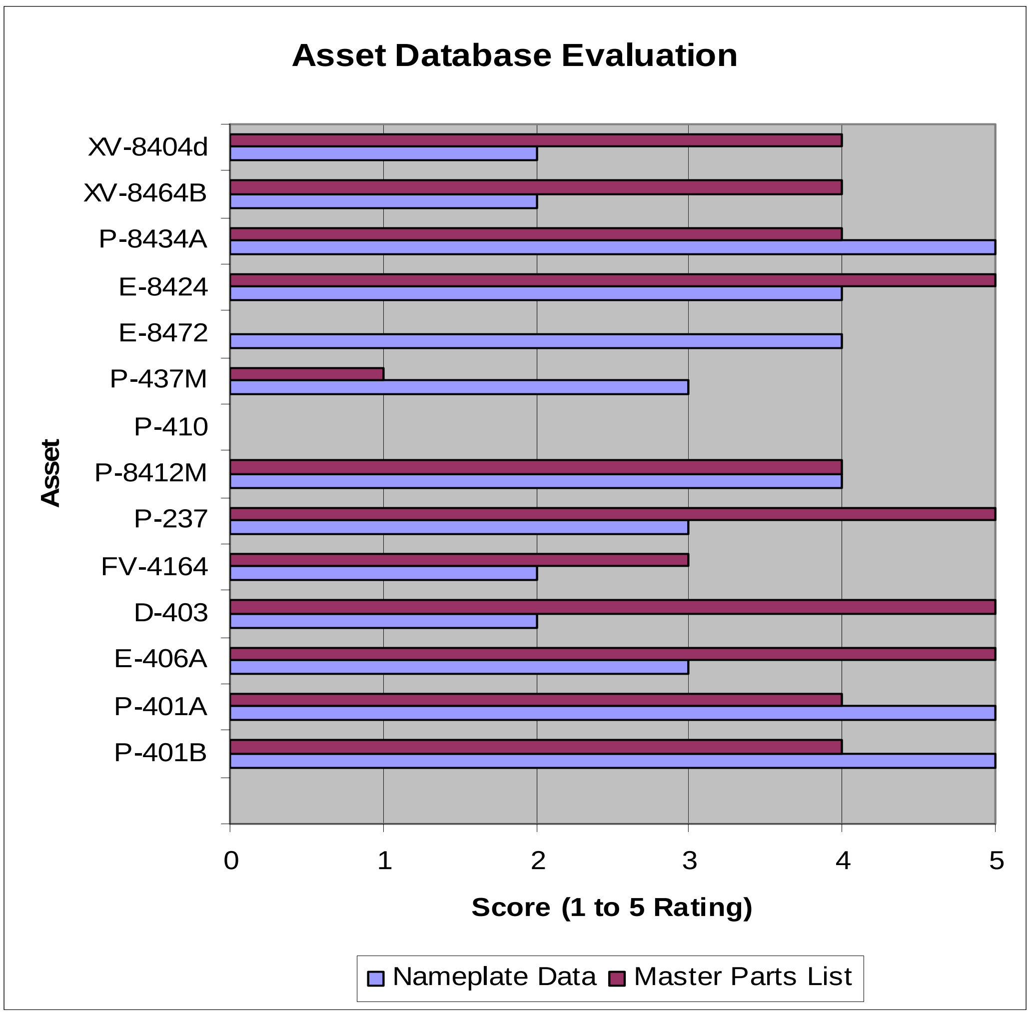
In the Organizational Reliability Model the foundation elements can be viewed as the strategic tools that are required for the staff and workforce to perform their job. Foundation elements provide the general direction and cross-functional vision of where the organization is heading. Governing principles, objectives & goals, master plans, organizational structure and budget & cost control provide the framework for how the organizational elements are interrelated. Configuration management, asset definitions, hierarchy & criticality, management reporting and facilities & tools provide the common platforms for maintenance and reliability processes.

Foundation elements are required in order for any organization to understand what needs to be done. These elements along with the work management process elements and focus & execution elements form the basis on which control and stability of processes are built. The overall rating of the foundation elements is 81.7%. The largest discrepancy is in the area of asset hierarchy and criticality which was evaluated at 49.3%.

At the XYZ Corporation plant, foundation elements were found to be generally in very good condition compared to most industrial plants. The Operating Plan articulates governing principles, objectives & goals, and provides a master plan outline in combination with Monthly Reports. There is an up-to-date organizational structure showing the reporting relationships and span of control. Budget and cost control is well managed with extensive data being reported monthly. The overall condition of the facility is excellent in comparison with other industrial sites. This reflects importance placed on the safety and Responsible Care programs.

Figure 2 provides an example of the data collected during the CMMS sampling process. Figure 3 provides the overall scoring for CMMS characteristic information, bill of materials (or master parts list), hierarchy and accuracy of the data in the database. The scores were developed by having the planner/scheduler locate each asset, then assigning a value of zero to five for each assessed criteria. A score of five would mean that the asset information in the CMMS was 100% correct. A zero score meant that there was no information. Ratings in between were assigned for varying degrees of information and accuracy.

The hierarchy of assets within the CMMS is not considered best practice and should be resolved as soon as possible. During the assessment we sampled assets in the plant and compared them with the asset database in the CMMS. Resolving the hierarchy discrepancy will allow reports and data mining to be more easily performed. The



discrepancy with hierarchy is considered to be significant and worth the effort to resolve considering the efforts within XYZ Corporation to increase reliability among all plants.

Criticality has not been assigned to plant assets. This is considered a major issue in that criticality is recommended to be used as a basis for business rules. Examples of business rules include determination of priority for work requests, determination of relative priorities for the planning and scheduling of work requests in the priority 3 category, determination of when to call-in off shift craftsmen for unplanned repairs, etc.

Other foundation elements that could be improved upon are governing principles, configuration management and management reporting. Governing principles relates to the penetration of the reliability message to all levels of the organization. This can be done through periodic newsletter topics and informal conversation, as well as more formal directed learning in performance evaluation requirements.

Configuration management refers to the recommendation that the CMMS data fields become more complete in the purchasing and nameplate screens, and that Master Parts Lists (MPL) are more actively used whenever a part has been researched for job tasks.

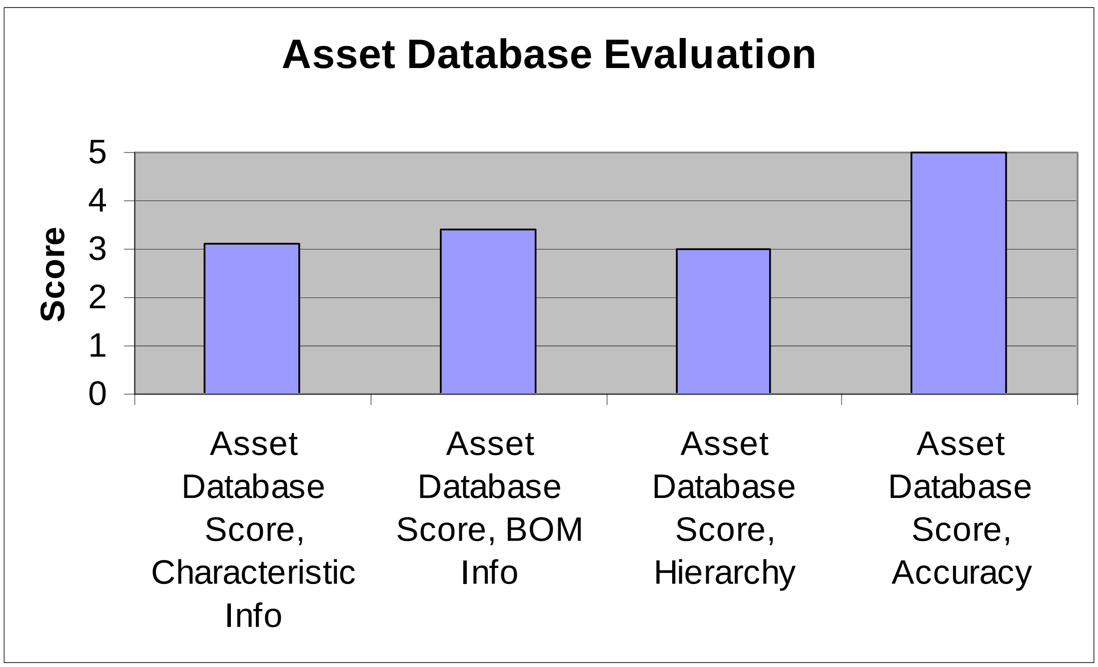


Figure 3 Qualitative Scoring of CMMS Asset Database

Work Management Process

Process Elements		
1	Work Control Guidance	64.00
2	Computerized Maint Management System	84.00
3	Work Planning	77.33
4	Work Scheduling	82.67
5	Procurement	81.33
6	Inventory Management	78.67
7	Completed Work Validation	84.00
8	Equipment History	85.33
9	Process & Behavior Measures	81.33
10	Contractor Management	70.67
	Element Score	**78.9**

Work management process elements are concerned with how well the core maintenance management process is described, communicated, established and sustained. A well run work management process is the heart of control & stability. The work management process capitalizes on the foundation elements, through focus & execution. Work control is the vehicle for generating plant asset performance data.

The overall rating for the work management process element is 78.9%. The greatest opportunity for improvement is in the work control guidance activities which are rated at 64.0%. Work control is concerned with how well the process and procedures are documented and communicated. XYZ Corporation is fortunate to be staffed with an experienced and engaged workforce and supervisors. Best practice in work process documentation is to have essentially three levels of process flows; level 1 is a high level, level 2 provides sub-flows and level 3 provides detailed procedures. In addition there should be a responsibility, accountability, support and information (RASI) matrix that provides information on what organizational positions are stakeholders in each process step. There should also be a detailed process guide that covers each flow chart block and thoroughly describes each procedure within the process.

