OPERATIONAL DISCIPLINE IN THE WORKPLACE[1]

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The purpose of this paper is to review the development, application, and continuous improvement of operational discipline programs at DuPont. DuPont defines operational discipline as a deeply rooted dedication and commitment by each member of the organization to carry out each task the right way, each time. Operational discipline reflects the strength of an organization's safety culture in making EHS systems effective and in providing tangible results for preventing injuries and incidents. In addition, a high level of operational discipline typically contributes to improved business performance through higher productivity, higher quality, reduced waste, and lower costs. 11 characteristics are used to help evaluate and drive continuous improvement of operational discipline via self-assessments, audits, and incident investigations.

Introduction

Managing potentially hazardous materials and processes to prevent serious injuries and incidents is an essential part of safety management programs, requiring the continuous dedication and commitment of everyone in an organization. While founded over 200 years ago in 1802 for the manufacture of gunpowder on the banks of the Brandywine River in Delaware [1], this commitment – now characterized as operational discipline – has always been an important part of DuPont safety culture and programs. Reflecting on the hazards of the gunpowder business in 1808, the founder, E. I. Du Pont, wrote:

> The safety of our family, the safety of the farmers who live in our neighborhood, has imposed upon us the absolute duty of making choice of steady, sober men and of establishing the most rigid discipline among our workmen [2].

While the company has evolved in many ways since then, the need for operational discipline along with other core DuPont safety philosophies, including that management is responsible for safe operations, that it is necessary to train all people to work safely, and that all injuries and incidents can be prevented, have remained fundamental beliefs. For example, DuPont CEO Edward Jefferson stated in 1986:

> On one hand there is the day-to-day analysis required of each employee. A safe employee sees what he or she is looking at, instead of looking over or through it. This results in greater concentration, a habit of mind that will

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> make a person work more safely as well as more intelligently. Everyone in every job must participate in this process of analysis. There are no exceptions [3].

Today, operational discipline is defined by DuPont as the deeply rooted dedication and commitment by every member of an organization to carry out each task the right way each time. No matter how comprehensive and well-designed safety programs may be, it is the day-to-day ability of everyone to practice operational discipline that successfully changes safety systems from concept to reality with tangible results in order to achieve program goals. Clearly, this ability not only helps prevent serious injuries and incidents, but also contributes to excellent business performance through increased operating excellence, including higher productivity, higher quality, reduced waste, and lower costs.

Process Safety Management

While operational discipline is fundamental to the success of all safety programs, it is especially important in process safety management (PSM) programs, where the risk associated with higher hazard processes could potentially result in catastrophic incidents with multiple injuries. Many of the current DuPont operational discipline practices were therefore developed by the PSM competency and then adopted and modified by other EHS competencies, as needed. PSM is the application of management systems and controls (programs, procedures, audits, evaluations) to a manufacturing or chemical process in a way that process hazards are identified, understood, and controlled, so that process-related injuries and incidents are prevented. Operational discipline is recognized as an essential part of the four steps used for implementation of PSM at DuPont [4, 5]:

- Step 1 – Establishing the Safety Culture
- Step 2 – Providing Management Leadership and Commitment
- Step 3 – Implementing a Comprehensive PSRM Program
- Step 4 – Achieving Operational Excellence through Operational Discipline

The PSM program at DuPont today is defined by corporate safety standards that both reflect and extend OSHA 1910:119 PSM and other regulations. The principles and essential features of the PSM program are described by 14 elements grouped by Technology, Personnel, and Facilities, as shown in Figure 1. Figure 1 is typically called the PSM Wheel, with each of the 14 elements, such as Process Hazards Analysis, Operating Procedures and Safe Work Practices, and Personnel Training and Performance, arranged around the spokes of the wheel. Management leadership and commitment, necessary for implementing PSM and providing resources, is shown at the center of the PSM Wheel. Operational discipline is shown as the rim of the PSM Wheel, connecting all of the elements and translating the required management systems into real results for preventing injuries and incidents. The requirement for operational discipline in the corporate PSM standard is:

> Sites shall implement and maintain programs and systems to achieve and maintain a high degree of operational discipline for all PSM elements in a manner that supports business and operating objectives.

