EPRI

Final Report on Leading Indicators of Human Performance

This report describes research sponsored by EPRI and the U.S. Department of Energy under the Nuclear Energy Plant Optimization (NEPO) Program.

Technical Report

Final Report on Leading Indicators of Human Performance

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REPORT SUMMARY

This report provides guidance and lessons learned for implementing Proactive Assessment of Organizational and Workplace Factors (PAOWF) and Leading Indicators of Organizational Health. These tools allow leaders to proactively manage human and thus organizational performance. PAOWF is a software-based assessment tool. The software and supporting documentation are available from EPRI. Leading Indicators of Organizational Health does not require any special software.

Background

PAOWF and Leading Indicators of Organizational Health were developed and tested in prior phases of this project. These tools help continue the progress made by the industry in improving human and overall plant performance in the last decade or so.

One side effect of the industry's progress has been the elimination of events, such as scrams and significant events, to provide a basis for identifying the next improvements. In addition, the economic penalties associated with these kinds of events in the deregulated environment mean that learning from experience alone is cost-prohibitive. For these reasons, the requirement arose for tools to provide a basis for *proactive* management interventions; that is, to take actions to improve performance without waiting for the analysis of plant events to provide a basis for improvements.

PAOWF has been implemented at two plants. Leading Indicators of Organizational Health has been implemented at one plant and is being implemented at another. The experiences in these implementation efforts provide the basis for this report.

Objectives

- To provide step-by-step guidance to implement PAOWF and Leading Indicators of Organizational Health at a power plant

- To summarize lessons learned from the current applications of PAOWF and Leading Indicators of Organizational Health

- To provide a perspective on the evolution of the proactive approach and its role in managing human performance at nuclear plants

Approach

This report was developed from the analysis of information received from the plants that have implemented PAOWF and Leading Indicators of Organizational Health.

Results

- PAOWF can be implemented successfully in different ways to identify strengths and weaknesses in the task and workplace factors at a nuclear plant. As a result, it can provide a basis for management actions.

- Leading Indicators of Organizational Health can be implemented successfully in plants through a structured step-by-step procedure.

- Implementation of both PAOWF and Leading Indicators of Organizational Health can be integrated with other human performance and plant performance improvement activities in a consistent and systemic manner.

- The process of implementing PAOWF and Leading Indicators of Organizational Health can have a beneficial effect on the ability of all levels of the plant staff and management to understand issues associated with human and organizational performance. It achieves this benefit by providing a set of concepts and a vocabulary that tie together the different levels of influences and how they interact. As such, the process sets the stage for an integrated approach for dealing with human performance in the context of the human performance system that is the organization.

EPRI Perspective

Leading indicators of human performance were developed in response to the need to detect or avoid plant performance declines, as perceived in the nuclear industry in the late 1990s. The economic incentive for leading indicators of human performance is stronger now than before. Not only must performance not decline, but the more dynamic business environment now demands faster organizational response. Therefore, techniques that can proactively assess the conditions that drive performance will be needed for the foreseeable future. PAOWF and Leading Indicators of Organizational Health meet this current and future need.

Implementing PAOWF and Leading Indicators of Organizational Health as part of a utility's self-assessment and corrective-action processes will enhance those processes. Use of these tools will result in opportunities to share information and lessons learned. At most stations, PAOWF and Leading Indicators of Organizational Health will evolve from their first application to match more and more closely the unique situations and needs faced by the utility. PAOWF and Leading Indicators of Organizational Health are designed to adapt to whatever future situations the stations may face.

Keywords
Human performance
Human factors
Human error
Human reliability
Organizational factors

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INTRODUCTION

This report details how a project manager can implement leading indicators of human performance at a station. The basic elements of leading indicators of human performance are contained in EPRI's Human Performance Assistance Package (HPAP). HPAP is a set of tools that can help stations proactively manage the key forces on human performance so that, as the number of opportunities to learn from significant operational events decreases, the ability to continue to improve human performance is not lost.

The Human Performance Assistance Package consists of three components:

1. **Proactive Assessment of Organizational and Workplace Factors** (PAOWF) collects information about conditions that influence people as they do their work. By watching how the conditions improve or decline over time, managers and supervisors can learn what is getting better and what is getting worse. PAOWF enables leaders to respond to situations before the situation causes events. In that sense, it is a leading indicator of human performance. PAOWF is a software tool to obtain ratings of potential problem areas from frontline workers and supervisors. The tool can also be used to assess the organizational factors that shape the work environment.

2. **Leading Indicators of Organizational Health** is a set of self-assessment measures that provide information to plant and utility management about the organizational characteristics that are strong influences on human performance. The indicators, developed from existing or new data, are analyzed in a way that can identify the onset of conditions that could lead to a change in a plant's performance. These indicators measure the upstream influences on future work conditions.

3. **Corrective Action Research and Evaluation** (CARE) helps utility management to identify potentially relevant corrective or preventive actions from existing databases and libraries. It also includes a method to document the effectiveness of corrective actions. CARE is described in *Guidelines for Trial Use of Leading Indicators of Human Performance: The Human Performance Assistance Package* [1]. See this document for further information. CARE software is packaged with PAOWF in the *Human Performance Assistance Package (HPAP) Code, Version 1.0* [2].

This report provides detailed guidance on how to implement PAOWF and Leading Indicators of Organizational Health. It also describes the results to date of using these tools at stations. The report closes with a perspective on how the leading indicator effort meshes with the ongoing evolution of performance improvement efforts in the nuclear industry.

This project has produced some basic tools for proactive leaders to adopt and use. As leaders gain and share experience with leading indicators of human performance, the potential of these tools will be more fully realized.

This final report is based on three earlier reports that provide further elaboration of the principles and uses of leading indicators of human performance:

- *Guidelines for Leading Indicators of Human Performance: Preliminary Guidance for Use of Workplace and Analytical Indicators of Human Performance,* TR-107315 [3]

- *Guidelines for Trial Use of Leading Indicators of Human Performance: the Human Performance Assistance Package,* 1000647 [1]

- *Human Performance Assistance Package (HPAP) Code, Version 1.0*, 1000918 [2]

This report is written to meet the needs of the individual tasked with implementing leading indicators of human performance at a station—the project manager. Other readers will get a general sense of what to expect when implementing leading indicators of human performance by scanning the how-to sections and by understanding the experience of other stations described in the latter part of this report.

References

1. *Guidelines for Trial Use of Leading Indicators of Human Performance: The Human Performance Assistance Package.* EPRI, Palo Alto, CA: 2000. 1000647.

2. *Human Performance Assistance Package (HPAP) Code, Version 1.0*. EPRI, Palo Alto, CA: 2001**.** 1000918**.**

3. *Guidelines for Leading Indicators of Human Performance: Preliminary Guidance for Use of Workplace and Analytical Indicators of Human Performance.* EPRI, Palo Alto, CA: 1999. TR-107315.

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PAOWF

Proactive Assessment of Organizational and Workplace Factors (PAOWF) is a versatile tool for measuring what is happening in the workplace. It is based on the premise that *people who do the job are also the ones most likely to know what influences the success or failure of the job*. The actual uses of PAOWF at the trial sites include:

- Assessing workplace conditions in a maintenance department

- Validating findings of external review reports at the plant

- Supporting the supervisor and manager observation program with an easy-to-use tool

- Facilitating self-assessments by supervisors and managers

Users have found several features of PAOWF to be particularly useful:

- The ability to provide real-time data about what is currently happening in the workplace by asking workers to assess the problems that they encounter.

- Immediate analysis and feedback capability.

- Burden-free usability. Basic PAOWF ratings require less than 90 seconds to complete.

- Integration into existing ways of doing business. For example, ratings can be used in post-job de-briefing sessions to discuss problems, shape future job briefings, and provide input into procedure redesign. Managers can use ratings to direct their focus during workplace observations.

> *PAOWF really has the potential, with proper forethought and design, to tap into what the craft personnel are thinking and what it's like to come to work every day.*
>
> *Al Jones, PM, Ginna*

Regardless of application, a project manager should follow certain generic steps to ensure the long-term acceptance and use of PAOWF. These steps are presented in a step-by-step outline of how to implement PAOWF (see Procedures for Implementing PAOWF). The procedural outline is followed by a section of detailed background for the procedure based on experience at the different trial sites (see Detailed Background for the Procedure).

This procedure is based on a generic change management model. It is highly recommended that project managers adapt these generic steps to the specific change management model in use at the station. A written, station-specific plan will be useful to align the various parties at each stage. Change management will require several iterations through the different stages, and written plans will help everyone keep track of evolving goals.

Procedure for Implementing PAOWF

Prerequisites/Getting Started

Note 1: The project manager or team tasked with implementing PAOWF should have a broad understanding of human performance principles and the methods for improving human performance in use at the station.

Note 2: Sources of assistance for this project include EPRI and other stations that have implemented leading indicators of human performance. Project managers are encouraged to contact EPRI to gain the benefit of this experience (for example, lessons learned as stations begin to use PAOWF, user group activities, and points of contact at other plants).

1. Review the steps below to understand the full process.

2. Read or review the two prior EPRI reports on the leading indicators of human performance [1, 2] and the *PAOWF User's Guide* [3] and software [4]. These reports provide useful background, including theory and details of implementation, for briefing different personnel within the plant later.

Establish Expectations and Roles With Senior Management Team or Senior Management "Champion" for PAOWF

1. Establish expectations, goals, or strategic objectives for PAOWF.

2. Establish an initial project management or business plan that includes resources (time and people), timelines, and measures of success.

3. Establish the project's organizational structure, including your role as project manager, senior management's role, key stakeholders, and affected personnel. Of particular importance is the senior "champion" role in which a senior manager vigorously supports the project.

PAOWF is not about people. PAOWF is about the conditions that affect people's performance. We can help people perform better if we make the conditions around them better.

Get the Support and Involvement of the Information Technology (IT) Group

1. Brief IT on the purpose of PAOWF and its functions. The senior champion of PAOWF should speak at the briefing.

2. Establish a PAOWF project manager in IT. Make that person a stakeholder and member of the PAOWF team.

Note: It is generally easier to install PAOWF first on a development server to enable the various stakeholders to begin gaining experience with the system. Most LANS have both development servers and production servers to protect the reliability of the production servers. Consider leaving PAOWF on the development server if initial trials with user groups are desired. It is recommended that PAOWF should be running in a production environment before formal rollout of PAOWF in any work group.

3. IT should review the PAOWF software and estimate the work/time for installation on the development server and the production server. Update the project plan with these estimates.

4. Install PAOWF, and perform some dummy ratings yourself to ensure that it is working as you expected.

5. When appropriate, transition PAOWF to the production server.

Select and Gain the Ownership of the Initial Test Group(s)

1. Determine the initial test group(s). This may involve formal or informal discussions with different groups to gauge and build enthusiasm. Look for the group that is motivated to participate; its success will persuade other groups later.

2. Brief and brainstorm with the test group(s) regarding the different uses of PAOWF, and allow the group(s) to shape the first trial.

   Note: PAOWF is designed to easily gather large amounts of useful data by seeking input from every worker after each job. The basic design supports craft workers and shift workers who interact directly with the plant. Other workers whose duties are more administrative in nature (for example, engineers) may provide input on a suitable frequency instead of a per job basis.

The supervisors and managers gladly accept that observations are part of their job, so they accept PAOWF as a tool to help them do their job.

Jim Gallman, PM, Commanche Peak

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3. Select the raters. Raters can consist of one or several work groups, shifts, or positions or of all personnel involved in a particular task or process.

4. Decide upon the level of rater identification. Completely anonymous rating is ineffective. The rating is more diagnostic if identified by trade/position and by work being done.

5. Establish the length of the trial (2–4 months) and frequency of ratings, such as each job, daily, by shift, weekly, or randomly.

6. Formulate the test items. More than 12–15 items is considered a mental burden. Use Table 2.3 of the *PAOWF Users' Guide* [3] as a starting point.

7. Decide which computers will have PAOWF. Be sure that they are convenient for the raters.

Select and Gain the Ownership of the Personnel Who Will Analyze the Data

1. Decide who will analyze the ratings. As a minimum, include first-line supervisors.

2. Organize hands-on training for analysts/first-line supervisors to input and analyze some dummy data.

3. Organize training for analysts/first-line supervisors on how to provide results feedback to the raters.

First Trial Rollout

1. Brief all members of the group about the trial, including duration of the project and expected results.

2. Provide training on the PAOWF system.

3. Provide a point of contact for questions and problems.

First Trial

1. Formally begin the trial after pre-announcing it in several work meetings.

2. Perform a walk-around, talking with raters about their experience with the software. Ask their first-line supervisor to do the same.

3. The first-line supervisor should review the data weekly and give results feedback to raters in weekly work meetings.

4. Formally end the trial.

5. Report on the trial to the test group, other departments, and senior management

6. Incorporate lessons learned from the trial (s) into the project plan.

7. Transfer the PAOWF process to the work group and line management or first-line supervisors.

Communicate With Other Groups and Departments About PAOWF

1. Before the first trial:

   - Publish information about PAOWF in the plant newsletter (before, during, and after the first trial).

   - Continue formal and informal work group discussions about PAOWF.

2. During the first trial:

   - Find early success stories in the initial trials, even small things that were found and improved. Celebrate these successes.

   - Continue formal and informal work group discussions about PAOWF.

   - Get the PAOWF trial included on different meeting agendas.

3. After the first trial:

   - Distribute widely the report from the first trial (horizontally and vertically throughout the plant). Celebrate the key successes; highlight the value added as perceived by the participants.

   - Continue formal and informal work group discussions about PAOWF.