There has been significant effort put into development of several flow charts and a descriptive text to support the flows. Based on a detailed review with the Facility

Manager, there are some process steps that need to be added, modified or removed. The current documentation can be leveraged to develop a comprehensive set of documents.

It is recognized that there is a gap in the mechanical planner/scheduler position. Even so, the balance between planned and unplanned maintenance resource hours is not aligned with best practices. Figure 4 provides a comparison between best practices labor allocations and XYZ Corporation, as assessed labor allocations.

Significant improvement is possible in this area. The large percentage of unplanned maintenance (48.5%) indicates that there is significantly more cost per unit produced because unplanned maintenance increases lost production, material and labor costs on the order of 2.5 to 4.0 more than planned maintenance. In addition note that PM/PdM is underrepresented and proactive reliability activities are not being conducted.

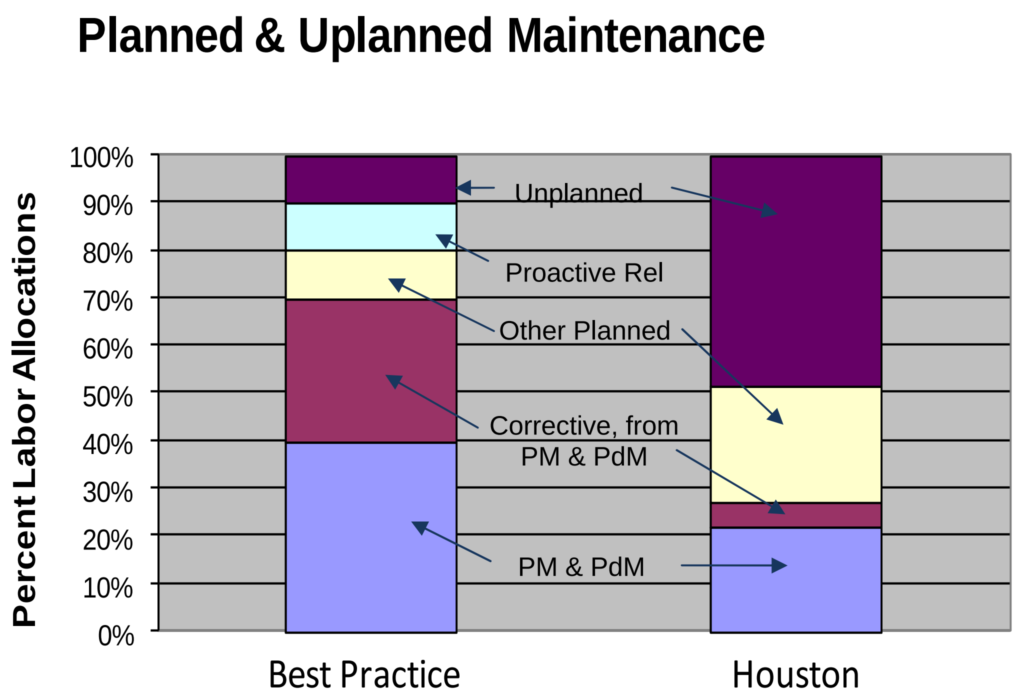


Figure 4 Best Practices and As Assessed Maintenance Labor Allocations

The contractor management score may be higher than evaluated in this assessment. Based on the brief amount of time available for the assessment the contractor management evaluation may not completely reflect the current performance in that area. The evaluation is believed to be somewhat low based on the manner in which backlog is managed. In a best practices scenario, effective backlog management allows the organization to project contract labor requirements as well as direct labor hours allowing the minimization of overtime and contract labor; maximum use of direct labor.

The assessment team believes there is effective use of contractors for overflow and specific skill sets (weld inspections, piping and pressure vessel inspections, etc.).
The assessment team believes that by instituting behavior measures and a suite of process performance measures that XYZ Corporation will be able to significantly improve the performance in work management processes. Appendix A, Performance Measures, provides a listing of measures that should be managed to increase process effectiveness.

	World Class	Typical	As Assessed
Parts Stock Out Rate	< 1%	4-6%	<< 1%
Stores Value % of RAV	0.25-0.5%	1-2%	1.3
Parts Inventory Turns	> 2	1	0.37

Inventory management is an area where significant improvement is available. The table below presents world class, typical and as assessed inventory measures for the Houston plant. The stock out rate is outstanding and the stores cleanliness and accuracy appears to be excellent. Although the volumes of procurements (type and quantity) were not determined during the assessment, the assessment team believes there may be significant opportunity in adjusting the inventory to match usage. There has been an effort to rationalize excess parts inventory. It was reported that a corporate policy regarding write off of parts and equipment results in a dollar for dollar offset to the plants budget. This provides a disincentive for expeditiously rationalizing excess inventory.

It is recommended that an ABC inventory management system be established which would allow a more favorable accounting of inventory items. Deep insurance, critical capital equipment normally does not turnover often. Houston has a significant amount of this type of material. As the proactive reliability elements increase there will likely be further opportunity to reduce stocked item.

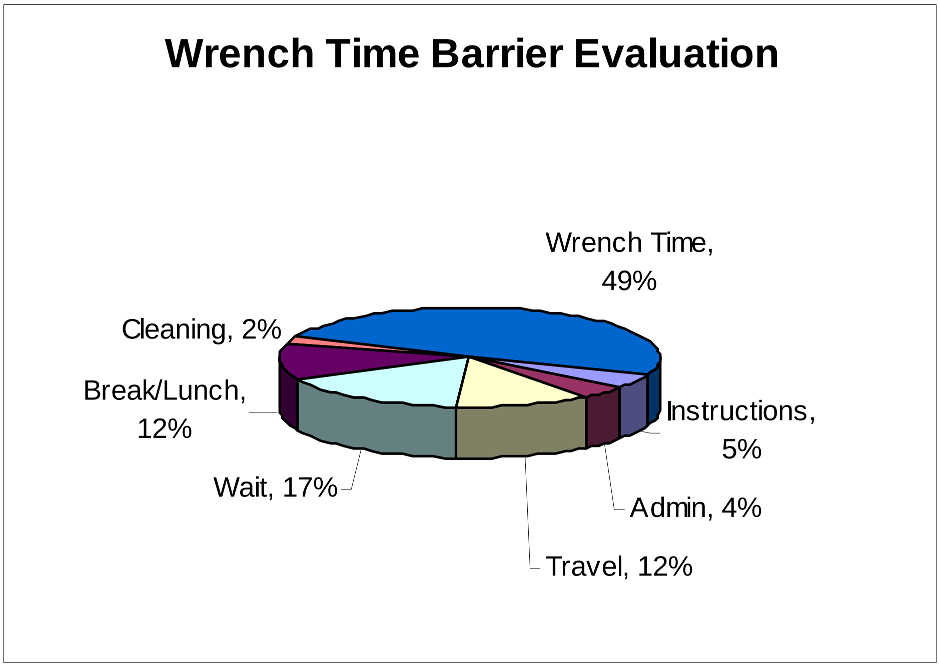


Figure 5 Wrench Time Barrier Data

All of the other attributes in this area are very close to the 85% required threshold indicating that the organization is well positioned to take advantage of proactive reliability through the generation of actionable information.

An important indicator of process effectiveness is the measurement of wrench time. Wrench time refers to the percentage of the work day that actual time on planned and unplanned work is being performed. Time spent on authorized breaks, lunch period, waiting on parts or tools, time in training, gathering information or instructions, and traveling to and from the job site and shop are not wrench time. Figure 5 illustrates the breakdown of a sampling of work day activities and their relative percentage of time.

A wrench time of 49% is considered to be very good. Average industrial wrench time is typically in the 25% to 30% range. Because this was a sampling we recommend periodic measurement of the wrench time to trend this number. Observations and data collected in other areas indicate that the observed wrench time percentage is probably high. It is unlikely that this level of wrench time is sustainable with the current status of the CMMS database and work management processes.

Focus & Execution

Focus & Execution		
1	Executive Focus	89.33
2	Functional Focus	84.00
3	Organizational Behavior	85.33
4	Performance Management	89.33
5	Workforce Motivation & Coaching	0.00
6	Workplace Climate	0.00
7	Workforce Development	92.00
8	Supervision	94.67
9	Safety Program	97.33
10	Management of Change	85.33
	Element Score	**71.7**

Focus & Execution relate to how well the organization provides leadership and management to make the best use of the foundation and work management process elements. In this section we look for clear vision, empowering leadership and development of the people that work in the organization.

Functional focus is the only significant marginal area. This element reflects the penetration of AU and reliability performance through all levels in the organization. Upon asking various persons about their understanding of AU and reliability in general terms the understanding quickly fades below the manager level. Getting all functions at all levels to understand how each of their jobs impact AU and reliability will be particularly important if the plant increases the activities of the operations workforce through operator care and asset condition assessments. Doing so will support reallocation of craftsmen resource hours to enhance planning and scheduling, as well as proactive reliability activities.

The only areas of the assessment that were not completed were the two surveys that were provided as part of the assessment. Unfortunately, the unavailability of web-enabled computers was not known before the assessment. As a result the assessment team was unable to process the two surveys. It is strongly recommended that XYZ Corporation complete these surveys and also re-survey periodically using the same format. By trending survey results the organization can target training and other development activities that can maximize leadership and management performance.

While the surveys were not completed, the assessment team noted that there is a high degree of communication, trust and respect within the organization. The team heard from multiple sources how the plant leadership places people and their family at the forefront. In particular, how the site managed the difficult times following hurricane Rita did a great deal to advance loyalty among plant team members. Assuming the survey scores would be fairly high, the assessment team believes the focus & execution score is well above the required 85% value that would support proactive reliability.