Development of Operational Discipline at DuPont

While operational discipline and operating excellence have long been important expectations at DuPont, formal programs for operational discipline were not developed until the late 1980's. PSM training in 1989 [6], for example, included a section on "The Importance of Operating Discipline," based on the principle that:

> The most technologically advanced plant in the world cannot be made completely safe unless the individuals managing and working there are dedicated and committed to keeping it free from accidents.

Premises supporting the importance of operational discipline were based on the following:

- No pound of production is worth an injury. (former CEO)
- Quality work can only be done when safety is step #1. (operator)
- Ye have the time to do the job right! (area manager)

Figure 1. DuPont PSM Wheel

Catastrophic incidents at Flixborough, Seveso, and Bhopal were cited as examples of where lack of operational discipline was a major contributing factor in the cause of the accident. The primary focus was:

> All of the principles and essential features [of PSM] mean nothing when it comes to operating a facility safely and preventing catastrophes – if the principles, procedures and practices established and set in place are not followed! Stated another way, the most technologically advanced plant in the world will not have a safe operating track record unless the individuals managing and working there are dedicated and committed to keeping it free from accident…

Essential practices for establishing high levels of operational discipline were:

- "Leadership by example" with accountability from the site manager on down.
- Follow established principles, procedures, and practices as documented in the site's PSM Program.
- Production priorities should not be placed ahead of safety and health of personnel.
- If there is not sufficient time available to do the job the right way, then the job must be stopped until there is sufficient time.

By the mid-1990's, the four key steps for effective PSM programs had been developed [4, 5, 7], with step #4 "Achieving Operating Excellence via Operational Discipline" receiving additional emphasis. The principle for operating excellence was:

> The manufacture, use, and handling of hazardous materials requires the dedication and commitment of those individuals managing and handling such material to complete each job the right way every time.

The characteristics of an organization that had achieved high levels of operational discipline were:

- Management is accountable and exerts leadership by example.
- Management action consistent with words.
- Open lines of communication.
- Strong sense of teamwork.
- Employees dedicated and committed to doing the job the right way every time.

Operational discipline was also linked to operating excellence and overall business success, since "the benefits and rewards of achieving operating excellence are many and extend well beyond the areas of safety, health, and the environment." Operational discipline was viewed as consistent with major quality initiatives, trying to achieve the same end result of outstanding performance "in every aspect of every endeavor." Common points with other programs needed for business success were:

- Sound and up-to-date technology.
- Trained personnel.
- Equipment that is maintained and reliable.
- Standard procedures.
- Effective management of change.
- Audits, including control and feedback.
- Doing the job the "right way."

- Continuous improvement.

In late 1996, the corporate ZIP (Zero Incidents… Period!) Team was formed to focus on eliminating process-related injuries and incidents, while at the same time, building business value for PSM. The ZIP Team included members from all businesses and regions, ranging from senior corporate leadership, to plant managers, to operators and mechanics, and eventually included 70 members. The ZIP team made several recommendations, including that operational discipline must be strengthened as an essential element of sustainable improvement. Operational discipline was added to the PSM Wheel (see Figure 1), and business leadership was expected to lead implementation of operational discipline (and other) ZIP Team recommendations:

> The SBU (Strategic Business Unit) will develop a program to drive operational discipline across all sites.

The result was a renewed corporate effort to evaluate and improve operational discipline that led to additional training programs, assessment tools, and metrics.

A new 4-hour operational discipline workshop [8], for example, was introduced in 1998. Initially, 39 trainers were available to lead this workshop, and an informal operational discipline network was established to promote communication between instructors and provide a forum for discussing and updating instructional and resource materials. The workshop introduced the following characteristics of organizations that have achieved operating excellence, which are also discussed in more detail in the following section:

1. Leadership by example
2. Sufficient and capable resources
3. Employee involvement
4. Active lines of communication
5. Strong teamwork
6. Common shared values
7. Up-to-date documentation
8. Practice consistent with procedures
9. Absence of shortcuts
10. Excellent housekeeping
11. Pride in the organization

Videos and reports of serious incidents were introduced, and small groups were asked to consider what errors were made and where operational discipline had failed or could be improved. Additional exercises asked participants to consider how operational discipline applied to their job, what best practices were available at their sites, how well they were being used, and finally, what they could personally do to help improve operational discipline.