   - Ask for spokespersons from the test group to speak at different meetings.

   - Look for other volunteer groups and applications of PAOWF.

   - Ask the IT leader to prepare a report on PAWOF readiness for other groups and projects.

   - Talk to human performance trainers about PAOWF, and ask them to demonstrate it in their training courses.

Using PAOWF Data

1. Provide regular feedback to raters, including summaries of ratings and responses (proposed actions).

2. Provide a follow-up on outcomes of action taken.

3. As the PAOWF database grows, provide advanced data analysis training to managers and supervisors

4. Organize a data hand-off to trending specialists in the plant for long-term use.

Integrating PAOWF With Other Plant Programs

CAUTION: A low rating in PAOWF is not the equivalent of an identified problem, and PAOWF is not a replacement for corrective action processes. The suggested interface between PAOWF and the station's corrective action process is that after a clear and convincing trend has been discovered in PAOWF data, supervisors and managers should decide that something needs to be changed. At that point, stations may find it convenient to track that the change in the corrective action process.

1. Incorporate PAOWF "identified problems" and "actions taken" into the plant's corrective action programs.

2. Communicate the areas of notable strength identified by PAOWF to other work groups. Celebrate success when work groups maintain strong workplace conditions.

3. Self-assess the PAOWF system, and revise the rating categories to keep the categories timely and relevant. Seek additional areas for proactive measures.

Detailed Background for the Procedure

The PAOWF procedure was written with several issues in mind. Generic project management and change management principles were combined with the early development work on PAOWF and the experience gained at the trial sites to produce a realistic procedure for implementing and sustaining PAOWF at a nuclear power plant. Below is the rationale that accompanied every step.

Prerequisites/Getting started

Before engaging others at the plant, you will want to have a good grasp of the project yourself. See the "big picture" of what needs to be done. Understand the theoretical basis for the project and the work done at other plants to date. Someone who knows the research literature and some of the industry's initiatives is in a better position to manage the project. Contact EPRI and INPO for access to external resources. Knowing what these resources are will help you later in the project.

> *You do not want someone naïve running PAOWF. That person needs to have some background in human performance issues. Reason's work and INPO's Human Performance Fundamentals Course would be a good start.*
>
> *Al Jones, PM, Ginna*

Establish Expectations With Senior Management

Like any new project at a plant, there are certain project and change management rules to abide. Namely, you want to be sure before moving forward that you and the and the senior leaders are clear about what PAOWF is intended to do, how it should be done, how long it will take, and who will be involved. Equally important is setting some expectations, or measures of success, for the outcome. Creating a project plan for the PAOWF project will concretize expectations and formalize the resources allocated to the project.

Having a senior manager who will champion PAOWF is invaluable to the project. Investing some time to ensure that this person understands what PAOWF is and can do will help you later. This senior manager can also provide the weight that may be needed to persuade others at the plant and, in situations of departmental conflicts, provide the seniority to balance the issues.

Senior management support in identifying stakeholders and affected parties, especially the station's information technology (IT) group, is a key factor in the success of PAOWF. People at all levels in the organization will need to understand that the priorities of the station at that point include the PAOWF initiative; and unless senior support is visible to people at all levels, people will continue to act in accordance with outdated priorities.

Get the Support and Involvement of the Information Technology Group

One of the major lessons learned at both trial sites was the pivotal role of the information technology group. In both cases, the PAOWF implementation was pushed back several times because of IT problems, either in installing the software for the plant's intranet or because IT had different priorities. As the project manager at one trial site said, "We underestimated the time, the timing, the problems that our IT people would have as we tried to bring PAOWF in-house. A question you need to ask before proceeding is, 'Can we get the support we are going to need? Can our IT people handle this?' The whole process and timetable became tied to the IT people and what they could achieve."

The project manager's relationship with IT warrants special attention. The senior manager may be able to facilitate a cooperative high-priority relationship. Because changes to the network production environment are potential threats to the reliability of basic infrastructure at the station, the IT personnel need to have a full understanding of the project's technical needs and of the degree of support the project has from senior management. Frequent communication is the key. To avoid surprises with IT, it is important to brief IT personnel on the project and to establish an IT leader for the project. Provide a copy of the *PAOWF User's Guide* [3] to the IT leader. This document is written with the system administrator in mind and contains all the technical requirements and specifications. Because of the pivotal role of IT, you may also want to consider appointing the IT person as a co-leader in the project to duly reflect the importance of IT's role.

Enlisting IT's help with the project management plan and timeline will solidify IT's commitment to the project. Mutually establishing a timetable and progress reports will keep surprises to a

minimum. The more closely you work with IT in the initial phases, the more likely the final product will match your expectations or be modified in a mutually acceptable way.

Generally, it is preferable to install PAOWF first on a development server to enable the various stakeholders to begin gaining experience with the system. Most LANS have both development servers and production servers to protect the reliability of the production servers. Consider leaving PAOWF on the development server if initial trials with user groups are desired. It is recommended that before permanent rollout of PAOWF in any work group, PAOWF should be operating in a production environment.

Select and Gain the Ownership of the Initial Test Group

The long-term acceptance of PAOWF depends on an early success. Avoid groups that are skeptical or negative; they will be persuaded later by the early successes. Find a group whose management is enthusiastic about understanding human performance in the workplace. Spend time with the manager or work group, and build realistic expectations for the POAWF test. As the trial group, the participants may have to tolerate some delays and "bugs" as the system goes online. On the other hand, the initial group will have the greatest input into how PAOWF will be shaped for their area and the plant.

Because PAOWF has so many potential applications, it is prudent to brainstorm different options with the group and to see which one holds the most initial interest. This will help build ownership for the trial group and keep participants involved during all phases of the trial. Deciding on the purpose of the PAOWF trial will also determine which raters to use and how often. For the trial, it may be possible to ask the raters to use their names; this would help track any queries or obvious problems in using the system. Generally, it is not necessary to know who the rater is; but it is helpful to know the person's occupation, the work group or shift, and the work that is being rated. This information makes the ratings more diagnostic. Note that greater detail on this issue is provided in Section 2 of the *PAOWF Users' Guide* [3].

Convening a meeting with the test group and IT will keep everyone informed and maintain realistic expectations.

With your help, the test group should decide the items to be used in PAOWF. Experience has shown that rating more than 15 items becomes a "mental burden" and is resisted. PAOWF should appear effortless (requiring less than 90 seconds to complete) so that the rater never feels that PAOWF is extra work. PAOWF comes with a useful set of factors as a starting point for the selection process (see Table 2-3 of the *PAOWF Users' Guide* [3]). These factors are identified as "latent organizational weaknesses" in INPO's *Human Performance Fundamentals Course* [4]. For the trial, it is acceptable to use these general items; however, the test group may also have some specific concerns that participants would like to see tested. Again, encourage the test group's input.

> *There is now enough research from the last 10 years to apply the research models (for example, the work by Reason and Westrum) to the questions. It helps provide some theoretical underpinning to the questions; and hence, they are more "stable"—that is, not only concerned with just today's pressure points and crises.*
>
> *Al Jones, PM, Ginna*

A final, pragmatic concern is the location of the computers used in the trial. Because PAOWF is premised on being quick and effortless, it is important that the computer terminals for accessing PAOWF are convenient to the raters.

Select and Gain the Ownership of the Personnel Who Will Analyze the Data

Data analysis occurs at two levels: feedback of results to the raters and long-term trending. The first-line supervisor—the person who knows the context of the ratings and, therefore, can bring greater meaning to the results—is best suited to handle the immediate feedback. The second level may be handled more successfully by trending specialists within the plant. The PAOWF software includes data analysis functions that can be mastered relatively quickly (see Section 5 of the *PAOWF Users' Guide* [3].)

It is important that the supervisors are comfortable with this process and with the associated process of providing feedback to raters before the trial begins. Experience at the trial sites has shown that when the raters fail to receive any feedback on their ratings, they quickly lose interest in the program. One trial site had to cancel their initial PAOWF effort with frontline workers because, as the project manager said, "The program just died on the vine because supervisors weren't comfortable with PAOWF. So, either they didn't tie their comments back to the PAOWF ratings, or they did nothing at all." To avoid such a result, provide some training on analysis of ratings and on type and timing of feedback.

> *Giving the appropriate analytical tools and skills to the people who are closest to and, therefore, have the most intuitive understanding of the workplace is the best way to ensure that meaningful information emerges from the data.*

First Trial Rollout

To ensure a smooth trial, be sure that everyone in the test group understands not only the specifics of the rating system, but the purpose of the trial and how it relates to other human performance programs at the plant. The group's supervisor should conduct this briefing with you in attendance as the resource person. You cannot assume that all personnel are familiar with computers and pull-down menus so it is advisable to provide some basic training on the system. Experience at the trial sites suggests that this can be very brief, even as little as 20 minutes. Finally, establishing a point of contact (you or the IT leader) will ensure that raters can quickly resolve any problems that they may have.

First Trial

It is important that the first trial has a clear start date, achieved via several advance work meeting announcements, so that the raters are primed and ready to begin. Be sure that someone, either you or the first-line supervisor, checks in with every rater during the first couple of days to ensure that they are comfortable with the software and that they understand their task. This will help calibrate the raters and reduce errors.

The first-line supervisor's role in keeping the data "alive" is vital to long-term success. As soon as the raters start providing input, they will want to see some outcomes. The first-line supervisor can begin by providing charts generated from PAOWF that will summarize the ratings under different headings and sub-headings. It is best that these charts be introduced and explained at a work meeting. The first-line supervisor can also assimilate the comments inserted by raters and use the comments as the basis for discussion of the seriousness and true frequency of the problems.

The duration of the first trial will depend on how many ratings are generated. Two months is a likely minimum duration although one month may be sufficient if several raters are using PAOWF daily. A trial longer than four months is likely to feel drawn out and cause important momentum to be lost. Then, the ideal trial is probably two to three months with an established finish date so that all affected parties know when to expect overall feedback and potential changes to the process.

During the trial, the first-line supervisors should provide ongoing feedback not only about the ratings, but also about action(s) that are taken in response to the ratings. This information becomes increasingly important as the trial proceeds. Experience with PAOWF and its predecessors in other industries show that raters quickly lose interest in the process if they perceive that nothing is being done in response to their ratings. That is why an important part of the feedback sessions should be a work group discussion of what the overall ratings mean and possible responses. Responses could range from "keep on doing what is being done" to imaginative solutions to problems discovered. Having the workers brainstorm possible solutions serves two purposes. First, people who do the job often have the best ideas about what influences the success or failure of the job. Second, some problems do not have easy solutions; and if the whole work group can arrive at this conclusion, then the outcome, or lack of outcome, will be better accepted.

A report that captures the procedure, the results, and the lessons learned should be prepared as soon as possible after the trial is completed. Then, this document can be distributed throughout the plant when the time is right. Contributors to this report should include you as the plant's PAOWF champion, the IT leader, the first-line supervisor, and the raters themselves. The document should be an honest assessment of the work involved in the trial, the benefits derived, and the future plans for PAOWF.

The next to last step in early trials will be to incorporate any lessons learned from the trial into the project plan. The early uses of PAOWF should reveal better ways to integrate PAOWF with existing methods (for example, the station's self-assessment process) and probably will discover issues that were not initially anticipated in the earlier stages of the project. Depending on the magnitude of the lessons, the project team will have to decide whether to roll out a revised approach to PAOWF or to make minor adjustments to the existing process. As these changes are being made, station management should consider the importance of having every work group use PAOWF in exactly the same way. Lessons learned in one group may have to be implemented elsewhere. Whether a station decides to have one PAOWF methodology for all groups or to allow (even encourage) groups to customize PAOWF for different purposes should be an informed but local decision.

The final step in the first trial, assuming that the trial was successful, is to hand off the entire PAOWF process to the work group and line management. By this stage, the group should have all the skills necessary to modify and implement PAOWF.

Communicate With Other Groups and Departments About PAOWF

The recommended approach for implementing PAOWF is not "You shall implement PAOWF in your group by this date." This approach is doomed to failure because the necessary enthusiasm and ownership have not been established. The procedure as written relies on a volunteer group to execute the trial PAOWF. This approach has several advantages. First, you can smooth out any bugs in the software and the procedure itself before rolling out PAOWF to a larger audience. Second, the group can customize PAOWF to their specific needs, making the package more attractive than a generic model. Third, if the trial is successful and its success is widely publicized, other groups will become interested and want to follow suit. PAOWF will work only when both the raters and people handling the resulting data are committed to improving their jobs or workplace conditions.

Establishing a curiosity about PAOWF is essential, hence, the need for some publicity and marketing. Writing pieces about PAOWF for the plant's newsletter, getting PAOWF on the agenda at different meetings, and talking to the trainers about a discussion of PAOWF in the human performance training course are all ways to raise awareness and instill curiosity. A succinct report of the trial once it has been completed will also help. This report, to be identified as a human performance initiative, should be distributed as widely as possible across departments and to senior management. Arranging for raters or first-line supervisors from the trial to speak at different meetings about their experience would likely be even more powerful persuasion than the report.

Also essential is celebrating the success of the pioneers who tried PAOWF, used it, and received some value from it as well as the success of the groups who stayed the course and made using PAOWF a part of the way they do things. These successes will happen at different times, and it is important that the project manager actively look for them because other people probably will not.

Using PAOWF Data

The goal of PAOWF is to improve workplace conditions, *not* to collect data for the sake of having data. In short, data collection is necessary but by no means sufficient to achieve the PAOWF goals. The collected data must be translated into meaningful information about current conditions and help point the way toward improvement.