Other positive items are the focus on staff performance evaluations and the anticipated hourly workforce performance evaluations. Review of the staff performance evaluation system indicates that it is a well designed and newly implemented program. Quarterly progress reviews increase communication and coaching opportunities and result in better alignment with goals. Some training has been provided to upgrade the leadership skills of supervisors The HR department is currently understaffed, but they are very conscientious and engaged in their work. The employee turnover rate would undoubtedly be higher based on the current demographics and craft employment market, if the plant were not so well led and managed. Although the measure for employee turnover is high relative to world class, in the Houston, TX area it is viewed as a positive measure.

	World Class	Typical	As Assessed
Training Hrs/yr per Craftsmen	40	20	Est 40 hrs
Employee Turnover	< 3%	> 5%	7.50%

A review of the safety program indicates that it is an exceptionally well run program. There is a high degree of interest and activity, incentives are provided to encourage behaviors the increase safety and environmental awareness throughout the plant. Houston is an OSHA Voluntary Protection Program (VPP) participant. The number of recordable incidents is above world class levels, but this is more an indication of the level of engagement the workforce and staff has with regard to surfacing safety issues.

	World Class	Typical	As Assessed
OSHA Recordable Incidents per 200K hrs	< 0.5	5-10	1.59
OSHA Lost Time Incidents per 200K hrs	< 0.05	0.2-0.5	0

Training hours per craftsman data was not readily available. Based on interviews and review of training plan samples, it is estimated that there is at least 40 hours of training per year, per employee. A recommendation is to begin tracking training expenses and hours in three categories; job skills training, regulatory requirement training and professional development training.

Proactive Reliability

Proactive Reliability		
1	Reliability Strategy	60.00
2	Reliability Modeling	60.00
3	RCM	33.33
4	RCA	73.33
5	Start Up/Shut Down & Commissioning Stds	85.33
6	PM	65.33
7	PdM	50.67
8	Stationary Systems Condition Monitoring	97.33
9	Precision Maintenance	82.67
10	Lubrication Program	73.33
11	Operator Care	36.00
12	Asset Condition Assessments	42.67
13	Opportunity Identification	94.67
14	Life Cycle Cost Analysis	78.67
15	Pareto Analysis	76.00
16	Reliability Measures Reporting	78.67
	Element Score	**68.0**

Proactive reliability is segregated into three reliability areas; reliability in design (RID), reliability in operations (RIO) and reliability improvement processes (RIP). RID is the entering point for new maintenance and reliability task development for new assets, or as a result of opportunities for improvement identified during a RIP evaluation. Refer back to figure 1 for a graphical representation. Activities in the RID area include reliability strategy, reliability modeling, RCM and RCA. There can be others but these are the more prevalent tools.

RIO involves the activities that are managed through the work management process and that contribute directly to improved asset or system reliability. These include start-up, shut-down and commissioning standards, PM, PdM, stationary system condition monitoring (thickness testing, weld inspections, pressure testing, etc.), precision maintenance (laser alignment, dynamic balancing, etc.), lubrication programs, operator care and asset condition assessments.

RIP is concerned with analysis of the actionable information generated from the control & stability of work management processes to identify opportunities for performance improvement. It is the systematic approach to finding the significant items that are worthy of expending resources on their solution.

Because the foundation, work management processes and focus & execution elements are close to or exceeding the 85% level the assessment team believes XYZ Corporation should engage in more proactive reliability activities.

In the RID area it is strongly recommended that a reliability strategy document be developed that outlines business rules for how and when to use proactive reliability tools, and what specifications are used for each tool (i.e. streamlined or classical RCM, minimum requirements for vibration analyzers, etc.).

Reliability modeling is recommended when new systems or redesign of existing systems are being developed. Reliability modeling allows the designer to understand the restrictions and potential constraints for achieving desired reliability performance.

XYZ Corporation is currently not using RCM as a reliability tool. It is recommended that RCM be employed at the system level to evaluate the current maintenance plans. The use of a software tool can effectively leverage previous analysis by developing an asset failure modes and effects analysis (FMEA) library. Properly conducted RCM analysis will identify the most applicable and cost effective maintenance tasks including condition monitoring (installed systems or PdM), time based PM, redesign or run to failure, based on system or asset criticality.

RCA should be deployed not just for catastrophic or large single events, but also for chronic problems that are built into the maintenance and operating budget. Part of the reliability strategy should include an objective of addressing all reliability issues that have an economic impact above a certain value.

The assessment team recommends the use of simplified techniques as well as a rigorous technique depending on the magnitude of the problem. One simplified technique is the "Five Why's" method that is used for small, non-critical analysis, close to the issue. An intermediate technique is Cause and Effect Diagrams based on a fish-bone diagram with categories to consider such as people, materials, methods and machine. A more detailed technique is based on logic trees as a top down approach. Tap-Root is currently being used as a root cause analysis (RCA) tool. Tap-Root was developed for analysis of safety issues but can be used for reliability RCA as well. Business rules on how RCA is to be employed should be developed.

In the RIO area there are opportunities in PM optimization, PdM employment, lubrication program, operator care program and asset condition assessments. Review of the PM and PdM programs indicate that the relative amount of hours spent on PM is good (22.2%) however the PdM program is under employed. Because criticality has not been assigned to each asset the PM/PdM program could not have been properly engineered. Ideally, best practice should tend toward 15-20% PM and 20-25% PdM in terms of resource hours. When properly designed the PM/PdM program should generate corrective maintenance work orders based on PM/PdM findings in the order of 30% of craft resource hours.

With regard to the current PdM program the vibration analysis coverage appears to be very good; approximately 85% of rotating equipment is on the vibe route. Defects that were identified are being entered into the work management system and corrected. The infrared program is predominantly used for electrical switchgear and motor control centers and periodically used for steam trap assessment. IR should be conducted no less than semi-annually and it is better if done quarterly on both electrical and mechanical systems. Mechanical systems can take advantage of IR for couplings, v-belts and smaller equipment that does not merit vibe analysis.

Ultrasound should be employed as part of a comprehensive PM/PdM program. Ultrasound can be used for rapid bearing fault detection, steam trap evaluation and as a safety precaution prior to entering electrical panels (ultrasound can detect corona, arcing and tracking).

Oil analysis is currently being done through Exxon Mobil. It is strongly recommended that you consider using an independent oil lab as opposed to the free vendor lab; asking a vendor to tell you when you need to replace oil is not a best practice.

Motor circuit analysis (MCA) should also be considered as part of a comprehensive PdM program. MCA provides detailed analysis of on-line motors and generators. Connection hardware can be installed that allow data collection without entering the enclosures.

Appendix B, PdM Graphs, contains graphs for chemical processing industry specific PdM measures. Indicators of opportunities in PM/PdM performance can be found in the measures below. Driving as much maintenance as possible from unplanned to planned is the objective. Planned maintenance includes PM, PdM, corrective planned work generated from PM/PdM and other planned work identified through asset condition assessments, or other input.

Measures relative to replacement asset value (RAV) are measures that should be trended as opposed to being taken as absolute indicators.

	World Class	Typical	As Assessed
Maintenance Cost % of RAV	1-3%	3-6%	4.80%
Planned Maintenance	> 90%	50-70%	51.5%
Unplanned Maintenance	< 10%	45-55%	48.5%
RAV per Craftsmen	> $6-8M	$2-4M	$13.1M
% Maintenance Rework	< 1%	> 10%	3%
Overtime	< 5%	10-20%	10.5%

As discussed earlier, improving planning & scheduling and backlog management will improve the organization’s ability to manage overtime and contracted services; this can result in lower maintenance costs. It is understood that overtime fluctuates a great deal depending on turn-arounds and operating constraints.

Approximately six years ago XYZ Corporation worked with Exxon Mobil to reduce the number and types of lubricants used in the plant. It was stated that all rotating equipment is not using the same grease and that most motors had grease relief ports installed. These are excellent lubrication program practices.

Observations during the plant tour and during the vibration analysis technician observation's were that grease fittings on exposed equipment do not have caps to protect the lubrication points. Wind blown dirt is in the order of 25 microns in size. Bearing clearances between rollers and races are in the order of 6 to 8 microns; meaning that dirty grease fittings have a high probability of inducing failures. A best practice is to use caps for the grease fittings. An additional best practice is to use an ultrasound tool (Ultraprobe and SDT have models) attached to the grease gun to ensure the proper amount of grease is being applied.

It is understood that there are currently planned activities to improve bulk lubricant storage. Lubricant storage areas require excellent housekeeping practices. It is also highly recommended that you procure an oil filter cart to filter new oil and recirculation of oil sumps. New oil cleanliness standards are less than you would expect; filter all new oil before it gets put into equipment. When oil analysis returns a recommendation to change large oil sumps based on contamination (as opposed to wear particles or depleted chemicals) you can extend the service life, reduce downtime and disposal costs by filtering the oil.

Operator care programs are aligned with Total Productive Maintenance. The objective is to increase the organization's ability to identify developing problems early enough to plan and schedule the repairs around the production schedule. A PM analysis was performed that indicated approximately 20-34% of PM tasks are candidates for operator performed maintenance.

Asset Condition Assessments are basically checklists that can be used by equipment owners or other stakeholders. Some examples are provided in Appendix C, Asset Condition Assessment Sheets. The checklists are used to ensure that specific areas on each asset are observed. There are already weekly plant tours, but using the checklist will ensure specific areas are checked. Additionally, these can be performed by operations persons because with a small amount of training, including their understanding of their contribution to AU and reliability, operations personnel can be very effective, while freeing craftsmen for more complicated activities.

The Reliability Improvement Process (RIP) requires opportunity analysis guidelines, life cycle cost analysis (LCCA) and Pareto analysis tools. In addition there should be a set of reliability measures that track the results of reliability improvement efforts. Reliability improvement results, in terms of production unit costs or perhaps improved profit margin, help to remind the organization what value the reliability program has been delivering.