An operational discipline self-assessment tool was first developed in 2000, and was used by some businesses to evaluate the status of operational discipline and to identify potential improvements. The self-assessment tool was improved, and in 2003, the Operations Director of each business actively supported a global commitment to complete the self-assessments at all manufacturing and R&D sites, with the goal to identify key improvement opportunities at the site level. The self-assessments are discussed further in the next section.

In 2001, a Six Sigma team was formed to focus on operational discipline as a key to eliminating process-related injuries and incidents [9]. Using process incident data based on an incident scoring system required in DuPont, operational discipline was identified as a key factor contributing to over 50% of process incidents in 2000. Some recommendations from the Six Sigma team included:

- Consider modifying the corporate incident investigation standard to require identification of operational discipline characteristics that contributed to the incident and could be improved. A decision tree was also developed to support high quality incident investigations involving operational discipline.
- Consider requiring more detailed evaluation of operational discipline in second party PSM audits, where it had previously been optional.
- Raise operational discipline as an important issue with the DuPont Plant Managers' Sounding Board for awareness and support.

This last recommendation helped lead to the formation of a corporate Operational Discipline Leadership Team in late 2001. Team members included an Operations Director, several Plant Managers, regional representatives, operators, mechanics, and EHS professionals. The mission of this team was:

> To engage our global operations in a way that institutionalizes a sustainable process that significantly advances our capability and will to improve operational discipline.

The team worked to better define the current status of operational discipline within DuPont, develop a vision, identify gaps, benchmark best practices within and outside the company, and develop a plan for improvement. The current status of operational discipline was determined partly from the experience of the team, interviews, and a survey of plant managers that identified three top strengths, three top opportunities, and other recommendations for improving operational discipline. Key recommendations of this team included:

- Develop a web site for operational discipline, including training materials, best practices, metrics, and reference materials.
- Add operational discipline requirements to the corporate PSM and incident investigation standards.
- Require evaluation of operational discipline in second party PSM audits for higher hazard processes.
- Revise the operational discipline self-assessment tool and require that all sites complete a self-assessment by the end of 2003.

This team also recommended that ownership of operational discipline activities be assigned to the corporate PSM Leadership Team, which has now also formed a sub-team to pursue continuous improvement.

Current Operational Discipline Practices

Characteristics of Operational Discipline

Organizations that have a high level of operational discipline usually exhibit an identifiable set of positive behaviors or characteristics. While it's possible that these characteristics may vary from one organization to another, DuPont experience has shown that 11 key characteristics seem to be most important. Other organizations have identified different sets of characteristics [10], although there is usually some common ground. The key is their usefulness in helping to evaluate operational discipline throughout the organization and in helping to provide guidance for continuous improvement.

The 11 operational discipline characteristics currently used by DuPont are:

1. Leadership by Example – Management "walks the talk" in a visible and consistent manner. Leaders demonstrate an unrelenting passion for safety, clearly communicate standards and expectations, are visible in their commitment, are personally involved in safety, encourage high employee participation rates, evaluate and recognize good performance, listen to employee concerns, and follow-up on issues that have been identified.

2. Sufficient and Capable Resources –Resources are provided with the required capability and adequate time to complete safety, health, and environmental activities in a timely and effective manner consistent with a high priority for safety. Metrics are used to measure progress and periodic reviews are used to evaluate performance.

3. Employee Involvement – Employees at all levels of the organization are involved and enthusiastic about participating in safety-related activities. Managing processes encourage and facilitate high levels of participation by providing multiple opportunities for involvement, and employees routinely volunteer to help improve site safety.

4. Active Lines of Communication – Clear and effective communications occur at all levels of the organization. Everyone is open and actively listens to the concerns and input of others, multiple methods (e. g., e-mail, meetings, postings, etc.) are used to reinforce communications, and people feel accountable and valued.