As the basis of workplace meetings, the data can be assessed for accuracy, frequency, and risk; and appropriate actions can be brainstormed, evaluated, and then prioritized. As stated previously, people who do the job are also the ones most likely to know what influences the success or failure of the job.

As the database grows, the first-line supervisors may need some training in more sophisticated data analysis to understand better the emerging picture. Such training could be a great investment in keeping the data alive and meaningful at the work-group level. Converting data into meaningful information, rather than just more data, is a vital step and cannot be overestimated. *Giving the appropriate analytical tools and skills to the people who are closest to and, therefore, have the most intuitive understanding of the workplace is the best way to ensure that meaningful information does emerge.*

Long-term trending by plant specialists may also highlight patterns across work groups that will aid senior management decision-making. However, long-term trending imposes certain restrictions on the data, namely, that it has to be identified and collected in the same form over an extended period of time. This restriction can nullify (take the life out of) data and may result in long but meaningless data trails. Proactive indicators need to be responsive to current conditions. Ultimately, to trend the new thinking and the responses that the data generate may prove just as beneficial as the data.

Integrating PAOWF With Other Plant Programs

PAOWF can be considered part of a plant's self-assessment program. Actions generated as a result of PAOWF can be considered part of the corrective action program. Establishing a place for PAOWF in these already established programs will solidify and validate its presence. Part of the successful experience at one of the test sites was the fact that PAOWF provided results that were consistent with findings of external inspections. Therefore, PAOWF can be integrated with plant programs to manage plant responses to such inspections.

Other plant programs with which PAOWF can be integrated include the development and deployment of Leading Indicators of Organizational Health and any special investigations of particular human performance issues. For example, PAOWF can be used as a specialized rapid-survey tool to assess short-term and long-term issues. In addition to the workplace factors used in most of the examples, PAOWF has been considered for performing surveys of such subjective assessments as employee concerns and discrimination program effectiveness.

> *When we spend time trying to fix things that PAOWF has targeted, we do see improvement. We can revisit with PAOWF a year later and see improvement.*
>
> *Al Jones, PM, Ginna*

References

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LEADING INDICATORS OF ORGANIZATIONAL HEALTH

Leading Indicators of Organizational Health is a set of self-assessment measures that provide information to plant and utility management about seven important themes that influence human performance and, thus, organizational success. These themes are:

- Management commitment

- Awareness

- Preparedness

- Flexibility

- Just organization

- Learning organization

- Opacity

For a complete description of the themes, see *Guidelines for Trial Use of Leading Indicators of Human Performance: The Human Performance Assistance Package* [1]. The section below, Detailed Background for the Procedure, has a brief definition of the meaning of each of the themes.

There are certain generic steps that a project manager should follow to ensure the long-term acceptance and use of Leading Indicators of Organizational Health. These steps are presented in a step-by-step outline of how to proceed (see Procedure for Implementing Leading Indicators of Organizational Health). This outline is followed by detailed background for the procedure based on experience at the different trial sites (see Detailed Background for the Procedure).

This procedure is based on a generic change management model. It is highly recommended that project managers adapt these generic steps to the specific change management model in use at the station. A written, station-specific plan will be useful to align the various parties at each stage. Change management will require several iterations through the different stages, and written plans will help everyone keep track of evolving goals.

Procedure for Implementing Leading Indicators of Organizational Health

Prerequisites/Getting Started

Notes 1: The project manager or team tasked with implementing Leading Indicators of Organizational Health should have a broad understanding of human performance principles and the methods for improving human performance in use at the station.

Notes 2: Sources of assistance for this project include EPRI and other stations that have implemented leading indicators of human performance. Project managers are encouraged to contact EPRI to gain the benefit of this experience (for example, lessons learned as stations begin to use Leading Indicators of Organizational Health, user group activities, and points of contact at other plants).

1. Review the steps below to understand the full process.

2. Read or review the two prior EPRI reports on leading indicators of human performance [1, 2]. These reports provide useful background, including theory and details of implementation, for briefing different personnel within the plant later.

   CAUTION: If your station does not have basic performance indicators that reliably display day-to-day performance results, development of leading indicators of organizational health will distract station personnel from a more immediate concern.

3. Review the station's existing performance indicators at all levels in the organization that use performance indicators.

Establish Expectations and Structure for the Project

1. Establish expectations with your senior manager(s) regarding goals and strategic objectives for the Leading Indicators of Organizational Health project.

2. Establish an initial project management plan that includes resources (time and people), timelines, and measures of success.

3. Establish the project's organizational structure, including your role, the role of senior management, the composition and role of a management steering group, a project implementation group (logistics and support), key stakeholders, and affected personnel. Of particular importance is the senior "champion" role in which a senior manager vigorously supports the project.

Select Management Steering Group

Note: The development of Leading Indicators of Organizational Health is primarily a management activity. In addition, leading indicators themselves are necessarily separate from day-to-day activities. The mental focus and abstraction of results of leading indicators is substantially different from the task focus and concrete results expected of persons engaged in day-to-day activities.

1. Identify the appropriate steering group, composed of senior leaders, that will evaluate leading indicator results and exercise judgement about when to initiate change based on leading indicator results. This group will also balance the relative importance of day-to-day considerations against the long-term considerations inherent in the leading indicators of organizational performance.

Select Plant-Specific Indicators to Address The Seven Themes of Leading Indicators of Organizational Health

1. Convene a brainstorming team comprised of the management steering group, the implementation team, performance indicator specialists, and other interested personnel.

   Note: The primary deliverable of this stage is a table that shows the relationship between each theme, its possible manifestations at the plant in the form of local issues, and the candidate indicators to track performance in that area. This document is the blueprint for future work.

2. Hold a workshop or series of meetings to translate the seven themes into local issues pertaining to the plant.

   - Brief the group on the purpose of Leading Indicators of Organizational Health, including the rationale for the seven themes. The background and basis for each theme is presented in *Guidelines for Trial Use of Leading Indicators of Human Performance* [1].

   - Brief the group on the brainstorming process for developing plant-specific indicators for each theme of Leading Indicators of Organizational Health.

   - Using a structured discussion, brainstorm candidate indicators for each theme (see the rationale section that follows for details on some questions to prompt discussion).

     Note: For any proposed leading indicator that relies on survey-type data, PAOWF provides a simple method to collect and analyze data to feed the Leading Indicators of Organizational Health. PAOWF can collect data continuously about organizational factors such as process effectiveness or conditions in the workplace; and it can be used periodically to collect information about other organizational factors, such as culture, values, and leadership attributes.

   - Establish the criteria for selecting the leading indicators of organizational health (see the rationale section that follows for details on selection criteria).

   - Establish the reporting frequency for Leading Indicators of Organizational Health.

- Select and prioritize the specific indicators to be used in the first reporting period. It may be reasonable to list criteria as "must-have" and "want" to prevent getting bogged down in unresolvable details.

Establish Data Collection for the Indicators

Note: Methods of data collection will vary by station. Experience shows that data quality is problematic and that active supervision of the collection and verification of data is warranted, especially in the early stages.

1. Begin collecting and storing data in the Leading Indicators of Organizational Health database.

2. During data collection, monitor the quality, consistency, and accuracy of the data, especially across work groups.

The discussions act as teambuilding, both among the management team and the whole site. The whole process can be viewed as a culture-strengthening exercise.

Paul Wilkens, Senior VP, Ginna

Interpret the Meaning of Leading Indicator Data

1. Display the indicators in trend charts for use as the basis of discussion.

   Note: Interpreting the meaning or importance of leading indicator data is difficult. Management judgement is a necessary element in this interpretation.

2. Convene a meeting of the management steering group during each period to review the collected data (quarterly is suggested, at least initially). Invite persons who may have relevant background information about significant changes in any indicators.

   CAUTION: An emerging concern in Leading Indicators of Organizational Health is not the equivalent of an identified problem. The suggested interface between Leading Indicators of Organizational Health and the station's corrective action process is that, after a clear and convincing trend has been discovered, managers decide something needs to be changed. At that point, stations may find it convenient to track that change in the corrective action process.

3. Produce a document that summarizes the relationship between the seven themes and the plant's progress during the quarter. This document—not the database—is the key outcome of the Leading Indicators of Organizational Health process because it records the "collective sense-making" of the data. As such, it includes narratives and stories—not just data charts—about the plant's progress, emerging points of concerns, proposed actions, and follow-up activities.

Self-Assess the Leading Indicators of Organizational Health Periodically

1. At some point, probably after several periodic meetings to review the Leading Indicators of Organizational Health, self-assess the diagnostic capability of Leading Indicators of Organizational Health. Focus primarily on the summary documents that capture the meaning of Leading Indicators of Organizational Health.

2. Self-assess the particular indicators in use. Look for signs of "flat-lining," that is, no discernable difference across time. You may want to retain these indicators as ongoing signs of success, but you will need other indicators that can detect the more subtle signals that could help point the plant toward improvement.

3. Review the indicators for accuracy and consistency of measurement, especially if data are collected at multiple sites.

4. Review ease and cost of collecting data, and consider alternatives if an indicator proves unwieldy.

5. Share lessons learned from these self-assessments with other utilities using Leading Indicators of Organizational Health.

Make Leading Indicators of Organizational Health a Way of Life, Coordinated With Other Plant Initiatives and Programs

CAUTION: An emerging concern in Leading Indicators of Organizational Health is not the equivalent of an identified problem. The suggested interface between Leading Indicators of Organizational Health and the station's corrective action process is that, after a clear and convincing trend has been discovered, managers decide something needs to be changed. At that point, stations may find it convenient to track that change in the corrective action process.

1. The periodic documents used to interpret the meaning of Leading Indicators of Organizational Health should be considered part of the station's self-assessment program.

2. Any identified problems determined by the steering committee to need a response could be entered into the station's corrective action process and change management process as appropriate.

3. Ultimately, Leading Indicators of Organizational Health is intended to provide senior leadership with a stream of informed hunches about the future. Initially, many insights could be discovered that warrant change at a utility. The important consideration is that continuous fine-tuning of the focus of Leading Indicators of Organizational Health over the long term will continue to provide new hunches about the future.

Detailed Background for the Procedure

Prerequisites/Getting Started

Before engaging others at the plant, you will want to have a good grasp of the project yourself. See the "big picture" of what needs to be done. Understand the theoretical basis for the project and the work done at other plants to date. Someone who knows the research literature and some of the industry's initiatives is in a better position to manage the project. Contact EPRI and INPO for access to external resources. Knowing what these resources are will help you later in the project.

Establish Expectations and Structure for the Project

Like any new project at a plant, there are certain project and change management rules to abide. Namely, before moving forward, you want to be sure that you and your senior leaders should be in agreement about what Leading Indicators of Organizational Health is intended to do, how the project should be done, how long it will take, and who will be involved. Equally important is setting some expectations, or measures of success, for the outcome. Creating a project plan for the Leading Indicators of Organizational Health project will concretize expectations and formalize the resources allocated to the project.

Having a respected senior manager who will visibly provide vocal and tangible evidence of support and endorsement for the project is invaluable. Investing some time to ensure that this person understands what Leading Indicators of Organizational Health is and can do will help later. This senior manager can also provide the weight that may be needed to persuade others at the plant and, in situations of departmental conflicts, provide the seniority to balance the issues. Requesting a formal identification of a senior champion also increases visibility and accountability.

Select Management Steering Group

The Leading Indicators of Organizational Health project is a top-down initiative aimed at improving plant performance. To succeed, the initiative requires substantial dialogue between senior managers about a future state, described in terms of the seven themes of Leading Indicators of Organizational Health, and the current state of the plant with regard to those seven themes. In addition, success requires the continued attention of these same managers to the station's ongoing day-to-day plan of action. Finally, success requires that the needs arising from the future desired state be balanced with the needs arising from the day-to-day activities. The management steering group fulfills this role.

The mental focus and abstraction of results of leading indicators are substantially different from the task focus and concrete results expected of persons engaged in day-to-day activities.

Identify the appropriate steering group, composed of senior leaders, that will evaluate leading indicator results and exercise judgment about when to initiate change based on leading indicator

results. This group will also balance the relative importance of day-to-day considerations against the long-term considerations inherent in the leading indicators of organizational performance.

Select Plant-Specific Indicators to Address the Seven Themes of Leading Indicators of Organizational Health

Convene the Team and Get a Common Understanding of the Project

Because a lot of discussion has to happen before the first tangible outcome with the Leading Indicators of Organizational Health project, a workshop or series of meetings is recommended. Workshop participants are asked to think about the plant in a completely new way, to consider abstract concepts—the themes as characteristics of an organization—and to reflect on how these characteristics arise. This thinking is quite different from the usual approach of evaluating the plant's performance by evaluating concrete monthly outcome statistics. This difference is why a brainstorming process is recommended—to help people step outside their usual modes of thinking about the plant.

At one trial site, the project manager held a series of meetings with different managers and technical groups instead of a workshop. At each successive meeting, participants reviewed the ideas of the previous meeting and added additional suggestions and comments. The project manager then integrated the different sets of inputs and circulated the compilation for review and endorsement.

It is important to recognize that not everyone will have thought previously about organizational health from the point of view of the seven themes, and some education may be in order. Spend time with all the participants discussing the background of the project, explaining the process in which they will participate, and clarifying the expected deliverables. This will help get everyone "on the same page." The early converts (for example, your senior champion) can help the others fully understand the application of the seven themes. With the foundation work established, the brainstorming of specific issues and indicators will proceed more smoothly.