Opportunity analysis guidelines provide information on how to analyze the actionable information that is developed from the control & stability of work management processes. It includes preferred methods to categorized data, basic statistical analysis, standard values for things like internal rate of return, loaded labor rate values, energy costs, etc. These guides streamline the analysis process.

LCCA is used to determine estimated cost avoidance from reliability improvements and trade-off analysis between alternatives. It is important to use terms and values that are commonly used by the corporate finance staff to link reliability initiatives and resource requirements.

Reliability measures allow the organization to track the estimated and actual cost avoidance and AU impact. The better the estimates are with respect to actual performance, the more credibility the reliability program will gain.

Recommendations

Figure 6 below is a graphical representation of the recommended actions for improving XYZ Corporation's reliability program. The approach is two pronged; the first prong is to shore up the foundation and work management process areas. The second prong is to initiate an operator care program, asset condition assessments and streamline the permitting process. The overall objective is reducing the cost per unit produced which provides an opportunity to improve margins, increase sales or both.

Instituting criticality at the asset level will support development of business rules to improve decision making for priority 1 and 2 call-in decisions, planning & scheduling of priority 3 work requests and general backlog management. Realigning the asset hierarchy within the CMMS will make report generation simpler, allowing better process management. It will have the added benefit of providing a corporate hierarchy format.

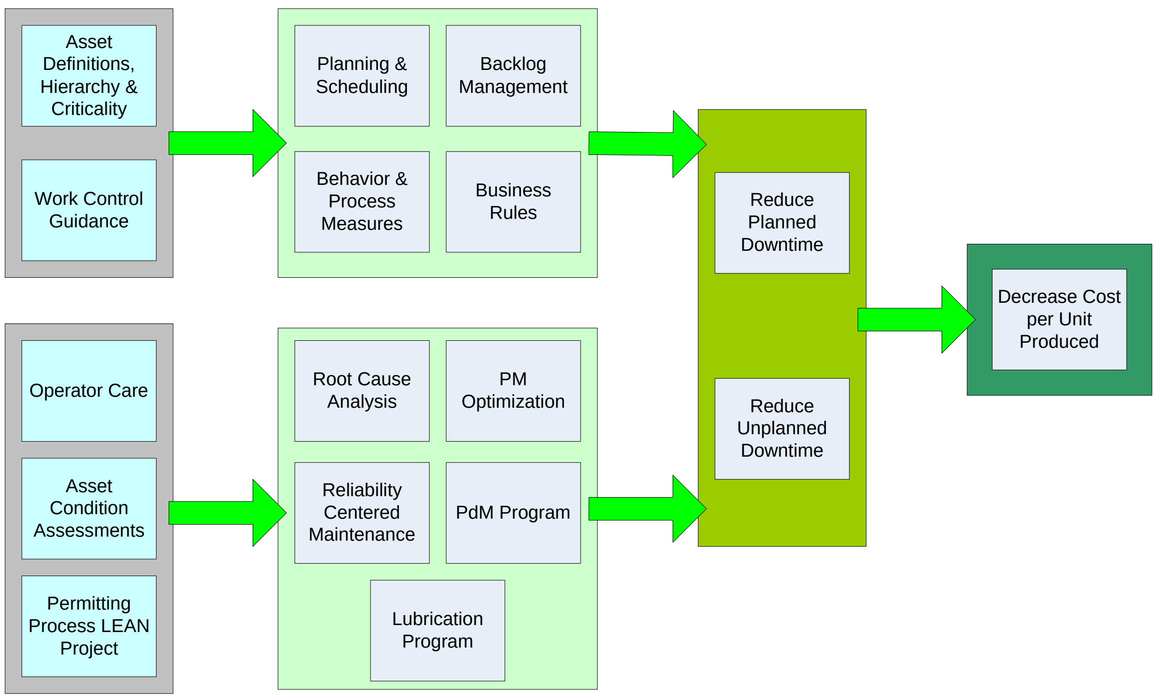


Figure 6 Recommended Actions

Part of the work management process improvement would be completely documenting the work management process. This will provide a process guide for new employees and clarification of responsibilities. From a detailed work management process behavior and process measures can be tied to specific activities. This will ensure the right behaviors are being performed; there will be an auditing tool for periodic process checks.

Fostering a higher level of engagement for hourly operations team members can be done by first providing training on business performance measures such as Asset Utilization and the impact of process reliability on unit costs and business results. As the operations workforce assumes more responsibility for perceptive monitoring of equipment through operator care and asset condition assessments, work orders will be generated as equipment defects are found. These work orders will be submitted in a timely manner, and prioritized, based on the new business rules.

Maintenance craftsmen can transition to first being educated on, and then performing proactive reliability activities. Proactive reliability activities include RCA, RCM, PM Optimization and PdM program development. Additionally, improved lubrication practices can be implemented to improve rotating equipment mean time between failures.

As RCA, RCM, PM Optimization and PdM programs gain momentum the plant reliability will increase. Unit cost of production will decrease due to reduced overtime, reduced outside contracting support and reduced costs for equipment repairs and materials. In addition waste/scrap should be reduced because process upsets should be reduced. Through reliability improvements there will be opportunities to investigate the repair parts inventory for additional benefit through reduced working capital requirements and reduced inventory carrying costs.

The following page provides a table of recommended actions to advance organizational reliability within the XYZ Corporation plant. Note that the items with importance indicated as “A” are must-do items. These items support a number of other areas and must be accomplished early.

There are two groups of “B” importance items. These are the next items that should be resolved. The upper group of B items target freeing up resources for higher complexity activities and assigning lower complexity activities to operations persons who can be trained. The lower group of B items target improving the efficiency of the work management processes. Both of the B items combine to reallocate some labor hours to capitalize on proactive reliability practices as they are brought on line.

Items with “C” importance are the activities that are focused on actually improving the reliability of physical assets.

While the assessment indicated a number of areas that are red and yellow, the items in the following table represent the most important issues to resolve. Do not be too literal in the application of these recommendations. For instance, a lubrication consultant can quickly help resolve the lubrication program opportunities, while working on criticality. The table is intended to help you organize your approach to correcting the major issues. Consider a formal action planning workshop to itemize the initiatives, develop implementation estimates and identify the resources needed.

Importance	Characteristic	Rationale	Comments
A	Asset Definitions, Hierarchy & Criticality	Must do. These items become the basis for further improvements.	Assign criticality to each asset. Realign GP Mate hierarchy.
	Business Rules for Common Practice		Create rules for decision support; call-ins, sub-priorities for planning/scheduling Priority 3 items.
	Work Control Guidance		Improve existing flow charts, RASIs and process guide for work management.
B	Operator Care	These items reallocate resource usage and provide resources for higher level activities.	Drive reliability/Asset Utilization message to all levels in the plant.
	Asset Condition Assessments		Increase the likelihood of identifying problems, scheduling corrective actions before they impact operations.
	Streamlining Permitting Process		Reduce waste in the process, increase craftsmen resource hours available.
B	Planning & Scheduling	These items form the basis for a world class work management system.	Drive unplanned maintenance lower by efficient planning/scheduling; < 10% of labor hours.
	Backlog Management		Maintain 4-8 crew weeks of backlog; reduce overtime, contracted labor and cost of maintenance.
	Behavior & Process Measures		Create, calculate, communicate and manage through behavior and process measures. Behavior measures become part of internal auditing tool.
C	Lubrication Program	These items leverage the control and stability of the work management system, increase planned maintenance and reduce unplanned maintenance.	Reduce cost of unreliability and increase return on investment of the lubrication program.
	Root Cause Analysis		Establish multi-level RCA program. Tremendous leverage is available from resolving major events, even more from solving recurring chronic conditions.
	Reliability Centered Maintenance		Use RCM for PM/PdM and run-to-failure decision support. Software tools can be used as the PM library and archive.
	PM Optimization		Conduct a review that identifies and discontinues non-value added activities. Base planned maintenance on asset failure modes and criticality.
	PdM Program		Engineer the PdM program and consolidate PdM vendors. Base planned maintenance on asset failure modes and criticality.

Projected Benefits

Using the budgeted production estimates for products A, B and C from the May 2007 Monthly Report, Product Cost Statements; the projected benefit is estimated to be approximately $984K to $1.1M dollars per year. This estimate includes reductions in overtime expense, outside services and equipment repair costs. Each of these three elements was assumed to have an improvement based on increased asset reliability, and therefore a more predictable production processes. Predictable production processes and a robust planning and scheduling process will reduce unplanned maintenance and increase planned maintenance.

It is assumed that the measured overtime cost is allocated between operations and maintenance proportional to their numbers. Overtime cost for the three evaluated products is 16% to 20% of total labor costs. Reducing this value by 15% though improved reliability and business rules is a conservative, achievable value.

Outside services are expected to also be reduced by 15% due to improved reliability of the plant and better backlog management. Operator care, asset condition assessments, PM optimization and a streamlined permitting process will conservatively account for 20% additional craft labor availability. A portion of this labor availability will go to proactive reliability activities and a portion will go taking more contracted work in-house. Contracted work can be replaced by direct labor.

Plant machinery, equipment and supply costs will be reduced. The savings in this category is estimated at a modest 15% reduction in the plant machinery, equipment and supplies portion of the cost of production. Of course a more reliable plant will have a higher percentage of planned work. Planned and scheduled work is typically much less expensive than unplanned work; on the order of 2.5 to 4.0 times less expensive. This conservative estimate is supported by the maintenance cost per replacement asset value measure; maintenance cost per RAV is reported as 4.8%. World class performance is 1% - 3% for maintenance cost per RAV; increasing maintenance management effectiveness and reducing current maintenance cost per RAV by 1.8% would result in a $5.2M cost reduction.