5. Strong Teamwork – Teams are formed to work on common objectives with active participation from all levels of employees. Teams are chartered with clear goals and responsibilities, teams are accountable for results, team members with diverse experience build on individual strengths based on trust, and team contributions are recognized by the organization.

6. Common Shared Values – Everyone knows and understands the organization's commitment to safety with a goal of zero injuries. Leadership demonstrates safety is a core value, employees believe that all injuries can be prevented, and everyone works safely and helps their co-workers work safely.

7. Up-to-date Documentation – All operating documentation, such as procedures, checklists, process prints, etc., is current and reflects best practices. Systems exist to maintain and update documentation consistent with best practices, changes are properly reviewed and authorized, documentation is readily available, and use of current documentation is required.

8. Practice Consistent with Procedures – Work is completed as planned, following authorized procedures. Periodic reviews of procedures are made to ensure they are correct and complete, training on procedures is provided, field audits are made to confirm that procedures are being followed every time, and changes to procedures are reviewed and authorized by affected employees.

9. Absence of Shortcuts – Employees are encouraged to and always choose to follow established procedures, rules, and practices. Expectations for following procedures are clearly established, proposed changes and deviations from established procedures for tests are reviewed and authorized, and employees seek assistance in uncertain situations.

10. Excellent Housekeeping – Employees throughout the organization are proud of their workplace, maintaining consistently high levels of housekeeping in all areas. Housekeeping standards are established and clearly communicated, all areas of the site are routinely evaluated, and equipment is maintained in good operating condition.

11. Pride in Organization – Every employee displays pride in the organization, often developed through successful application of the other characteristics. Employees understand the organization's goals, know and share core values, and present a positive image of the organization in the workplace and community.

Clearly, many of these operational discipline characteristics are connected to one another, such as Up-to-date Documentation, Practice Consistent with Procedure, Absence of Shortcuts, and Sufficient and Capable Resources. If qualified engineering resources are not available for maintaining current process documentation, for example, then operations personnel would not have complete procedures and prints, training would be less effective, and possibly inadvertent deviations from procedures could result in increased risk of injury. Despite these connections, the 11 characteristics have proven useful in helping to evaluate operational discipline and provide guidance for continuous improvement.

An internal website has been set-up to support operational discipline efforts in DuPont. The website is accessible from the Global EHS website and includes the following main sections:

- Background – provides an introduction to operational discipline and background materials on activities supporting the development of operational discipline at DuPont.
- Self-assessment Tool – provides the operational discipline assessment tool and guidance for completing successful reviews and for evaluating results.
- Training and Education Tools – provides basic training materials on operational discipline for site use.
- Useful Tools and Best Practices – provides supporting information for the 11 characteristics of operational discipline.
- Resources / Reference Materials – provides recommended external sources for additional information, such as for employee involvement and successful teams.

The section on Useful Tools and Best Practices includes results from the Six Sigma project described in the previous section. This includes the components critical to quality (CTQ's) and the independent variables (critical X's) for each characteristic. A partial example for Leadership by Example includes:

- CTQ – Visible leadership presence and involvement across the organization.
- Critical X – Build value in leaders that this is a critical part of their role and hold them accountable with specific expectations.
- Critical X – Define and communicate what is "visible leadership" throughout the line organization.
- Critical X – Senior leadership spends time reinforcing EHS value at sites and communicating business value for EHS excellence.

Assumptions, metrics, leadership actions, and best practices are also listed for each characteristic. The result is a wealth of specific information available to support implementation, evaluation, and improvement of operational discipline at both site and business platform levels.

Operational Discipline Self-Assessments

Operational discipline self-assessments were developed in the late 1990's, recommended for broad corporate use in 2002, and required at all global manufacturing and R&D sites in 2003. The self-assessments are intended to provide a common methodology to assist sites in evaluating their level of operational discipline and to identify areas where improvement opportunities may exist to strengthen their EHS programs and performance. The self-assessment consists of approximately 75 questions, which are used to qualitatively score 10 characteristics of operational discipline (Pride in the Organization is considered to result from strength in the other 10 characteristics). Since operational discipline is not always easy to evaluate, pre-work to collect data and metrics on the current state of performance is recommended, including information such as progress on site EHS goals, open and overdue audit or incident recommendations, adherence to schedules for maintenance and training, and the extent of up-to-date documentation. In addition, multi-disciplinary teams are used representing a cross section of the site based on role and function, such as operations management, technical, EHS resources, operators, mechanics, and support staff. Depending on the size and complexity of the site, multiple self-assessments might be required, with the time commitment typically varying from about six to fifteen hours of meeting time. Several sessions are often scheduled to maintain team focus and energy.