Leading Indicators of Organizational Health is a set of self-assessment measures that provide information to plant and utility management about seven important themes that influence human performance in the long term and, thus, influence future organizational success. For a complete description of the themes, see *Guidelines for Trial Use of Leading Indicators of Human Performance: The Human Performance Assistance Package* [1].

A brief description of the seven themes is reproduced here from that document.

Top-Level Commitment

- Top-level commitment is a powerful influence on many of the other themes and involves several pieces. To demonstrate commitment, top management must do the following:

- Know and address the human performance concerns.

- Provide the organization with a sense of the significance of human performance, including recognizing how much filtering, attenuation, or amplification is applied to issues from the bottom to the top. For example, is it recognized that bad news is always attenuated when passed upwards.

- Provide continuous and extensive follow-through to actions related to human performance.

- Value human performance, both in word and deed.

Awareness

The focus of this theme is on gathering and understanding data to provide management with insights regarding the quality of human performance at the plant, the extent to which problems occur, and the current state of the defenses against the problems.

Preparedness

Preparedness refers to recognizing and doing the work necessary to conduct activities in a well-planned and orderly fashion. Being prepared reduces the potential for problems in human performance and their consequences. The organization is not constantly reacting to problems, but instead being proactive to avoid problems in the first place. This concept applies to all levels of the organization. Having to react to unforeseen events is a significant source of stress for organizations.

Flexibility

Flexibility represents the ability of the organization to adapt itself to new or complex problems in a way that maximizes its ability to solve the problem without disrupting overall functionality. Flexibility refers to both the organization's ability to adapt and the preparation of the people at the working level (particularly first-level supervisors) to make important decisions without having to wait for management instructions. A lack of flexibility, for example, may result in problems remaining compartmentalized rather than solved (the "silo" or "stove-pipe" effect) or work stopping when workers encounter a problem and management is not available to give orders.

Just Culture

A just culture supports the reporting of issues and factors up through the organization, but does not tolerate culpable behaviors under the guise of a "blame-free" culture. Without a just culture, the willingness of workers to report problems is diminished, which results in the reduction of the organization's capability to learn and to know where the weaknesses exist in its defenses.

Learning Culture

A learning culture recognizes the need to identify better ways of carrying out business and identifies when new issues and problems start to appear. The answer to the question, "How much does the organization respond to events by reform rather than repair?" indicates whether an organization is a learning culture.

Opacity

This theme is sometimes recognized by its positive connotations—transparency, boundary or margin awareness, threat visibility, and clarity of defenses. The concern with opacity is that the organization does not see clearly the boundaries to safe and economic performance. Knowledge of the boundaries and the plant's stance with respect to them is a requirement of using a well-defended technology. Because there are many barriers (both physical and organizational) in preventing a hazard from becoming a problem to safety or reliable performance, degradation can occur without people in the organization readily becoming aware of it. Testing usually reveals failures and gaps with the physical barriers; however, it is much more difficult to observe failures and gaps in the organizational processes.

Experience and research provide some generic considerations about Leading Indicators of Organizational Health that should be considered at the outset of the initiative. In addition, experience and research offer examples of particular indicators that have been tried or considered. However, it is important to remember that what is useful, relevant, or cost-effective at one plant may be unimportant and expensive at another. A key learning from EPRI's development of Leading Indicators of Organizational Health is that few, if any, universally acceptable leading indicators can be compared directly among different utilities. After many stations have used Leading Indicators of Organizational Health for a sufficient time to share experiences, this conclusion may change. For the time being, Leading Indicators of Organizational Health is intended to be generated by each utility for its own use.

The plant-specific nature of Leading Indicators of Organizational Health is illustrated by the following example. One of the trial sites placed great importance on the first theme of management commitment. An explanation that the plant gave for its success was the very close supportive relationship between the site and the senior vice president (SVP) of generation. This relationship and level of mutual support were repeatedly described as a major predictor for the positive trend at the plant. Therefore, it was considered very important to monitor the strength of this relationship and to inform the plant personnel if any reduction in the strength of the

relationship occurred. The simple conclusion was that the SVP presence at the plant became a useful indicator of senior management's commitment for this plant. This approach proved useful to the single-plant utility with the corporate office some miles away from the site. Conversely, this approach could not generate useful information at a site where the senior nuclear officer has his normal office at the site, nor at a multi-station utility where significant dilution or competition for the senior nuclear officer's time exists.

Experience has shown that utilities are not likely to get a perfect set of balanced leading indicators of organizational health from the first workshop. It is far more important to get started than to be overly concerned about the accuracy or predictive capability of any leading indicators of organizational health. The success of Leading Indicators of Organizational Health depends less on the quality of any particular indicator than on the meaningful dialogue that the process generates. The indicators provide a means of allowing that discussion to continue and mature.

Dialogue is the key determinant of success. Nonetheless, it is important to establish and maintain a structured approach to developing and interpreting Leading Indicators of Organizational Health. Key steps in the process discussed below involve producing a table similar to those shown in the Appendix that demonstrates the links between the themes and the station's leading indicators of organizational health (see Appendix A, Process for Identification of Candidate Leading Indicators of Organizational Health).

The tables in Appendix A provide many specific examples of candidate indicators that a station may consider. Participants should be familiar with the contents of these tables but should not treat them as a complete menu or pick list. The need to consider the local situation before selecting any particular plant-specific indicators remains paramount, and existing station processes and data availability should drive the selection of particular indicators.

A final generic consideration is that it is not necessary to have fully developed consensus on a complete set of indicators detailing all seven themes before implementing some or all of the data collection process. Judgement can be applied. EPRI recommends that utilities strive to establish at least one indicator for each of the themes. In addition, EPRI recommends that care be exercised if a substantially limited coverage of the seven themes is all that can be established. The nature of the seven themes is such that if the overall approach is unbalanced, it is likely that strength in one theme at the expense of another could create blind spots hidden within the Leading Indicators of Organizational Health.

Brainstorm and Select Plant-Specific Leading Indicators of Organizational Health

Once the group has an understanding of the seven themes, it can start to translate the themes into concrete manifestations and indicators. A brainstorming approach is encouraged for this phase to get as many ideas on the table as possible without a formal evaluation. The formal evaluation comes later after the creative process has finished. Again, this is a new way of thinking about performance, and the group will need to think "outside the box" and move beyond traditional measures.

> *The real strength of the leading indicators is not a number or a new trend; it is the dialogue it generates between departments. The leading indicators provide a language and a set of questions to direct discussions. This process of dialogue and inquiry is the true benefit of the LI project.*
>
> *Paul Wilkens, Senior VP, Ginna*

Using a structured discussion, brainstorm candidate indicators for each theme. Use specific prompts to help the group generate ideas. Some examples follow.

- What would a process to manufacture theme X look like? How would we measure the effectiveness or output of that process?

  Example: For the theme of preparedness, one could consider that preparedness is an outcome of a planning process. In other words, we are more prepared when we have planned our actions. The work control process is a good example of a planning process. The outcome of a work planning process is a work plan that can be executed without change at the right time. Therefore, a candidate indicator may be some measure of the frequency that a work plan has to be changed at the last minute. For plants with a standard twelve-week rolling schedule, a count of the changes to work documents or schedule after the freeze date would suffice. Perhaps $P = $ preparedness $= (1 - N/M)$, [where N=number of changes to work documents (pen and ink changs, schedule delays, revisions once work starts) or schedule after the freeze date and M=number of work documents completed] would behave correctly in a suitable range to be a useful indicator.

- What would an abundance of theme X look like? In other words, if we were as strong in this theme as possible, what measurable characteristics and processes would be obvious or would be different than what exists today?

  Example: For the theme of flexibility, if we were very flexible, we might expect to see people doing different jobs at different times, instead of the (hypothetical) case now where people come to work and do the same thing every day. We might see a high proportion of rotating staff positions and cross-trained personnel. We might see tremendous bench strength, where for each management position, there are several people who could step into the job right now. Perhaps $F = $ Flexibility $=$ station average by department of Q/P, [where Q=number of qualified individuals ready for promotion in the department and P=number of positions above front line worker in the department] would behave correctly in a suitable range to be a useful indicator.

- How would theme X manifest itself horizontally (different departments) and vertically (different levels) throughout the plant?

  Example: For the theme of awareness, one key element is the quality or strength of defenses. Certain error reduction practices (defenses) require a certain investment in effort by individuals that could be monitored using PAOWF. Depending on the station's acceptance of such error reduction practices, a PAOWF question of the form "To what extent was the pre-job brief (or self checking, or procedure use) a problem in my work today?" might yield

useful data with a sufficient range of variability to measure progress toward full acceptance of error reduction practices.

Note: The absence of reports from PAOWF would be a useful leading indicator of improving performance at a station that does not have high confidence that error reduction practices are currently used. For stations where high confidence exists that error reduction practices are well established, the PAOWF question could elicit data that would indicate the onset of complacency.

- What existing processes, people, or policies are our strongest contributors to theme X?

  Example: For the theme of learning culture, one might consider that the station's self-assessment process may be the overall process where we would prefer to learn our lessons proactively. Corrective action processes have historically been used to learn lessons reactively. A large number of corrective actions will always be in play, but the number of self-assessment actions being considered is a bit more discretionary. Perhaps L=Learning Culture=SAC/CAC [where SAC=number of self-assessment actions completed and CAC=number of corrective actions completed] would behave correctly in a suitable range to be a useful indicator.

  Note: Appendix A (reproduced from *Guidelines for Trial Use of Leading Indicators of Human Performance* [1]) provides four sets of themes translated into candidate leading indicators. The first list was developed at an industry workshop; the other three were initiated at plants using different processes. The tables provide examples for the brainstorming team and show that what is relevant at one plant is not necessarily important at another. Indicators will differ depending on the plant's current state of health with regard to the different themes

Separate from the brainstorming of candidate indicators, the group should establish selection criteria that will be applied to judge the best set of plant-specific leading indicators of organizational health. Research and experience provide some generic criteria that can be applied. Plan-specific leading indicators of organizational health should be:

- **Objective**. The value of the indicator can be determined from observable and non-manipulatable sources so that people can observe the measure without relying on judgments or perceptions that can be swayed by political considerations.

- **Quantitative.** The value of the indicator can be measured and trended so that it is possible to be aware that changes are taking place.

- **Simple to understand/worthy goals/face validity**. The measures of the indicator will almost inevitably become the subject of management attention and effort. This attention should, in itself, move human performance in a desirable direction.

- **Related to/compatible with other programs.** In many plants, multiple initiatives and new data gathering efforts are taking place (for example, the NRC's cornerstone indicators in support of the Revised Oversight Process). It may be undesirable to add an additional program to these activities. Conversely, it may be desirable to establish independence of leading data from performance data. Local judgement should evaluate this issue.

In addition, there are local issues of cost and convenience associated with collecting the data. Some indicators can be truly creative, but ultimately not practical. For example, plants with sophisticated performance monitoring systems may decide, as did one of the trial sites, that data associated with an indicator must already be available from existing sources to avoid further data collection. Experience has shown that utilities are not likely to get a perfect set of balanced leading indicators of organizational health from the first workshop. It is far more important to get started than it is to be overly concerned about the accuracy or predictive capability of any leading indicators of organizational health. The success of Leading Indicators of Organizational Health depends less on the quality of any particular indicator than on the meaningful dialogue the process generates. *The quality of the dialogue among the participants and the management steering group's commitment to an ongoing discussion of the issues are the true desired outcomes of the workshop.* The indicators provide a means of allowing that discussion to continue and mature. Nonetheless, it is important to produce a document containing tables similar to those shown in the Appendix that show the links between the themes and the candidate leading indicators.

Apply the selection criteria to the indicators. Some indicators may be successfully applied to more than one theme. Also, some indicators may be better when recorded monthly; others, every quarter or even annually. Prioritize the list by balancing the resources needed to collect the data against the resources allocated to the project, particularly for the indicators that will require new data collection.

Establish Data Collection for the Indicators

Data collection with the indicators can begin when a person on your team is appointed to manage the database and can coordinate with others. In cases where the indicator is already collected as part of an ongoing trending process, the database manager/coordinator needs only to contact the relevant individual in the plant and establish delivery requirements.

In cases where the indicator is new, your team will be responsible for starting the data stream. Initially, this will require some effort and explanation to persons who will be impacted by the data collection. In time, the data collection process will become more streamlined as routines are established and expectations for the indicator are clarified or refined.

Interpret the Meaning of Leading Indicator Data

This step is the most essential step in the Leading Indicators of Organizational Health project, and yet experience at the trial sites has shown that this is the point at which the project is likely to falter. *The ultimate goal of Leading Indicators of Organizational Health is not to collect data; it is to improve organizational health for the long run through structured dialogue and intervention.* Yet the data collection process often has a way of assuming primary importance and ultimately overshadowing more important steps. In some cases, charts have been produced— dutifully, monthly, precisely—for each indicator; and the accumulated charts have been distributed to an increasingly bewildered audience. As one senior manager said, "I understand that Leading Indicators are important, and I want to support this project, but I have to tell you

that these charts mean nothing to me. What am I supposed to do with these charts?" This manager is not alone. Data do not think; people do. In other words, data collection is a necessary but by no means sufficient process for achieving the goals of Leading Indicators of Organizational Health.

The collected data has to be translated into meaningful information about current conditions to help point the way toward improvement. That is why a quarterly meeting of the management steering group and other interested personnel is recommended. Generally, one month is too short a time to detect meaningful changes; such over-attention to the indicators can lead to short-sighted action. Inviting persons who have information pertinent to any changes in the indicators ensures that the steering group will get the "whole story" instead of numbers without the full context.