The estimated cost avoidance is provided in Appendix D Benefits Calculation, using the 2007 budgeted production amounts of products A, B and C. In addition to the conservative nature of the 15% improvements in overtime, contracted services and plant/equipment/supply costs, other benefits such as potential benefits were not included in the benefit calculations. Reduction in waste or scrap from process upsets were not factored in (this is a small number, <1% overall). The benefit estimate also does not include benefits from reduced working capital in stores inventory and reduced carrying costs on the rationalized stores items. If stores inventory can be reduced by 10% there would be a one time reduction in working capital of $390K and an annual recurring benefit of $78K (based on a 20% carrying cost).

Appendix A:
Measures of Performance

	Nominal World Class	Typical
Production Performance		
On-Time, In-Full	99%	80-90%
Uptime	90-95%	70-80%
OEE or AU	85-95%	50-70%
Quality (Cpk)	> 2	> 1.33
Defect Rate	50-100ppm	500-5000ppm
Waste or Scrap % of Production Costs	0.1-0.2%	1-3%
Customer Returns	< 0.01%	< 0.1%
Availability	95%	30-70%
OSHA Recordable Incidents per 200K hrs	< 0.5	5-10
OSHA Lost Time Incidents per 200K hrs	< 0.05	0.2-0.5
Maintenance Performance		
Maintenance Cost % of RAV	1-3%	3-6%
Planned & Scheduled Maintenance %	> 90%	50-70%
Reactive Maintenance	< 10%	45-55%
RAV per Craftsmen	> $6-8M	$2-4M
% Maintenance Rework	< 1%	> 10%
Overtime	< 5%	10-20%
Breakdown Production Losses	< 1-2%	5-10%
Work Management Process Performance		
Percent PM Hours	15-20%	5-40%
Percent PdM Hours	20-25%	0-10%
Percent Corrective Maintenance Hours Identified by PM	10-15%	0-20%
Percent Corrective Maintenance Hours Identified by PdM	15-20%	0-10%
Other Corrective Maintenance Identified by Other Means	10%	30-70%
Percent of Hours Spent on Proactive Reliability Improvement Efforts	10%	0-2%
Percent Unplanned Maintenance Hours	5-10%	40-70%
Percent of Craft Hours Scheduled	100%	40-70%
Percent of Craft Schedule Compliance	90%	25-70%
Percent Wrench Time	52-65%	25-34%

Appendix A:
Measures of Performance

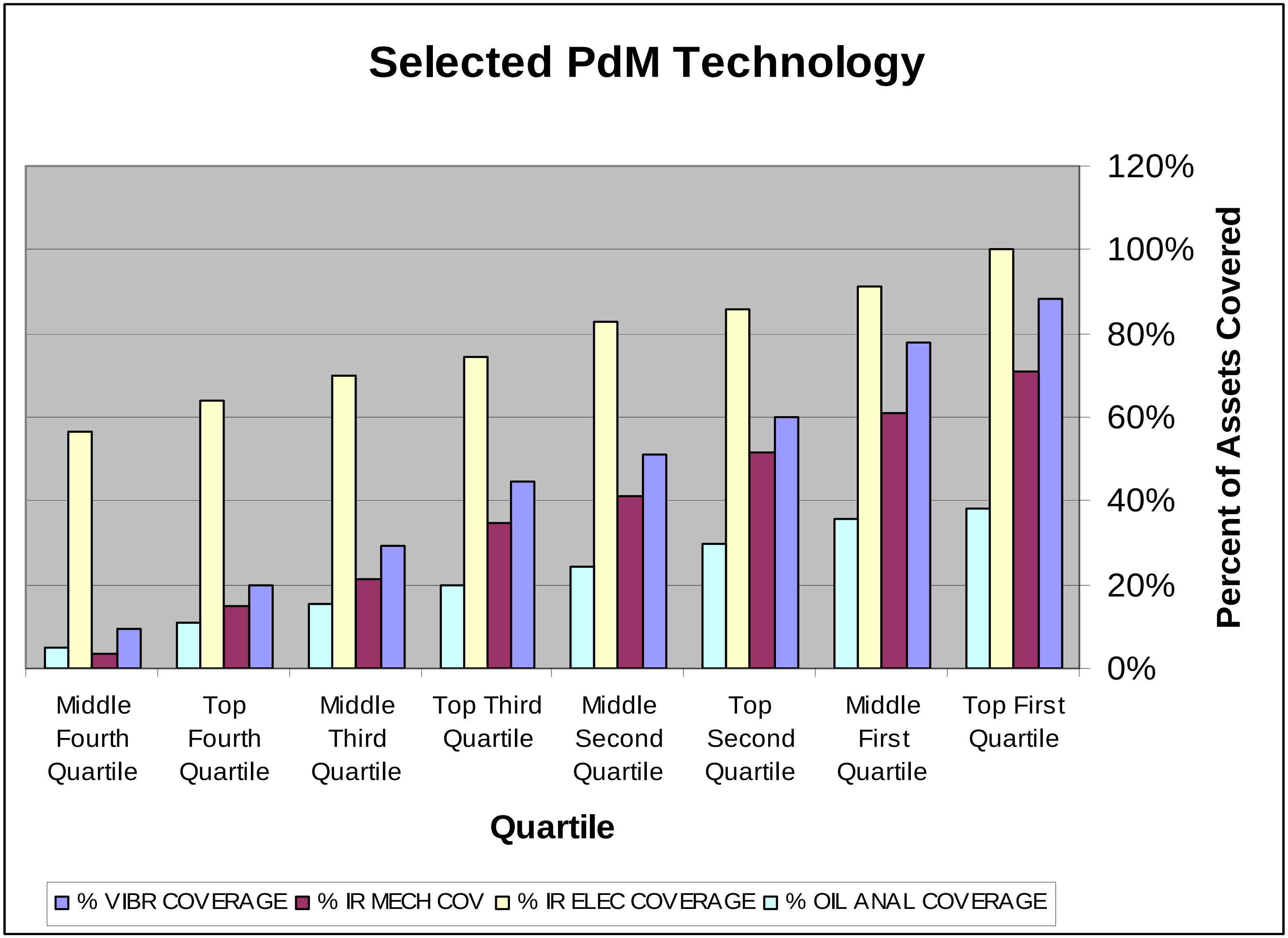
Stores/Parts Management

Parts Stockout Rate	< 1%	4-6%
Stores Value % of RAV	0.25-0.5%	1-2%
Parts Inventory Turns	> 2	1
Stores Value per Stores Employee	$1-1.5M	$0.5-1.0M
Disbursements per Stores Employee/yr	$1.5-2M	$0.5-1M

Human Resources

Training $/yr per Craftsmen	$2-3K	$1-1.5K
Training Hrs/yr per Craftsmen	40	20
Job Skills Training	Breakdown is plant specific	
Regulatory Training	based on climate survey	
Professional Development Training	and needs.	
Employee Turnover	< 3%	> 5%
Absentee Rate	< 1%	> 3%

Appendix B: PdM Coverage for Chemical Processing Industry



Fixed Equipment

System Condition Worksheet

Asset Area		***Classification***	**Cooling Tower**
Operating Unit		*Criticality*	
System		*Manufacturer*	
Sub-System		*Serial Number*	
Equipment Number			

Done By		*Date*	

Operating Function

Operating Standard/Range

Evaluation Criteria

#	Criteria	Yes	No	Method/Measurement
1	Does the component's care appear to meet plant standards?			• Visual inspection with special attention to corrosion • Check cleanliness & overall condition, valves, gauges, etc.
2	Is the cooling tower part of a PM program and is it being done?			• Tabware/SAP/Work Order history
3	Is the structure in sound condition?			• Physical inspection • Check rails and ladders
4	Are the jackshaft and motor mounts in good condition?			• Physical Inspection
5	Is the fan vibration within operating limits?			• Test with hand held vibration device
6	Is controller/transmitter operating properly?			• Stroke valve open and closed
7	Is the lube oil/grease appropriate for this component?			• Go to lube man and compare to manufacturer's recommendations
8	Are the fans rotating efficiently?			• Visual inspection • Compare motor load to full load rating on motor name plate
9	Is the drive shaft and couplings in good operating condition?			• Check for unusual vibration and noise
10	Are the chemical injection systems working effectively?			• Do water sample • Check history

Condition	

Component Condition Worksheet

Asset Area		***Classification***	**Pumps etc**
Operating Unit		*Criticality*	
System		*Manufacturer*	
Sub-System		*Serial Number*	
Equipment Number			

Done By		*Date*	

Operating Function

Operating Standard/Range

Evaluation Criteria

#	Criteria	Yes	No	Method/Measurement
1	Does the component's care appear to meet plant standards?			• Visual inspection • Check cleanliness, gauges, pump bases and drains
2	Is vibration acceptable?			• Feel • Vibration meter
3	Is the component free of any unusual sounds?			• Listen for abnormal sounds such as bearing squeal, surging or rattling
4	Are the temperatures normal as per SME?			• Feel bearing house for heat. • Check temp gauges. • Verify flush cooling temp. • Verify case coolant temp.
5	Is the equipment part of a PM program and is it being done? (What is the repair history?)			• Tabware/SAP/Work Order history
6	Is the lubrication system working and adequate for the service?			• Vent, lubricators, oil level, oiler, and oil mist
7	Is the seal or seal flush free of leaks?			• Check flush & visible steam quench • Visual check of seal pot • Check secondary seal pot pressure
8	Does the component meet the operational rate requirement?			• Consult SME • Trend flow
9	Does the component meet the design standard?			• Compare operating conditions to design curve
10	Are the suction, discharge and line block valves fully open?			• Check valving inlet/outlet & bypass positions

Condition	

Component Condition Worksheet

Asset Area		***Classification***	**Compressors (Reciprocal) – Integral (includes driver)**
Operating Unit		*Criticality*	
System		*Manufacturer*	
Sub-System		*Serial Number*	
Equipment Number			
Done By		*Date*	