A sample self-assessment question is shown in Figure 2. Each operational discipline characteristic is assigned a section (e.g., Excellent Housekeeping is section 10) and one of the Critical to Quality (CTQ) elements is identified, such as "Personal value and demonstration of personal housekeeping standards by each individual" in the figure. One of the independent variables (Critical X) is listed, such as "Giving status and recognition of good housekeeping. Reinforce link between good housekeeping and excellence in EHS results" in the figure. The Critical X is qualitatively scored from 1 to 5 (highest), with the ratings defined as:

1. Not addressed in current state.
2. Significant gaps or components missing.
3. Partially in place with multiple opportunities for improvement.
4. In place with minor opportunities for improvement.
5. Fully in place with strong results.

To assist with scoring, suggested questions are also provided to help teams better understand the intent of the Critical X and to evaluate performance. Active team discussion of site activities and performance is essential, and pre-work can also be used to help provide data on actual performance. Scoring is qualitative based on team consensus, and improvement opportunities are identified when scoring on individual questions is low. Typically, improvement opportunities are prioritized to identify the most significant system improvements that will have the greatest impact for improving site operational discipline. Results of the self-assessment are reported to site management for follow-up.

10-3 Personal value and demonstration of personal housekeeping standards by each individual.

- Giving status and recognition of good housekeeping. Reinforce link between good housekeeping and excellence in SHE results. 1 2 3 4 5

Consider :
Is everyone involved in housekeeping in their own areas or only a critical few?
How does the site or area recognize excellence in housekeeping?
Is there a periodic or annual focus on housekeeping?
Is housekeeping evaluated and included in incident investigations and reports, where applicable?
What percentage of time do individuals spend on personal housekeeping in their area?

Figure 2. Sample Operational Discipline Self-Assessment Question

The results for a limited number of self-assessments are shown in Figure 3. This figure shows the range and average of results from about 25 self-assessments for 10 of the operational discipline characteristics, including data from the US/Canada, Europe, and Asia/Pacific Regions. Since the figure includes a wide range of global sites, including some relatively new to DuPont due to acquisitions, there is a fairly broad range for each characteristic. The average of each characteristic is between 3 and 4, suggesting that most sites have programs in place, but were able to identify several opportunities for improvement. While comparison between sites and regions, etc., would be interesting, the qualitative nature of the scoring prevents generalizing too many conclusions. Results are primarily intended to help sites improve operational discipline locally, although corporate programs could be developed for characteristics that generally score lower.

Incidents and Audits

A requirement to consider and document the contribution of operational discipline to incidents was added to the corporate incident investigation standard in 2003. Where lack of adequate operational discipline is noted as a key factor in the incident, incident investigation teams must identify which of the 11 characteristics needs to be strengthened. Typically, recommendations must be developed to address all key factors identified in the incident investigation, including operational discipline. Detailed analysis of incident data is on-going, but suggests that operational discipline continues to be identified as a key factor in approximately 50% of PSM incidents. The most commonly cited characteristic of operational discipline contributing to incidents is Practice Consistent with Procedures.