Stations will vary with respect to the construction of this meeting. It may be reasonable to have the project manager prepare a draft report on the meaning of Leading Indicators of Organizational Health, to be followed by a discussion/re-direction meeting. Alternatively, after generating the raw data, the project manager could consult with individual line managers, who would present the results to their peers for team discussion. An appropriate method for analyzing the data should be established, and the project manager should already be in close touch with the steering group. Mechanically, setting up a suitable forum for discussion is trivial.

On the other hand, interpreting leading indicator data is difficult. Because local situations vary, no foregone conclusions can be offered about how to interpret the data. Some typical questions that could be used to focus the discussion (or analysis, if the project manager is expected to draft an initial report) include:

- What changes appear real as opposed to simply being noise in the data?

- Can we account for the changes observed in terms of purposeful changes that we have tried to make? Are there other reasons for the changes? Are we surprised?

- Subjectively, how do the changes in the leading indicators correlate with changes in overall performance? What is the story behind the changes observed?

- In the aggregate, are we satisfied with the observed changes? If satisfied, do we want to continue as we are, or do we want to look elsewhere? If less satisfied than expected, do we think it is time to act?

- Is there any relationship among the changes that would indicate the likelihood of future success or failure?

- The final step in reviewing the data is deciding if action is required. Proposed actions can also be recorded and reviewed before enactment, and follow-up action can be deferred with expectations for future indicators.

> *[A lesson that] caused me to change the way I think about safety: ...*
> *I thought: Reporting is necessary to track problems and progress.*
> *I learned: Stories are needed to gain knowledge.*
>
> *We're hooked on information. What we need are stories. Reporting that loses the story is mostly a waste. We need to harvest the knowledge... We need firesides, not spreadsheets. The question "How many?" isn't powerful. The question should be "What happened?"*
>
> *I learned that conversation is the mainstay of safety.*
>   *Donald M. Berwick, M.D., CEO, Institute for Healthcare Improvement, MA*

At this stage, the project manager can review the original list of plant-specific leading indicators of organizational health—the blueprint linking themes to indicators—to prompt people's memories about the intended use of the different indicators and then evaluate if in fact the indicators do contribute meaningful information. To understand the big picture—progress on the plant's performance with regard to the themes—one has to begin by understanding the details— which indicators, singly or in combination, reveal meaningful information about the themes. As the group becomes more conversant with the themes and indicators, the participants will be able to detect larger patterns connecting the themes. The outcome of analysis and this meeting is a document that summarizes the relationship among the seven themes, the plant's progress during the evaluation period, and any actions that have been deemed appropriate. This point cannot be over-emphasized: *This document—not the numbers, the database, or the charts—is the key outcome of the Leading Indicators of Organizational Health process.* This is the only *meaningful* outcome, and it has been derived through a collective effort at making organizational sense out of data. Again, data do not think; people do. The Leading Indicators of Organizational Health process facilitates ongoing meaningful discussion of plant performance and possible improvement initiatives substantiated by data. The document becomes the organizational trace, or memory, of these discussions. Not only does it summarize the interpretation of the data, but it also records the emerging concerns so that they can be reviewed in later quarters.

Review Indicators Periodically

An interesting consequence of this shift in focus from collecting data almost as an end in itself to an organizational search for meaning is the realization that *data collection can and should change in order to create and sustain meaning*. Long-term trending by plant specialists can highlight certain patterns that will aid senior management decision-making. However, long-term trending imposes certain restrictions on the data, namely, that it has to be identified and collected in the same form over an extended period of time. This restriction can nullify (take the life out of) data, and may result in extended but ultimately meaningless data trails. Proactive indicators need to be responsive to current conditions; hence, it is necessary to review indicators regularly and to update them as plant conditions change. These changes may occur after an outage as a normal part of the general plant review or after an adverse event or third-party report.

Allowing for such flexibility, it is important to keep control of the data collection process by reviewing indicators for accuracy, reliability, responsiveness, and costs associated with

collection. A quarterly review of the indicators should be encouraged. As one site's project manager noted, "You never get it all right on the first pass." For example, depending on the current health of the plant, you can expect to find that some indicators will flat-line and show no response. While such stability is highly desired in safety monitoring processes, it fails to indicate the more subtle changes associated with faint signals and emerging concerns.

> *In the early stages of seeking leading indicators of organizational health, it is far more important to start than it is to get it exactly right the first time. The process will self-correct as the meaning of the various indicators becomes clear.*

Integrate Leading Indicators of Organizational Health With Other Plant Initiatives and Programs

The quarterly document arising from the discussion of the leading indicators should be considered part of a plant's self-assessment program, and actions generated as a result of the document should be considered part of the plant's corrective action program. Establishing a place for Leading Indicators of Organizational Health in these already established programs will solidify and validate its presence.

In sum, Leading Indicators of Organizational Health represents a significant departure from traditional data-trending activities at a plant. The goal is not simply to collect data; it is to improve organizational health and, thus, plant performance in the long run via a focused and ongoing dialogue (a collective sense-making supported by data) of how a plant might achieve and sustain significant improvement associated with the seven themes of organizational health.

> *"The process is the product." We are now able to lock in key people, and we are starting to pay more attention to human performance issues. It's even spreading to our fossil plants. Personnel at these plants have received Reason's book and been asked to become familiar with the models and the language. The common vocabulary is spreading.*
>
> *Al Jones, PM, Ginna*

Ultimately, Leading Indicators of Organizational Health is intended to provide senior leadership with a stream of informed hunches about the future. Initially, many insights could be discovered that warrant change at a utility. The important consideration is that continuous fine-tuning of the focus of Leading Indicators of Organizational Health over the long term will continue to provide new hunches about the future.

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4
RESULTS ACHIEVED TO DATE

PAOWF has been successfully deployed at two nuclear power plants and is under development at several others. Leading Indicators of Organizational Health is employed in some form at two plants and is under development at another. Important lessons have been learned from these implementations that are useful for other plants considering implementation of these tools.

PAOWF—Success Stories and Lessons Learned

The applications of PAOWF at the two plants have been quite different for several plant-specific reasons, but both plants demonstrated success. The following are the key characteristics of the application of PAOWF at Plant A:

- The applications at Plant A were more extensive and so far have been aimed at the maintenance craft. The evidence to date shows that used at this level with proper forethought and design, PAOWF, as one project manager said, "really taps in to what the craft personnel are thinking and what it is like to come to work every day."

- Plant A used the front-line workers and supervisors to help define the questions that were used in PAOWF. This was seen as an important step in creating ownership of PAOWF and making it directly relevant to the work

- PAOWF was found to be effective in identifying meaningful information associated with two particular situations of concern to Plant A:

  - PAOWF provided information about human performance issues to the plant management that was independently identified during a visit by INPO. This experience gave the management confidence that using PAOWF reduces the likelihood of surprises during INPO visits. The convergence of the PAOWF data and the INPO findings has strengthened the management's confidence in using PAOWF.

  - Plant A wanted to evaluate their own experiences in an area identified in an INPO report on electric shock events. A particular set of issues was identified, and PAOWF was used in a focused way to gather data associated with these issues from about 20 managers, engineers, supervisors and craft workers. Using PAOWF in this specialized way allowed Plant A to validate the opinions of local experts and the INPO report as to the reasons for Plant A's success in this area, as well as identifying potential "holes" in their defenses. Again, this experience confirmed the validity of PAOWF to the plant management and workers.

- Plant A emphasizes to its staff and management that it is not possible to "get it all right on the first pass." Even though PAOWF was first implemented over two years ago, it is still considered a trial system. This encourages the idea that it can be adapted and modified to new or special issues, such as the electrical shock issue, and that questions can be revised and updated.

- One area where additional efforts are planned at Plant A is in promoting the feedback of results and uses of data to the workers. One approach under consideration is to provide online live feedback via the plant intranet.

> *Using PAOWF as a survey tool, we were able to quickly and extensively validate the findings of our local experts. PAOWF provided access to more respondents, immediate results, and the opportunity to gather more information from the respondents. In addition, several opportunities for improvements were identified by the team and validated by PAOWF.*
>
> *Al Jones, PM, Ginna*

At Plant B, the first application of PAOWF was not successful, largely because the supervisors and managers were not initially prepared for using and responding to the data. However, Plant B has reconsidered how to use PAOWF in a different way, and the system is now in operation. The following are the primary features and lessons learned in this plant:

- PAOWF is now aimed at supervisors and managers providing data, not the workers. This has been seen as a way to build the needed support for PAOWF among the supervisors before working with the frontline workers again.

- There are four modules for PAOWF data. Three are used to collect and report observations associated with training, safety, and human performance. The fourth module is a self-assessment module, allowing the supervisors and managers to report on their own work and identify problems and bottlenecks. The first three modules are used extensively; the self-assessment module is used less.

- Additional modules are under development. These are associated with Operations management observations, radiation practices observations, and feedback from customers of the Nuclear Overview Group reports.

- Requests for ratings are sent out on a weekly basis by the Lotus Notes system to randomly selected recipients from the supervisor and management pool. Over 1,000 data entries have been received so far.

- With the emphasis on using PAOWF as a tool for gathering observations, the staff at Plant B is seeking to use their hand-held devices (Palm PDAs) to collect and then transfer data into the PAOWF system. In other words, the current users are trying to simplify and extend the uses of PAOWF.

Leading Indicators of Organizational Health—Success Stories and Lessons Learned

Compared with PAOWF, Leading Indicators of Organizational Health has been in use for a much shorter time. However, longer time in use at a plant is needed for the leading indicators to produce compelling evidence for management intervention. Therefore, the opportunities to learn extensive lessons and to achieve demonstrable success stories have been much less to date. Three utilities have started to implement Leading Indicators of Organizational Health.

Plant A has implemented Leading Indicators of Organizational Health, and data gathering and analysis are under way. The following are the important findings from Plant A:

- The most important success to date at Plant A is the way the seven themes and the development of the issues have structured and extended the conversation throughout the plant's management about the importance of the higher-level organizational influences in managing safety and human performance. These concepts have provided a common vocabulary for an area that most nuclear industry people find too abstract. Discussing the themes and related issues has helped the management team focus on what approaches need to be taken by plant management to control these concerns. To quote the senior vice president of production, "The process *is* the product."

  The utility is now spreading the language and concepts associated with Leading Indicators of Organizational Health to the non-nuclear parts of its business.

- All indicators initially selected at Plant A were chosen on the basis that the data already existed at the plant and that no extra data collection was needed. This was seen as a great efficiency.

- As a plant improves its performance, the indicators that are initially attractive and meaningful to managers are rendered uninformative simply because few "bad things" happen, even low level events such as employee disciplinary actions. Therefore, the selection of indicators must not be cast in stone, but allowed to evolve over time. This natural emergence of indicators will take time and is contiguous with the evolution of the concepts and language among the participants, as mentioned above.

> *For Southern Nuclear, the big picture is to select a few issues that we think are important to human performance and then track those issues. When we did that, we were surprised to see that we weren't necessarily getting what we anticipated. But as we talked to the people, as we continued to focus on what we thought was important to human performance and reinforce expectations, the performance started to change. For example, in the Just Culture theme, we identified "negative reinforcement as a corrective action" to be one of our issues. We were surprised to find that we did quite a lot of counseling the person to close the item instead of fixing the process. As we focused on this item, people changed how they closed similar items, so now we're really fixing more problems. That's good for human performance.*
>
> *Phil Crone, Licensing Supervisor, Southern Nuclear*

Plant A integrated the use of PAOWF, Leading Indicators of Organizational Health, and the INPO Human Performance Fundamentals together in its human performance training program.

As a result, the plant found that it could help all plant people (secretaries and clerks as well as technical, operational, and managerial staff) to see the big picture of human performance and how all these initiatives fit together as a coherent body of ideas and a management philosophy that has practical applications for all parts of the company. Human performance is no longer a special issue but just part of the way that work is done at Plant A.

At Plant B, a brainstorming session to generate candidate leading indicators of organizational health initially identified 74 potential indicators. The participants are using a weighting procedure to shorten and prioritize the list. However, their priority is PAOWF.

At a multi-site utility C, leading indicators of organizational health for several of the main themes were developed at a departmental level. The trends in department level indicators, given to managers, provide a basis for coordinated effort among the three sites. In its second year of using Leading Indicators of Organizational Health, Utility C has revised the originally selected set of leading indicators of organizational health to continue to extract useful information and to reinforce what they consider to be the most important issues. This illustrates a significant lesson evident from the development of Leading Indicators of Organizational Health—that most sets of leading indicators will continue to need adjustment to continue to yield meaning.

Statistical Evaluation of Leading Indicators

The project plan to develop leading indicators of human performance considered the possibility that leading indicators of human performance could forecast changes (improvements or declines) in overall station results. A study was performed to determine if forecasting ability could be statistically verified. EPRI's Strategic Science and Technology (SS&T) Human Performance Program performed the evaluation of the *Predictive Validity of the Leading Indicators of Organizational Health* [1].

The purpose of this study was to examine the statistical relationships between the leading indicators of organizational health then in use at Plant A and a range of the plant outcomes associated with economic, reliability, and safety performance. In addition, potential relationships between the leading indicators of organizational health and measures associated with outage performance—for example, its duration—were assessed using formal statistical tools. In addition to data for Plant A, data from another plant were analyzed using the same concepts. This plant had developed indicators of organizational performance different from the process used for the leading indicators of organizational health.

This analysis used a statistical technique (cross-correlation function) that examined potential relationships between the indicators and the plant outcomes that assessed the degrees of correlation at different lead times between the measures. For the outage measures, two outages were compared—one that was called the "best outage performance ever" and a second outage where significant delays occurred. Statistical "t" tests were used to assess whether the difference between performance of the indicators in the period before each outage was significant.