Operating Function

Operating Standard/Range

Evaluation Criteria

#	Criteria	Yes	No	Method/Measurement
1	Does the component's care appear to meet plant standards?			• Visual inspection • Check cleanliness and condition including foundation
2	Is the equipment part of a PM program and is it being done?			• Consult Tabware/SAP/Work Order history, etc.
3	Has the component been worked less than 4 times within the last year?			• Check work order history
4	Is the lube oil system functioning and adequate?			• Check levels and flow • Check trap on system
5	Is cooling normal?			• Check lube oil cooler, water levels, water temps, compressor and engine jackets
6	Are process conditions normal?			• Check discharge and interstage temps
7	Are equipment sounds normal?			• Consult SMEs
8	Are exhaust parameters normal?			• Check panel board • Ensure alarms enabled
9	Is ignition and speed control normal?			• Check tachometer and altronics panel board
10	Is system free of process leaks?			• Visual with snoop and LEL meters

Condition	

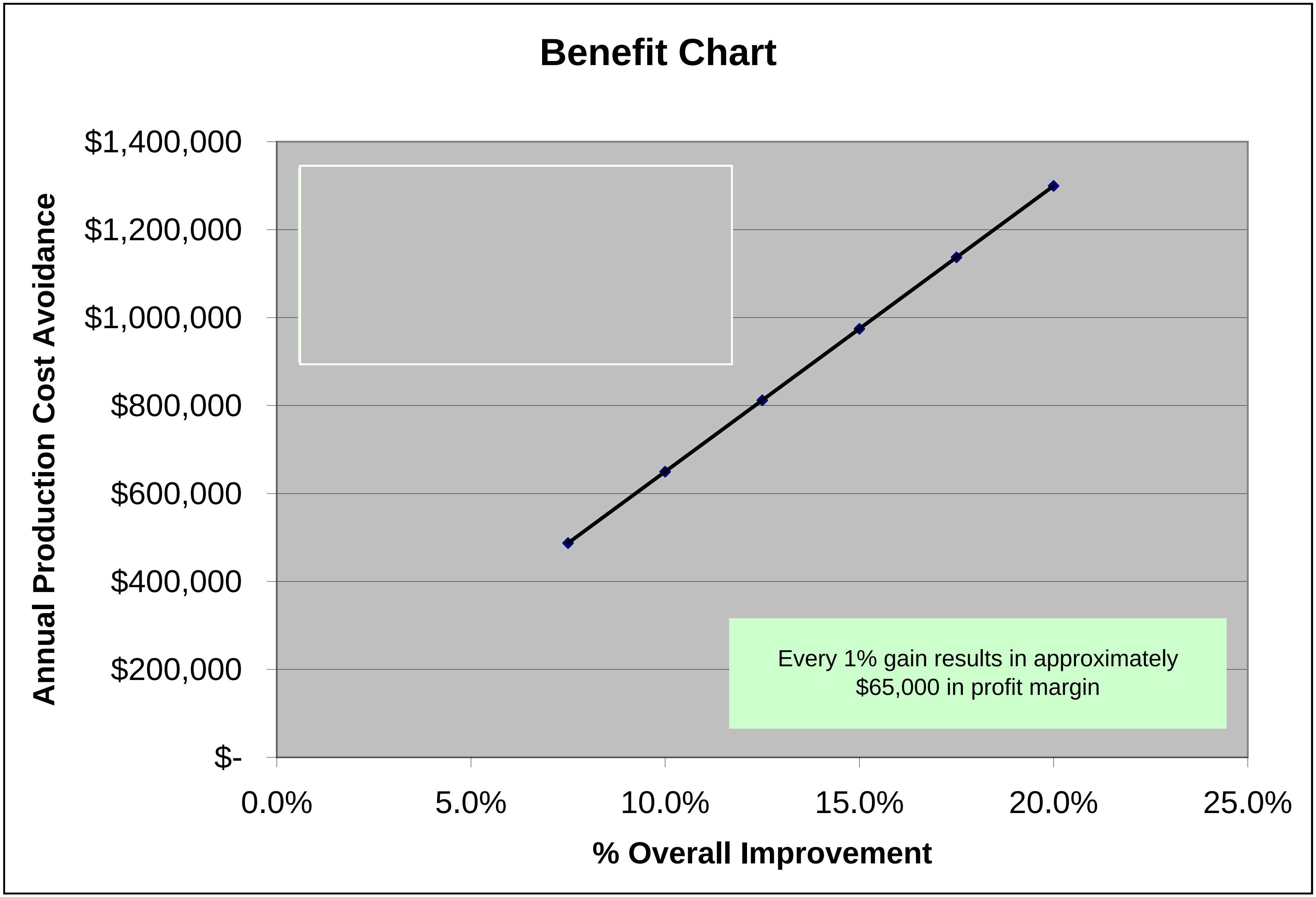
Benefit Calculations

Budgeted Production	Cost Line Item	Current Cost per Pound	Projected Benefit 7.5%	10.0%	12.5%	15.0%	17.5%	20.0%
156,262,920	Overtime Expense	0.00298	$ 34,924.76	$ 46,566.35	$ 58,207.94	$ 69,849.53	$ 81,491.11	$ 93,132.70
156,262,920	Outside Services Expense	0.01110	$ 130,088.88	$ 173,451.84	$ 216,814.80	$ 260,177.76	$ 303,540.72	$ 346,903.68
156,262,920	Plant, Machinery, Supplies	0.01077	$ 126,221.37	$ 168,295.16	$ 210,368.96	$ 252,442.75	$ 294,516.54	$ 336,590.33
	Totals		$ 291,235.02	$ 388,313.36	$ 485,391.70	$ 582,470.03	$ 679,548.37	$ 776,626.71

Budgeted Production	Cost Line Item	Current Cost per Pound	Projected Benefit 7.5%	10.0%	12.5%	15.0%	17.5%	20.0%
54,175,000	Overtime Expense	0.00615	$ 24,988.22	$ 33,317.63	$ 41,647.03	$ 49,976.44	$ 58,305.84	$ 66,635.25
54,175,000	Outside Services Expense	0.01988	$ 80,774.93	$ 107,699.90	$ 134,624.88	$ 161,549.85	$ 188,474.83	$ 215,399.80
54,175,000	Plant, Machinery, Supplies	0.00819	$ 33,276.99	$ 44,369.33	$ 55,461.66	$ 66,553.99	$ 77,646.32	$ 88,738.65
	Totals		$ 139,040.14	$ 185,386.85	$ 231,733.56	$ 278,080.28	$ 324,426.99	$ 370,773.70

Budgeted Production	Cost Line Item	Current Cost per Pound	Projected Benefit 7.5%	10.0%	12.5%	15.0%	17.5%	20.0%
100,000,000	Overtime Expense	0.00290	$ 21,750.00	$ 29,000.00	$ 36,250.00	$ 43,500.00	$ 50,750.00	$ 58,000.00
100,000,000	Outside Services Expense	0.00185	$ 13,875.00	$ 18,500.00	$ 23,125.00	$ 27,750.00	$ 32,375.00	$ 37,000.00
100,000,000	Plant, Machinery, Supplies	0.00285	$ 21,375.00	$ 28,500.00	$ 35,625.00	$ 42,750.00	$ 49,875.00	$ 57,000.00
	Totals		$ 57,000.00	$ 76,000.00	$ 95,000.00	$ 114,000.00	$ 133,000.00	$ 152,000.00

Total % Benefit	7.5%	10.0%	12.5%	15.0%	17.5%	20.0%
Total $ Benefit	$ 487,275	$ 649,700	$ 812,125	$ 974,550	$ 1,136,975	$ 1,299,400


Benefit Chart
$1,400,000
$1,200,000
$1,000,000
$800,000
$600,000
$400,000
$200,000
$-
Annual Production Cost Avoidance
0.0%
5.0%
10.0%
15.0%
20.0%
25.0%
% Overall Improvement
Every 1% gain results in approximately
$65,000 in profit margin

Appendix E

Comparison of XYZ Corporation Reliability Self Assessment with Alidade MER Assessment

ALIDADE was asked to evaluate the XYZ Corporation Internal Reliability Assessment tool as part of the assessment recently conducted at XYZ Corporation's Houston, TX plant. The following page contains a side by side comparison of the summary pages. The column titles "Houston Self Assessment" was performed by Houston's staff. The column titles ALIDADE Assessment" was completed by the ALIDADE assessment team.

Overall the average scores across all summary categories are not bad; average difference between the scores has an absolute value of 6%. However the standard deviation between of average difference is 37%. This indicates that there will likely be large variation in how different plants interpret the assessment questions. When each plant, or individuals within each plant fill in the form there will likely be a range of scores.

As a self assessment tool for internal plant use, when the same person will be periodically re-evaluating their program the tool can be effective when used for trending. However, use of the tool to compare across multiple plants should only be given credence if the same person or teams of people are evaluating all plants.

The trade off between having a quick, easy to apply tool and having a comprehensive assessment is that the assessment elements must be short phrases. The fewer the elements, and the shorter the description, the more interpretation there will be. Two people looking at the same phrase more often than not will come to two different conclusions about the meaning and application of the phrase.

Another shortcoming of the XYZ Corporation Internal Reliability tool is that it is limited in the subjects and depth to which it investigates issues related to a comprehensive organizational reliability program. ALIDADE recommends that foundation, work management processes, focus & execution and proactive reliability elements be evaluated.

Using the XYZ Corporation Internal Reliability Assessment tool as a comparison among multiple plants with diverse production assets may result in erroneous conclusions leading to inefficient use of resources. If XYZ Corporation is interested in comparisons among plants, or comparisons among a representative group of plants from which to target reliability improvement efforts ALIDADE recommends the use an independent and comprehensive assessment. The cost of the independent assessment will be minor in comparison to accurately identifying the most important areas for corporate attention.