A requirement to include evaluation of operational discipline in second party PSM audits was established in 2004. PSM audits use a lengthy checklist, with questions scored from 0 to 100% to

establish an audit score for each PSM element. Several specific questions have been added to the checklist in the Management section, which help provide a general assessment of operational discipline. A sample audit question is shown in Figure 4, where additional factors to consider when evaluating the question are also provided in the audit checklist. In addition, approximately 100 other specific questions under the various PSM elements relate directly to operational discipline, such as revision of procedures, communications, and overdue action items. The spreadsheet used for scoring questions for each PSM element has therefore been revised to also allow simultaneous scoring of 10 characteristics of operational discipline. For example, there may be several questions for various PSM elements throughout the audit checklist that relate to Practice Consistent with Procedures. The score for these questions is used to score the separate PSM elements, and is then also combined in the spreadsheet to calculate a score for Practice Consistent with Procedures. The result for a limited number of audits is shown in Figure 5. This figure shows the range and average of results from about 10 PSM audits for 10 operational discipline characteristics. Since the figure again includes a wide range of sites, including some relatively new to DuPont due to acquisitions, there is a fairly broad range for some characteristics. This data is used to help audit teams evaluate operational discipline at the site and to provide additional recommendations, as needed.

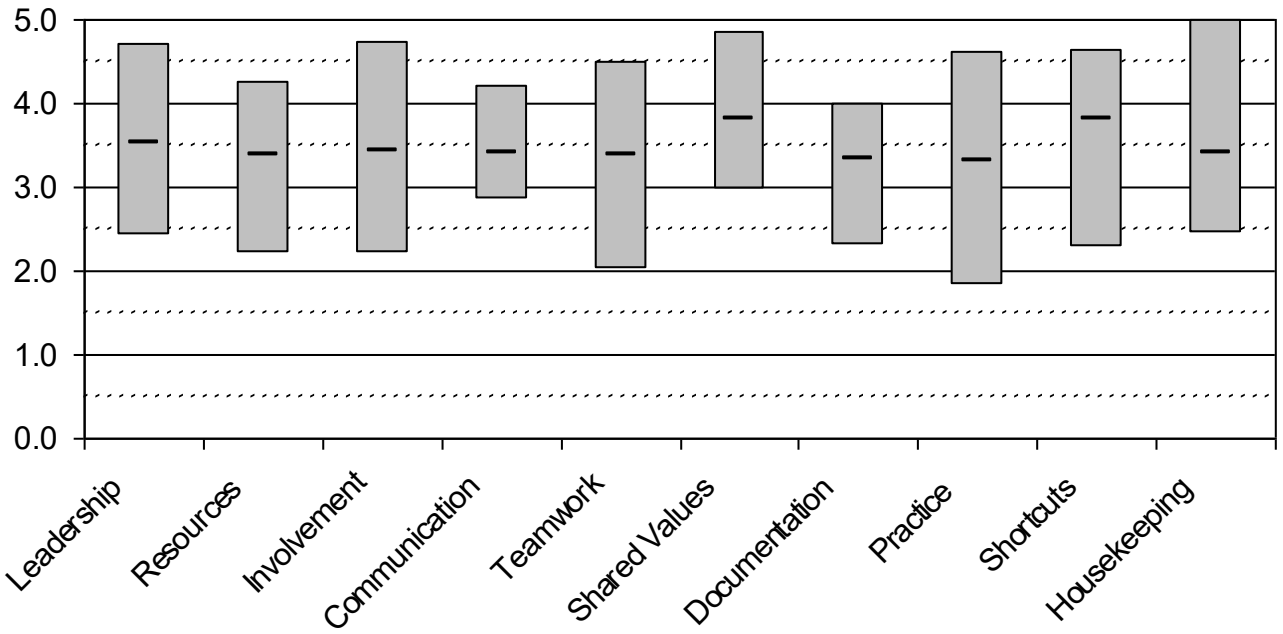

Figure 3. Operational Discipline Self-Assessment Scores

A full operational discipline audit protocol involving employee interviews and requiring additional audit resources is also available as an option in PSM audits. The somewhat larger audit team interviews six people each for three days during the audit in addition to using and scoring the PSM audit checklist. The 18 people interviewed should include a mix of operators, mechanics, supervisors, technical, contractors, and site management, who are selected randomly, consistent with their rough proportion on the site. One hour is scheduled for each interview, focusing on both the strengths and opportunities for improving PSM and operational discipline. Sets of questions are provided for the auditors to assist with conducting the interviews. Sample questions for operational discipline include:

- Is site management providing opportunities for employee involvement in each and every one of the elements of PSM?