Unfortunately, difficulties in applying these techniques in appropriate ways occurred because of limitations in the data sources. These were:

- Insufficient data existed at the second plant (15 data points—that is, 15 months of data—compared with an ideal set of at least 50 data points per indicator) for valid statistical analyses using the appropriate tools.

- There was very little variation in most of the leading indicators of organizational health. There was also very little variation in the plant performance outcome measures for Plant A. Most measures were "0" for the entire period. Therefore, no meaningful correlations could be made with such flat-lined data.

- For some of the indicators, there was a problem (from the analysis point of view) with definitions of indicators changing over the period of analysis. These changes typically occurred because management wanted to improve the measures being used for other reasons (for example, excluding contractors from a particular measure at the end of one reporting period). These changes made it impossible to use the indicator beyond one reporting period (typically 12 months or one fuel cycle, depending on the measure) and, therefore, restricted the data to less than the 50 points needed for analysis.

- In other cases, management responded to incipient problems detected by leading indicators of organizational health. From the plant perspective, this was obviously appropriate; if management observed an increase in backlogs and addressed the resource requirements, then the plant performance benefited. However, the response to the incipient problem often prevented the consequences of the problem from being observable in the plant outcome data. The project team believes that the management prerogative to intervene clearly outweighs the researcher's desire for statistical accuracy. This practical constraint leads to the conclusion that Leading Indicators of Organizational Health probably will never be objectively proven to have predictive ability.

- Concerning the analysis of differences between the outages, several indicators suggested problematic situations for the upcoming outage. These were:

  – Increasing maintenance backlogs

  – Less preventive maintenance activities

  – Fewer man-hours worked

  – Less training provided

  Plant management agreed that these situations contributed significantly to the problems of the outage. Because of the responses to these problems, the plant management termed the following outage the "best ever."

In general, this analysis was considered successful as an exploratory process. However, the study concluded that real-world limitations with the data associated with leading indicators of organizational health would often prevent a complete scientific validation. Reasons include the sparseness of the data, variations in definitions and scope from one reporting cycle to another, and the fact that management (rightly) acts on the same data before the situation impacts measurable plant performance.

Conclusions

- PAOWF was successfully applied in a variety of situations and yielded useful information to local managers and supervisors. Stations continue to expand the applications of PAOWF.

- Leading indicators of organizational health were developed, and stations are gathering data. The process of evaluating the data is a participative process that helps to improve performance by shaping the dialogue among station leaders.

- The PAOWF and Leading Indicators of Organizational Health tools were developed as generic tools for application to specific situations at plants. Plant personnel at the trial sites discovered uses for the tools that the research team had not even envisaged. This diversity of application speaks to the flexibility of the tools and the benefits that can accrue from customizing the tools.

- The value of these tools at the participating stations was qualitatively demonstrated.

- It is not likely that quantitative evidence of the value of these tools will be available soon. However, PAOWF and Leading Indicators of Organizational Health provide current value by focusing station leaders on important issues and providing additional perspective on ongoing activities.

> *Until six months ago, projects were independent; now there's a concerted effort to pull it all together. PAOWF and Leading Indicators of Organizational Health are discussed in the HP training that is given to everyone at the plant. Consequently, people are starting to see the big picture… The plant now has a better focus on HP; it's not "strange." It's become part of the daily process and plant language.*
>
> *Al Jones, PM, Ginna*

References

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5
THE ROLE OF LEADING INDICATORS IN THE EVOLUTION OF THE NUCLEAR INDUSTRY

From Reactive to Proactive Measures

The significant performance improvements in safety by the nuclear power industry in the last 10 to 15 years are largely the results of carefully crafted responses to problems that have been found and analyzed in plants. That is, careful attention to analyzing events for significant contributing factors and developing appropriate responses to these factors have led to reductions of an order of magnitude or more in the numbers of unwanted automatic scrams and significant events. This approach is *reactive*; that is, it relies on events to occur to provide a basis for investigating the causes of the event and then reacting to them.

While improvements in safety have been occurring, economic pressures have resulted in efforts to raise productivity. In response to these needs, the industry has significantly reduced the cost of generation, and the average duration of a refueling outage has shrunk by about a factor of 3. A common view of the interaction between the need to improve safety and the need to raise productivity is shown in Figure 5-1 [1].
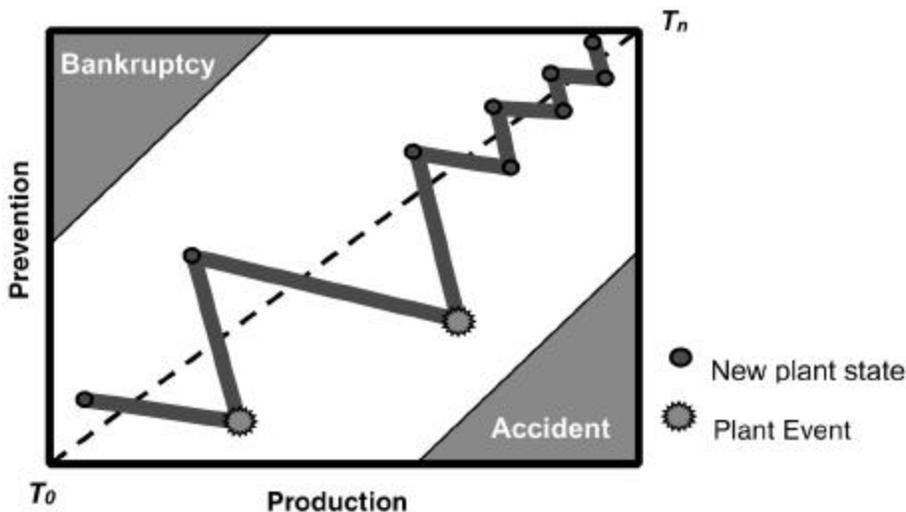

Figure 5-1
Cycles Between Production and Protection Investments

This figure shows the commonly occurring drift from an intended level of safety because events are sparse and the production pressures are compelling until some salient event occurs and

directs the attention of the management and staff back to the issue of safety. Resources are then added to the safety area; but with time, the same drift recurs until another salient event occurs. And so the cycle continues.

While this approach proved successful over the last decade or so, there are limits to the approach. First, its very success is eliminating the basis to learn safety lessons from experience; fewer and fewer events occur to provide a basis for reacting. This is true both for individual plants and for the industry collectively. This reduction in events limits the ability of plants to calibrate themselves as to the their current level of safety. When everything is running smoothly, determining where the edges of safety performance are is difficult.

In addition, the Nuclear Regulatory Commission (NRC) implemented a new performance-based oversight process that relies on judging licensee performance less on the occurrence of major events and more on day-to-day performance as reflected in performance indicators, such as the number of unplanned power changes, the availability of safety equipment, and the leakage rate for the reactor coolant system. Further, the NRC is emphasizing the importance of the crosscutting issue of problem identification and reporting. These NRC priorities increase the attention on the behavior of the organization in handling low-level events, and increasingly, on the behavior of the organization to prevent such small events.

Apart from the evolving influence on safety, the economic costs of learning from events are such that no utility can afford to wait for events as a routine approach to business. The effect of deregulation on the electric power market has been to create the potential for dramatic cost penalties to utilities for unplanned outages.

The consequence of these changes is to move the emphasis of management oversight from reactive to *proactive* measures. Proactive measures are intended to provide information to plant management about the potential for performance problems, particularly problems associated with human performance.

Because the proactive measures do not rely on events to provide a structure for selecting the important factors to monitor, it is important to use some kind of model or set of models for selecting the important factors that will influence performance.

One such model that has received considerable support is the model of organizational accidents developed by Reason [1] (see Figure 5-2). This model shows that the unsafe actions by the frontline workers (for example, the operators, maintenance crafts technicians, and health physics technicians) that create the breaches of defenses are very often the results of local workplace factors. These factors—which include the work environment, the procedures, and task training—are in turn strongly influenced by the broader organizational factors discussed below.
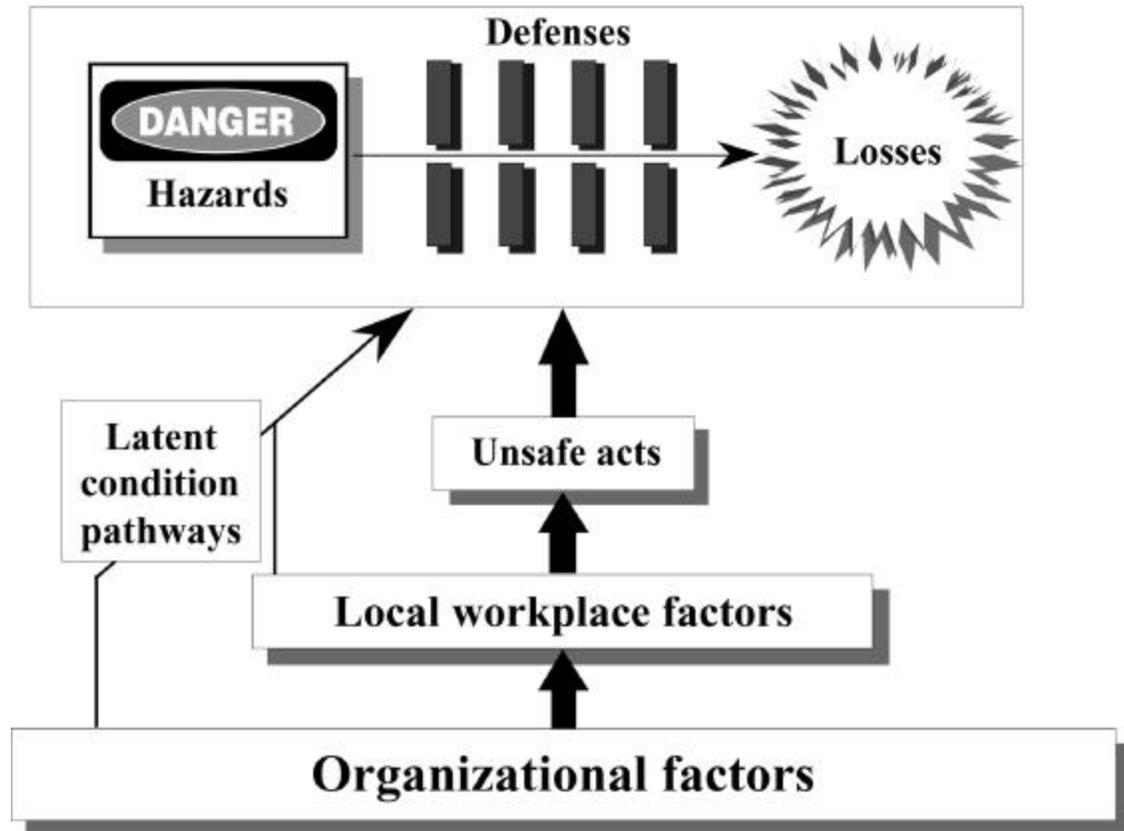
Figure 5-2
Reason's Model of Organizational Accidents

To summarize, a clear relationship exists between the EPRI leading indicators of human performance project and Reason's model. PAOWF provides a tool to monitor the local workplace factors, that is, the conditions that exist in the workplace that influence people *as* they work. Leading Indicators of Organizational Health provides a tool for monitoring the organizational factors, that is, the conditions that exist elsewhere in the organization that influence how workplace conditions are established. Until now, there has been little direct measurement of organizational factors as they affect plant results. Therefore, there has been little demand for recommending specific changes in response to organizational factors. Leading Indicators of Organizational Health provides the basis for identifying specific organizational factors to which leaders will want to respond. Needed next in the evolution of the industry's efforts to sustain improvement will be methods to determine what actions to take in response to changes in Leading Indicators of Organizational Health.

The Way Forward: Organizational Factors and Performance Improvement

The previous section described the accomplishments of the nuclear industry over the last decade or so in improving performance, particularly with respect to the improvements in human performance. As EPRI continues to develop ways to support the performance improvement process, its focus is shifting to organizational factors, the next tier shown in Reason's model.

EPRI recently held a workshop to explore the best way to support the industry efforts in this area. The results of this workshop are presented in *An Integrated Framework for Performance Improvement: Managing Organizational Factors* [2]. This workshop aimed to increase the communal understanding and objectivity of ways to control organizational problems as part of the overall performance improvement mission.

Workshop attendees recognized that many researchers and utilities are converging on a common understanding of organizational factors. Specifically, there is consensus that the development of tools and techniques for addressing organizational factors is now possible. Such tools and techniques would address both the diagnosis of organizational conditions at different levels throughout the site and the design of appropriate interventions given the prevailing conditions. An integrated, structured process is needed to successfully develop these tools and techniques. .

A new conceptual landscape has begun to emerge in the nuclear industry, starting with IAEA identifying the importance of safety culture [3]. "Organizational factors" began to appear as a key phrase in the nuclear industry in the early 1990's [4], and the term "organizational accident" was coined by Reason [1] to reflect this broader and deeper etiology. The current state of international agreement appears to be that beyond the person who touches the equipment, it is also important to consider the workplace, which is the product of several interacting organizational considerations or issues (for example, resource allocation, prioritization, training, supervision, quality of leaders, procedures, structure, culture, and so on indefinitely). These organizational issues shape overall performance by constraining or promoting error. [2]

This report is a final report on the development of Leading Indicators of Organizational Health. With the initial work complete, it is time for further cooperative work between utilities and researchers as follows:

- Apply PAOWF and Leading Indicators of Organizational Health to the performance-improvement process in a diagnostic manner

- Share the knowledge gained among industry participants

- Identify specific relationships between latent organizational conditions and leading indicators of human performance

- Develop advice regarding what actions to take at various levels of the organization in response to the latent conditions

References

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A
PROCESS FOR IDENTIFICATION OF CANDIDATE LEADING INDICATORS OF ORGANIZATIONAL HEALTH

The information is this appendix was previously published as Appendix D of *Guidelines for Trial Use of Leading Indicators of Human Performance: The Human Performance Assistance Package.* EPRI, Palo Alto, CA: 2000. 1000647.