Appendix E: Reliability Self Assessment Review

RELIABILITY BEST PRACTICE ASSESSMENT - SUMMARY

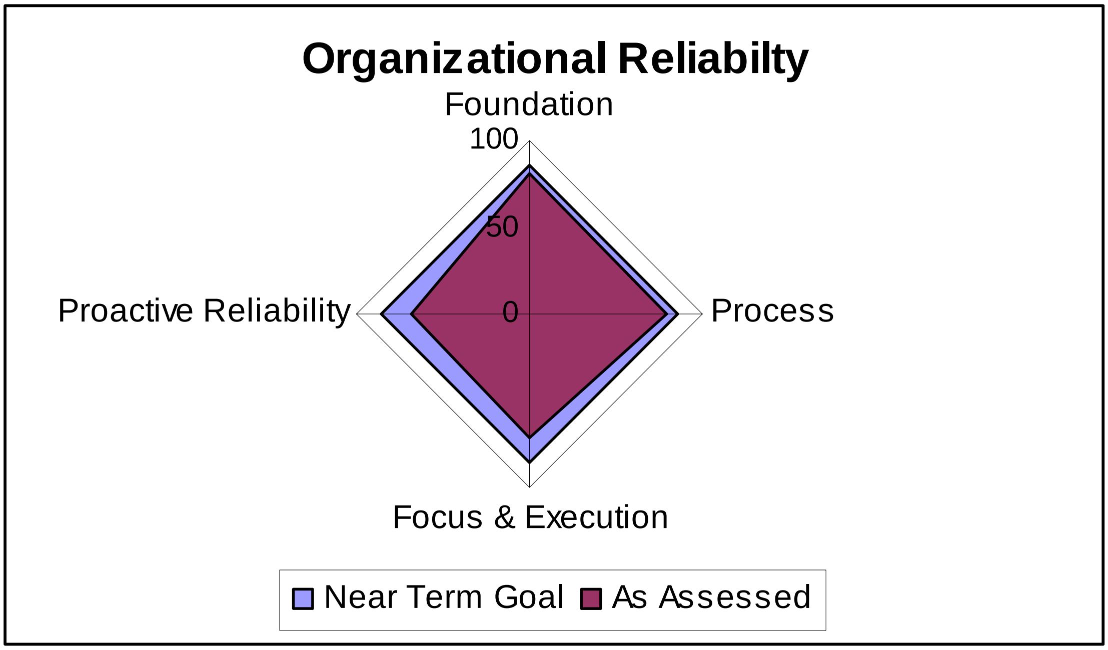
Plant:	Self Assessment		Assessment		Percent Variation
LEADERSHIP		**2.4**		**4.8**	-98%
1. Leadership	2.4		4.8		
MEASURES		**4.6**		**3.0**	36%
2. Measures, Goals and Objectives	4.6		3.0		
PLANNED MAINTENANCE		**4.7**		**4.8**	-2%
3. Planning and Scheduling	4.7		4.8		
4. Quality of Work	3.7		4.3		
5. Planned Shutdowns	4.8		4.9		
PROCESS AND EQUIPMENT RELIABILITY		**3.6**		**3.1**	16%
6. Critical Equipment Strategies	4.0		3.8		
7. Operating Asset Utilization	4.2		3.2		
8. Failure Mode Analysis	2.8		2.8		
9. Reliability Centered Maintenance	3.0		1.0		
PREVENTATIVE MAINTENANCE		**4.4**		**4.5**	-1%
10. Routine Checks	4.0		3.7		
11. Lubrication	4.9		4.9		
12. Mechanical Integrity	4.0		4.0		
13. Replacement of Wear Parts	3.0		3.0		
14. Calibration	3.5		5.0		
15. Relief Valves and Rupture Disks	3.0		4.0		
16. Steam Traps	4.9		4.3		
PREDICTIVE MAINTENANCE		**3.1**		**2.6**	18%
17. Predictive Maintenance Programs:	3.1		2.6		
RELIABILITY-CENTERED DESIGN		**3.8**		**3.0**	20%
18. Reliability-Centered Design	3.8		3.0		
MAINTENANCE MATERIALS MANAGEMENT		**3.7**		**4.4**	-19%
19. Spare Parts Management	3.3		4.3		
20. Maintenance Materials Suppliers	4.0		4.5		
21. Standardization	5.0		5.0		
CONTRACTOR MANAGEMENT		**5.0**		**5.0**	0%
22. Contractor Management	5.0		5.0		
HUMAN RESOURCES DEVELOPMENT		**2.7**		**3.3**	-25%
23. Training and Skills Development	2.5		3.0		
24. Reliability Networks	3.0		4.0		

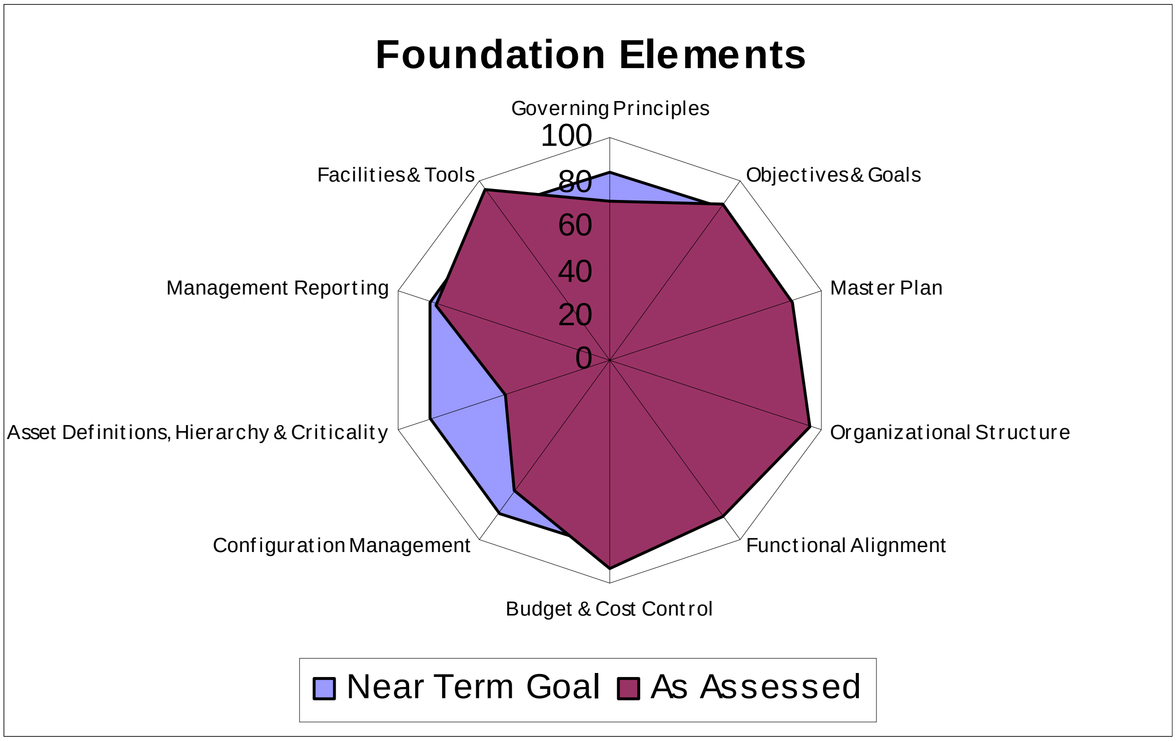
Average Variation -6%

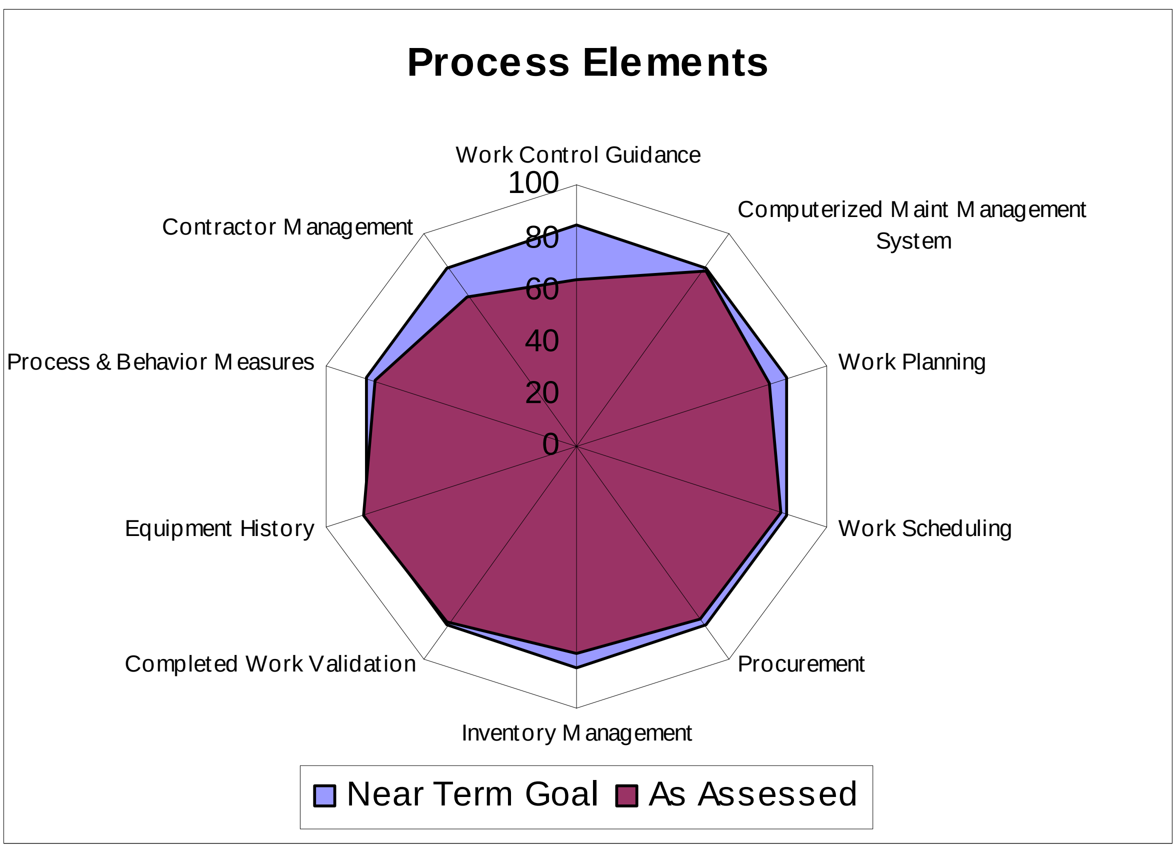
RELIABILITY BEST PRACTICE ASSESSMENT - SUMMARY

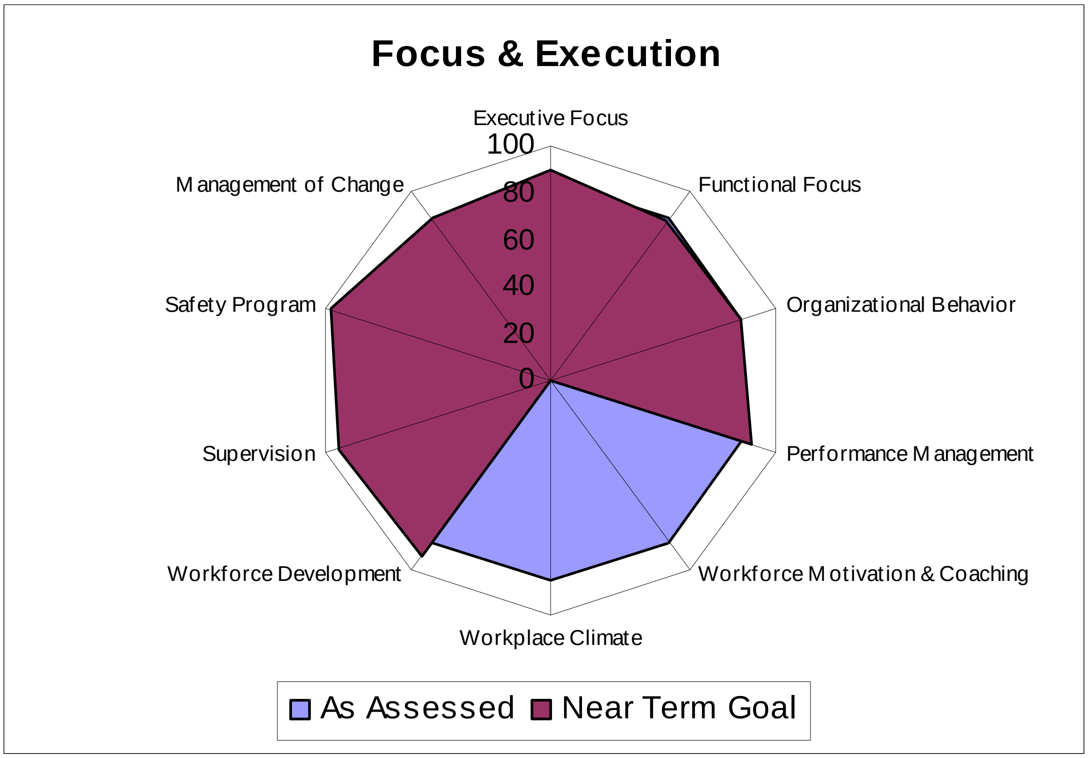
Plant:	Self Assessment		Assessment		Percent Variation
LEADERSHIP		**2.4**		**4.8**	-98%
1. Leadership	2.4		4.8		
MEASURES		**4.6**		**3.0**	36%
2. Measures, Goals and Objectives	4.6		3.0		
PLANNED MAINTENANCE		**4.7**		**4.8**	-2%
3. Planning and Scheduling	4.7		4.8		
4. Quality of Work	3.7		4.3		
5. Planned Shutdowns	4.8		4.9		
PROCESS AND EQUIPMENT RELIABILITY		**3.6**		**3.1**	16%
6. Critical Equipment Strategies	4.0		3.8		
7. Operating Asset Utilization	4.2		3.2		
8. Failure Mode Analysis	2.8		2.8		
9. Reliability Centered Maintenance	3.0		1.0		
PREVENTATIVE MAINTENANCE		**4.4**		**4.5**	-1%
10. Routine Checks	4.0		3.7		
11. Lubrication	4.9		4.9		
12. Mechanical Integrity	4.0		4.0		
13. Replacement of Wear Parts	3.0		3.0		
14. Calibration	3.5		5.0		
15. Relief Valves and Rupture Disks	3.0		4.0		
16. Steam Traps	4.9		4.3		
PREDICTIVE MAINTENANCE		**3.1**		**2.6**	18%
17. Predictive Maintenance Programs:	3.1		2.6		
RELIABILITY-CENTERED DESIGN		**3.8**		**3.0**	20%
18. Reliability-Centered Design	3.8		3.0		
MAINTENANCE MATERIALS MANAGEMENT		**3.7**		**4.4**	-19%
19. Spare Parts Management	3.3		4.3		
20. Maintenance Materials Suppliers	4.0		4.5		
21. Standardization	5.0		5.0		
CONTRACTOR MANAGEMENT		**5.0**		**5.0**	0%
22. Contractor Management	5.0		5.0		
HUMAN RESOURCES DEVELOPMENT		**2.7**		**3.3**	-25%
23. Training and Skills Development	2.5		3.0		
24. Reliability Networks	3.0		4.0		

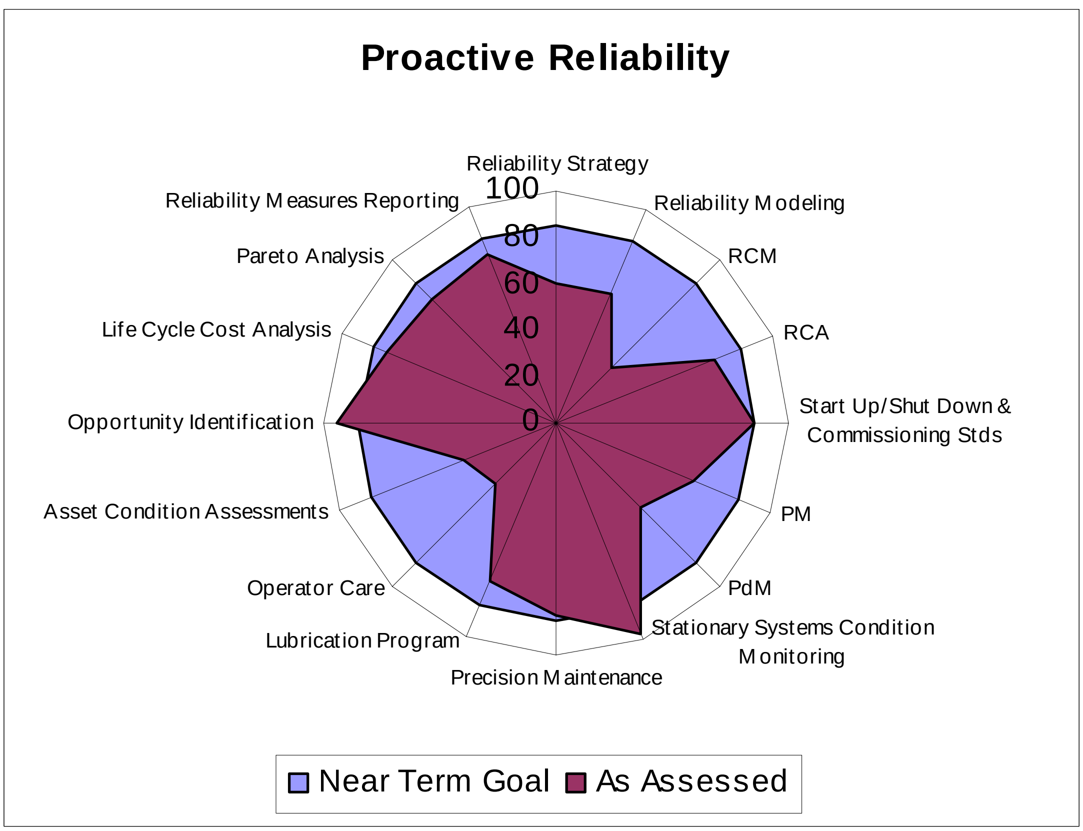
Average Variation	-6%
Standard Deviation	37%


Organizational Reliabilty
Foundation
100
50
0
Process
Focus & Execution
Proactive Reliability
Near Term Goal
As Assessed


Foundation Elements
Governing Principles
Objectives & Goals
Master Plan
Organizational Structure
Functional Alignment
Budget & Cost Control
Configuration Management
Asset Definitions, Hierarchy & Criticality
Management Reporting
Facilities & Tools
100
80
60
40
20
0
Near Term Goal
As Assessed


Process Elements
Work Control Guidance
Computerized Maint Management System
Work Planning
Work Scheduling
Procurement
Inventory Management
Completed Work Validation
Equipment History
Process & Behavior Measures
Contractor Management
100
80
60
40
20
0
Near Term Goal
As Assessed


Focus & Execution
Executive Focus
Functional Focus
Organizational Behavior
Performance Management
Workforce Motivation & Coaching
Workplace Climate
Workforce Development
Supervision
Safety Program
Management of Change
100
80
60
40
20
0
As Assessed
Near Term Goal


Proactive Reliability
Reliability Strategy
Reliability Modeling
RCM
RCA
Start Up/Shut Down & Commissioning Stds
PM
PdM
Stationary Systems Condition Monitoring
Precision Maintenance
Lubrication Program
Operator Care
Asset Condition Assessments
Opportunity Identification
Life Cycle Cost Analysis
Pareto Analysis
Reliability Measures Reporting
100
80
60
40
20
0
Near Term Goal
As Assessed