This appendix provides four lists of candidate leading indicators of organizational health. The first was developed at an industry workshop; the other three were initiated at plants.

The overall process for identification of organizational indicators in this program is a top-down development process. The highest level in the process is the identification of themes from which general issues are identified. The general issues are the manifestation of the themes in organizational processes and issues. Some of the issues are more narrowly interpreted into the way nuclear power plants are organized and operated. While the themes are generic and relevant to all NPPs, it is recognized that issues vary from one plant to another. Therefore, developing a set of indicators that are relevant and appropriate must be a plant-specific activity.

A culling process is necessary to arrive at a final list of indicators. The development cycle requires the generation of a long list of candidate indicators to determine what data may be available and in what form it may be available. Then, the practical concerns of data collection, data quality, and data reliability have to be considered. Indicators that were initially appealing may be dropped if they fail to be easily quantified and recorded. Conversely, new indicators may emerge in the search for existing or new trending data. After this second phase identifies the subset of suitable indicators, the list can be reviewed to see if all themes are represented. Note that each theme does not have to be represented by an equal number of indicators. It is possible that some themes may have only one or two indicators; others have five or more. The final list of indicators will be a qualitative and quantitative articulation of the proactive management themes.

The process of finding appropriate indicators can be frustrating. One role of the beta trials is to find better ways of creating the list of indicators. Existing lists will be integrated and published as a kind of brainstorming and initial starting point from which other sites can develop their own lists.

Industry Workshop

Table A-1 shows how each theme was translated into issues and then further specified into potential indicators during the industry workshop.

Table A-1
Themes, Issues, and Potential Indicators

Theme	Issues	Potential Indicators
Top level commitment	Human performance (HP) matters are important to senior management	HP matters recurring in senior management meetings
		HP matters featured in job requirements/specifications
		Line managers rewarded for tackling HP problems
	Resource allocation	Lead HP person reporting level
	- Staffing	HP staff status
		Number of HP staff
		Involvement of HP staff in wider HP community
		HP staff expertise
		HP status and focus of root-cause analysts and QA/QC auditor
	- Systems	HP training for non-specialist staff
	Management systems sensitive to HP	Systems that monitor HP issues
		Fraction of self-assessments that contain a human-performance component
		How often HP issues are monitored/assessed beyond regulatory requirements
		Where do HP data go up the management chain
Awareness	Data gathering	Analysis of HP events and related root causes
		Proactive HP data gathering and analysis
	Reporting	Strength of reporting culture
		Adequately low threshold for reporting of HP issues
		Reporting process that is user friendly and encourages use
		Reports that are confidential or anonymous
	Collection and analysis	Data analysis based on HP principles
		Analytical tools sensitive to HP problems and precursors
		Analysis revealing recurring problems and error-producing situations
	Dissemination	Visible and obvious feedback occurs
		Data reviewed by senior management
	Uses of data	Management acting on data in timely manner
		Demonstrable connection between data analysis and remedial actions

Table A-1 (cont.)
Themes, Issues, and Potential Indicators

Theme	Issues	Potential Indicators
Preparedness	Both commercial and safety hazards considered	Number and comprehensiveness of planned-for crisis scenarios
		Crisis plans based on sound HP principles
		Crisis plans including business recovery plans
		Plans actively reviewed and considered "live"
	Training for crisis responses	Crisis training beyond minimum requirements
		Training linked directly to crisis plans
		Crisis rehearsals involving collaboration with local, state, and/federal emergency agents
		Crisis rehearsals performed more frequently than legal minimums
Flexibility	Adaptability of management structure	Command and control structures prepared for all credible eventualities
		Encouragement for individuals to think for themselves vs. compelled to follow procedures
		Individual's expertise and special skills recognized and used by organization regardless of formal status
		Support of senior management for first-line supervisors to take initiatives in special circumstances
	Training of first-line supervisors	First-line supervisors trained to effectively manage novel or exceptional situations that lack procedures or management direction
		Line managers and supervisors trained to be aware of error-producing conditions
		Line managers and supervisors trained to take responsibility when conditions arise
Just culture	Who gets punished for what?	
	Is there a clear distinction between unavoidable errors and unacceptable actions?	
	Who is involved in deciding disciplinary actions?	
	Does the disciplinary system inhibit the reporting of errors and near misses?	
	Are peer assessments involved in determining the outcome of disciplinary investigations?	

Table A-1 (cont.)
Themes, Issues, and Potential Indicators

Theme	Issues	Potential Indicators
Learning culture	"Band-Aids" and "work-arounds" as a normal way of life	Number, duration of temporary modes, procedures, systems out-of-service
	Responses to HP problems	Fractions of corrective actions: discipline/counsel, retrain or new procedure, systematic changes
	Has the organization radically reviewed or modified its structures and practices in response to some event--business as well as safety or economic events?	
	Do the same or similar HP problems keep recurring?	Number of repeat causes or corrective actions for event classes
	How long is the utility or plant memory?	
	How are whistle-blowers or bearers of bad news treated?	
	Has the management system adopted the equivalent of the "ORCA" (observe-reflect-create-act) learning cycle?	
	How is change managed?	
Opacity	To what extent are management and technical staffs aware of the current integrity of the system's defenses?	
	To what extent are the strengths and weaknesses of the human understood and catered for within the working environment?	
	How does the organization create the requisite variety in its policy and project groups?	
	How does the organization combat the process of "forgetting to be afraid?"	

Plant A

Plant A adopted the seven themes and developed their own plant-specific set of issues associated with them. Potential data sources at the plant were then reviewed for each issue to select individual candidate indicators. Table A-2 lists the initial candidate indicators of Plant A.

Table A-2
Candidate Indicators for Plant A

Theme	Issue	Candidate Indicators
Management Commitment	Personal commitment	Percentage of HP incidents discussed by the Performance Enhancement Review Committee (PERC)
		Percentage of times that meaningful discussion of HP topic is included in Nuclear Board of Directors meetings, VP staff meetings
		Number of separate HP day meetings
		Number and quality of Management Observations, using Behavior Equals Accident Reduction (BEAR) methods for determining quality
	Programs/training	Number of hours of HP-related training given in which the instructor is not from Training and is at least two levels above the target audience
		Number of observations on training with meaningful feedback included (already part of training program health indicators)
		Training program health indicators
		Industrial Safety and ALARA program health indicators
		Note: We propose that the self-assessment program be developed into program health and that its indicators feed here.
	Resource commitment	Number of HP day man-hours
		Percentage of ongoing overtime for Ops/Chem/Radwaste, Maintenance, RP (hands-on groups)

Table A-2 (cont.)
Candidate Indicators for Plant A

Theme	Issue	Candidate Indicators
Awareness	Knowledge seeking	Number of times program health results/issues are reviewed by the management team.
		Number of hours spent in HP steering committee
		Percentage of managers attending monthly PPR meetings
		Percentage of HP incidents PERC'd (or PIRC'd)
		Percentage of HP incidents reviewed by Corrective Action Review Committee (CARC)
		Number of hours spent by managers in the radiologically controlled area (RCA)
		Percentage of HP issues getting root cause analysis
		Number of proactive site wide HP initiatives/programs (partial credit for departmental efforts - scaled by ratio of effected people to site population)
		Number of good catch awards
	Issue reporting	Number of HP reports issued per month
		Number of Management Observation Reports (MOPs) with quality findings
		Distribution of HP issues throughout the five levels of SmartForms (SMFs) (ratio of number of level 1 HP events to Number of level 2, level 2 to level 3, etc.)
		Percentage self-reported HP SmartForms
	Fault tolerance	Self-assessment program health indicator (proposed to be developed)
		Percentage of annunciators, safety SMFs, etc. that are addressed in required time constraints
		Number of operator + maintenance workarounds
Preparedness	Proactive	Percentage jobs that have defense-in-depth plans
		Emergency Preparedness (EP) program health indicator
		Total manhours spent in prepared/contingency training vs. job proficiency training
	Reactive	Ratio of corrective maintenance to preventive maintenance work orders
		Ratio of unplanned to planned work orders
		Percentage of planned versus unplanned-limiting condition of operation action statement entries
		Total days. Any unplanned manual or automatic trip counted every day from the trip to the return to 100 percent. Any unplanned downpower > 20 percent counted every day from the start of the downpower to the return to 100 percent.

Table A-2 (cont.)
Candidate Indicators for Plant A

Theme	Issue	Candidate Indicators
Flexibility		Number of cross-discipline qualification cards (or percentage of qualification cards completed outside job requirements)
		Average number of signatures per SMF needed to close
		Average time to close a SMF
Just Culture		Percentage of HP issue SMFs self reported
		Percentage of corrective actions that are discipline- or counseling-based
		Absenteeism
		Staff turnover
		Number of Safeteam + QA hotline + NRC complaints
		Number of union grievances
		Ratio of high level to low level event SMFs
		Ratio of supervisors/managers on positive discipline to workers on positive discipline
		Number of good catches
	Knowledge seeking	Percentage of HP issues receiving root cause/HP analyses
		Percentage of training requests submitted by non-training personnel
		Number of man-hours spent on "reform learning" vice proficiency training (for example, training for new modifications)
		Number of self-assessments, peer reviews, benchmarking trips, industry contact meetings
		Industry Operating Experience Reports evaluated as Percentage of total screened (or number of Industry Operating Experience Reports (IOERs) evaluated)
		Number of good catches
		Percentage of SMFs with root cause codes (assuming this becomes an optional feature for levels 3, 4, and 5)
		Percentage of training no-shows
	Fault tolerance	Number and duration of temporary modifications
		Number of operator and maintenance workarounds
		Budget for non-staff augmentation consultants
		CIAs + Simulator Action Requests that are reform oriented
		Ratio of BEAR action plans to observations (or number of action plans)
		Number of label requests/hung (non-new equipment)
	Results	Ratio of INPO beneficial practices to INPO issue findings
		Number of NRC/INPO/JUMA findings not found by utility
		Ratio of non-cited to cited violations
		Days of Excellence

Table A-2 (cont.)
Candidate Indicators for Plant A

Theme	Issue	Candidate Indicators
Opacity	Knowledge seeking	Number of quality Management Observations
		Number of self-assessments
		Number of BEAR Observations
	Diversity	Distribution of executive to manager to supervisor or quality Management Observations
		Number of INPO assists, JUMA, and peer reviews
		Number of utility peers participating on evaluations, self-assessments, and JUMA reviews
		Number of non-departmental people participating on self-assessments
	Results	Days of Excellence
		Number of NRC/INPO findings not previously noted

Plant B

Like Plant A, Plant B adopted the seven themes described earlier. Senior utility staff (senior vice president and vice president levels) reviewed the themes and associated issues and generally endorsed them and their associated issues. In addition, the plant adopted the principle that no new data would be gathered beyond what was already being gathered for other purposes. Since the plant already had an extensive performance-indicator program in place, it was considered unlikely that other relevant data would exist. Also, given the extent of current reporting systems, the plant management would probably not be willing to create new and extensive data systems.

Table A-3 shows the candidate indicators for Plant B.

Table A-3
Example Indicators for Plant B

Theme	Issues	Candidate Indicators
Top level commitment	HP matters are important to senior management	Time spent by CEO or SVP, or frequency of visits to Plant B
	Resource allocation	
	- Staffing	Total training budget (dept 50)
		Fraction of workers assigned to training who attend
		Amount of overtime worked (dept 49)
		Difference between time scheduled and required for jobs
	Management systems sensitive to HP	Fraction of action reports containing HP components
		Fraction of errors that are self reported
Awareness	Data gathering	Ratio, Licensee Event Report (LER)/event investigations/ACTION reports
		Observations of field activities by management
		Observations of training by line supervisors and management
		Observations of training by non-line supervisors and management
	Reporting	Fraction of event reports that are self reported
	Collection and analysis	Fractions of LERs, event investigations and ACTION reports identifying human performance components
		Active involvement of line management and supervision in providing critical feedback on the quality of instruction provided in the areas of responsibility
	Uses of data	Fraction of HP problems from ACTION reports that are trended and reported to management
Preparedness	Both commercial and safety hazards considered	Time horizons for business plans
		Mean time between revisions of business plans
		Fraction of business strategies that are completed on time
	Preparedness training	Curriculum committees address training content and schedule proactively (beyond next quarter)
	Hardware preparedness	Ratio of emergent to total equipment work orders
		Ratio of preventive to corrective maintenance man-hours
		Ratios of priority 1 and 2 work orders to scheduled work orders
		Ratios of priority 1 and 2 work orders to total work orders
	Work backlogs	Note: Fourteen potential indicators are listed in the Performance Monthly reports.

Table A-3 (cont.)
Example Indicators for Plant B

Theme	Issues	Candidate Indicators
Flexibility	Training of first-line supervisors	Number of exchange visits by supervisors to other plants, facilities
		Ratings of supervisory and team leader skills & knowledge
	Flexibility of organizational processes	Fraction of team-based responses to problems
		Fraction of workers who are cross-trained
	Adaptability of training	Timely training and materials provided on all plant procedure changes
		Timely revisions of training procedures and guidelines
Just culture	Are employees "happy"?	Employee satisfaction index
	Who gets punished for what?	Employee terminations (number and reason)
		Disciplinary procedure initiated (number and reason)
	Does the disciplinary system inhibit the reporting of errors and near-misses?	Fraction of event reports that are self reported
		Fraction of event reports that are anonymous
	Consequences of a lack of a just culture	Rate of absenteeism and labor turnover
		Rate of reporting of employee concerns
		Rate of employee concerns reported to NRC
	Types of corrective actions	Ratio of corrective actions involving disciplinary actions
Learning culture	Band-Aids" and "work-arounds" are a normal way of life	Number of temporary equipment modifications
		Number of temporary procedure modifications
		Number of systems out-of-service
	Responses to HP problems	Ratio of corrective actions involving discipline/counseling/retrain or change procedure/systematic changes
	Do the same or basically similar HP problems keep recurring?	Fraction of events involving repeated corrective actions
	How long is the utility or plant memory?	Comparison of data in performance monthly reports with YTD, previous year, or earlier
	Has the management system adopted the equivalent of the "ORCA" (observe-reflect-create-act) learning cycle?	Number of reviews of organizational effectiveness: self-assessments, peer reviews, INPO assist visits, and other (non-mandatory) assists
		Use of industry operating experience
	How is change managed?	Timely revisions of training procedures and guidelines
		Timely training and materials provided on all plant procedure changes

Table A-3 (cont.)
Example Indicators for Plant B

Theme	Issues	Candidate Indicators
Opacity	Availability of information about quality of plant defenses	Ratio of LERs/event investigations/ACTION reports
		Ratio of consequential/non-consequential event reports
		Fraction of human performance problems reported and trended by management
		Availability and use of PAOWF data
		Numbers of walk-around observations by supervisors and managers
		Number of deficiencies in defenses identified by third parties not identified first by the plant

Utility C

Utility C (a multiple-plant utility) took a different approach in identifying indicators of human performance. Originally pragmatically based without relying on the specific themes, in the second year of effort further refinement has occurred. The relationship among the indicators currently in use and the themes is now clear as indicated in their current definitions. The utility intends to apply a common set of Leading Indicators of Organizational Health across all plants within the utility.

The following describes the current list of indicators and their relationship to the themes.

A. Performance Area (Leading): Top Level Commitment

The purpose for measuring Top Level Commitment is to assist in demonstrating interest by senior management; however the data is objective in that changes in the trends do not represent management commitment.

Performance Indicators

1. **Overtime/Excess Straight Time** : High work hours lead to fatigue induced error. Reliance on routine overtime may indicate a weakness in organizational processes or values.

    a) Parameters:

    1) Any time, paid or unpaid, worked beyond a regular work shift is included.

    2) "Built-in" overtime is included.

    3) The plant computerized timekeeping system is to be used to determine actual overtime/excess straight time worked.

    4) Management, supervisory, and salaried employee excess straight time should be included, if available.

5) Paid or unpaid leave, such as holidays, vacation, or sickness counts as time on shift.

b) Measurement method: (total OT + total EST / total employees), for time period, by department

c) Example: Department 01 has a total of 50 employees. Some of the employees are on "straight eight" hour shifts, while others are on "4-tens," and others on "rotating twelves." The time worked in addition to these standard shifts, due to shift turnover, weekend work, etc. was 8000 hours. This would be credited to the department as an overtime rate of (8000 / 50) = 160 hours per department employee.

B. Performance Area (Leading): Awareness

Individual awareness of the principles of human performance necessarily precedes human performance improvement. "People achieve high levels of performance based largely on the encouragement and reinforcement received from leaders, peers, and subordinates. Events can be avoided by an understanding of the reasons mistakes occur and application of the lessons learned from past events." (INPO Excellence in Human Performance)

Performance Indicators

1. **Human Performance Training:** This is a measure of the amount of formal training received on topics directly relating to human performance. The expectation is that human performance training is an integral component of human performance improvement; and that conversely, if training is discontinued or minimized, human performance will deteriorate.

   a) Parameters:

      1) Training must be on human performance fundamentals, OR

      2) Training must be on behaviors/techniques that minimize human error, OR

      3) Training can be review of industry or site events directly tied to human performance.

   b) Measurement method: (student-hours / total dept. personnel) / time period, by department and by plant.

   c) Example: Department XYZ has 300 employees. During a calendar quarter, 150 dept. employees are trained for one hour on 3-part communication, while 50 receive training on the flow loop simulator for 16 hours. The simulator instructor estimates that half the simulator time was directly involved in techniques for human error reduction. Department XYZ would be credited with (150 x 1 + 50 x 8) / 300 = 1.8 hours / person / quarter.

C. Performance Area (Leading): Preparedness

Organizational processes should facilitate and support the human activities involved in plant operation and maintenance. High backlogs represent untimely correction of identified problems in these processes, increasing the likelihood of human performance errors.

Performance Indicators

1. **Procedure Revision Requests:** Incorrect or unclear procedures lead to human errors by increasing the possibility of the procedure user being placed in the knowledge based performance mode. A high number of procedure change requests correlates to a high potential for human error.

   a) Parameters:

      1) Procedure revision requests are counted if they are from procedure users, or from outside auditors, inspectors, etc.

      2) Procedure revision requests are not counted if they are from upcoming changes in plant design, licensing documents, organization, etc.

      3) Procedure revision requests are counted not only for procedure content corrections, but also for clarifications or enhancements (human factors, editorial, etc.).

      4) Multiple change suggestions from one individual for one procedure are considered one revision request.

      5) Backlog is measured as the total, open procedure revision requests on the last calendar day of the time period (multiple requests for one procedure to be counted as one change).

      6) A procedure revision request may take any form, i.e., it can be verbal, written, e-mail, note, etc.

      7) Revision requests for the entire set of department procedures are counted, including procedure derivatives such as guidelines, instructions, etc.

   b) Measurement method: (total open procedure requests) at point in time, by department

   c) Example: On 6/30/99, Department AR has 10 procedure revision requests open with no work begun; 5 that have been incorporated into procedure changes that had not yet been approved by management; and has received an audit finding on errors in 2 procedures. In addition, one other procedure has revision requests from 5 different department employees (counted as 1). The department would be credited with a backlog of (10+5+2+1) = 18 procedure revision requests.

2. **Open Corrective Actions:** High numbers of open corrective actions for both in-house and industry events represents missed opportunities for preventing human error by correcting identified weaknesses.

   a) Parameters:

      1) Incomplete corrective actions equate to "open action items."

      2) Corrective actions counted include, but are not limited to, those addressing NRC violations, SAER findings, WANO/INPO findings, and plant deficiency control reports (either SORs, ORs, or CRs).

      3) Backlog is measured as the total actions open on the last calendar day of the time period.

      4) For a specific item with multiple corrective actions, each action is counted individually.

   b) Measurement method: (total open corrective actions) at point in time, by department

   c) Example: Department XYZ has 5 open SAER findings that have a total of 12 open corrective actions, 5 SORs (or CRs or ORs) with a total of 10 open corrective actions, 3 WANO items each with 2 corrective actions open, and one Information Notice open corrective action. The department would be credited with a corrective action backlog of (12+10+6+1) = 29.

3. **Percent of Planned to Unplanned (Emergent) Work**: Emergent work is new or revised work of high priority and of an urgent nature identified during a given workweek. As emergent work items develop, error likely situations are created. This is due to possible error precursors such as work load, time pressure, etc. It is intended to compare the number of emergent work items to the number of planned work items in order to acquire data demonstrating potential error likely situations.

   a) Parameters: the numbers of started emergent work jobs and started planned (scheduled) jobs are available weekly through the Workweek Manager.

   b) Measurement method: (total number of started emergent items during the month / total planned (scheduled) work started during the month)

   c) Example: If during a month there were 55 started emergent work jobs and 290 planned jobs that were started, the result is 55 / 290 x 100 yields approximately 19%.

D. Performance Area (Leading): Just Culture

A workplace culture that supports safe and reliable plant operation is one that cultivates open communication, that establishes positive reinforcement of desired behaviors, and that exhibits an understanding of the factors that cause errors to lead to events.

Performance Indicators

1. **Process Centered Corrective Action**: Human performance errors are caused not only by poor individual performance, but also by organizational factors. Merely "counseling" or "disciplining" involved individuals only perpetuates the blame cycle. Therefore, prevention of human performance events must include investigation of the organizational framework the individual was performing within.

   a) Parameters:

      1) Corrective actions are counted that address any item within the plant corrective action or deficiency identification programs.

      2) Only corrective actions are counted that consist of correcting organizational processes.

   b) Measurement method: (total process centered corrective actions) / (total corrective actions), for time period, by department)

   c) Examples:

      1) A system operator incorrectly implemented a clearance, causing a plant scram. Corrective actions consisted of entering the employee into the plant positive discipline program. This would be credited to the Operations department as people centered reinforcement and not as a process centered corrective action.

      2) A system operator implemented a clearance, which resulted in a plant scram. Investigation revealed a lack of understanding of the clearance procedure on the part of the system operator, as well as others. Corrective actions included refresher training on the procedure. This would be credited as process centered corrective action.

2. **Self-Identification of Problems:** This provides an indicator of the openness and candor of an organization, of its promotion of the importance of problem self-identification, and of its willingness to identify and capture its own problems.

   a) Parameters:

      1) A problem is considered self-identified if it was identified by the department that has responsibility to correct it.

      2) The term "problem" in this context is defined as a Significant Condition.

      3) Only problems classified as "human performance" will be tracked for this indicator.

b) Measurement method: (total human performance problems self identified / total problems), per time period, by department

c) Examples:

1) A maintenance mechanic identifies a leaking pipe flange, which is repaired by the Maintenance department. The pipe flange was leaking due to end of life of the material. This is not a human performance problem, and would not be tracked.

2) A maintenance mechanic identifies a leaking pipe flange, which is repaired by the Maintenance department. The pipe flange was leaking due to improper torque applied during a previous repair by Maintenance. This would be credited as a self-identified human performance problem.

3) An instrument technician identifies a problem with his calibration procedure, which is corrected by the Maintenance procedure group. This would be credited to Maintenance as a self-identified human performance problem.

4) An instrument technician pulls the wrong annunciator card while performing a calibration, causing an alarm in the control room. Operations writes a deficiency (or CR or OR). This would not be credited as a self-identified human performance problem.

3. **Turnover**: Increases in turnover (moves within an organization) create error likely situations.

a) Parameters:

1) Employee moves to and from new departments/groups.

2) Promotions within a department are considered moves within an organization.

3) personnel substitutions are considered turnover (for example Facilities' Helpers working with maintenance teams during outages)

b) Measurement method: (the number of employees added to the department and the number of employees moved from the department / the number of employees / department, on a 12 month rolling average)

c) Example: If Department A has 20 employees and one employee is transferred to another department but is replaced during the same month, the result is 2 / 20 x 100 = 10% turnover for the month. If during the next month 1 employee is transferred in or out of Department A, the result is (2+1) / 20 = 15%. This calculation is a running total by month on a 12 month rolling cycle. It should also be noted that if a SSS (formerly SFO) is promoted to a Shift Supervisor, this would be included in the calculation as a turnover.

E. Performance Area (Leading): Learning Culture

A learning culture can be described as the ability of a company to recognize the need to identify better ways of carrying out business and the ability of a company to identify when new issues and problems start to appear. A measure of this performance area could be determined by how an organization responds to events. Response by reform rather than repair indicates a learning culture.

Performance Indicators

1. **Focused Self-Assessments, Benchmarking Trips, and Assist Visits:** To assist in maintaining a learning culture, focused self-assessments, trips and visits help to adjust perspective and mindset.

   a) Parameters:

      1) Focused self-assessments as defined procedurally.

      2) Benchmarking trips per department per month.

      3) Assist visits as requested per department.

   b) Measurement method: (number of formal self-assessments, benchmarking trips, and assist visits / month / department)

   c) Example: Department A performs 1 formal self-assessment and 1 benchmarking trip during the month. The total reported for the month is 2. This calculation is a running total by month on a 12 month rolling cycle.

F. Performance Area (Leading): Opacity/Transparency

Opacity/Transparency is the ability to recognize where hazards and weaknesses within the organization exist. Measures of Opacity/Transparency provide information about features of the plant that prevent significant undesired events from occurring. It is necessary to monitor Opacity/Transparency to assist an organization in realizing when degradation in the features designed to help prevent undesired events is occurring.

Performance Indicators

1. **Number of Human Performance Observations:** This is effectively a measure of the amount of reinforcement individual workers receive from their supervision or observations from other individuals. Direct observations of human performance are a key element in influencing worker actions and behaviors.

   a) Parameters:

      1) Observations must be performed "formally," with the results documented as part of a site and/or department program.

2) Observations are not included that are undertaken as part of routine supervisory duties for work assignment and completion.

3) Observations must be of any phase of work in progress, but not of completed work or of work documentation.

4) Observations may be of employees within or outside of the observer's department.

b) Measurement method: (total observations / total # of observers) / time period, by department

c) Example: Department "A" has 30 observers, who make a total of 15 formal observations during a calendar quarter. However, 3 of the observations are of other department personnel, and 2 are of data packages being filled out. Department "B" has 10 observers, who also make a total of 15 observations during the quarter. Department "A" would be credited with (13 / 30) = 0.4 observations / quarter. Department "B" would be credited with (15 / 10) = 1.5 observations / quarter.

Target:

Nuclear Power

Human Performance Technology

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