- Is site line organization paying as much (or more) attention to listening as to communicating?
- Do site teams which address PSM issues cut across both levels and functions, i.e., manager/employee and operations/maintenance?
- Does the site have an active communications system to document concerns/problems which interfere with following procedures as written?
- Do site policies on achieving excellence in housekeeping extend to all areas of the plant?

1.18 Has the area/site established systems to achieve and maintain a high degree of operational discipline across the PSM program elements?

Consider:

⇒ Did the site/area conduct an operational discipline self-assessment in 2003? If so, what were the results/findings and improvement activities?
⇒ How do leaders communicate expectations and measure operational discipline across the site/area PSM program and systems?
⇒ Is operational discipline included as part of the training for new site employees and refresher training for existing employees who are involved with PSM?
⇒ Is the status of open/overdue metrics indicative of a high degree of operational discipline across the site line organization?

Figure 4. Sample PSM Audit Question on Operational Discipline

Some of the interviews are also supplemented with tours of the work area to talk to the employee in more informal conditions and also to allow a better assessment of area housekeeping and other practices. The interview discussions provide the basis for the audit team to develop strengths, opportunities for improvement, and recommendations for follow-up by the site for improving operational discipline. In all cases, specific interview discussions are kept confidential.

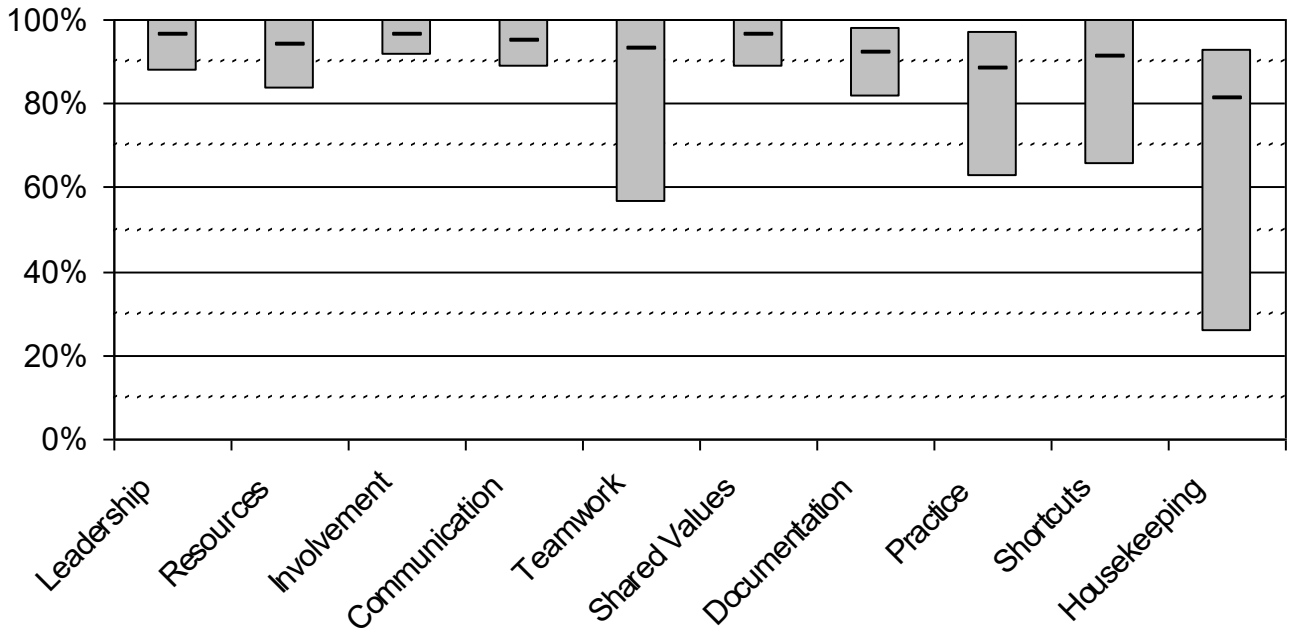

Figure 5. Operational Discipline Audit Scores

Future Focus

Increased access to data on operational discipline from self-assessments, incident data, and audits provides detailed information for driving continuous improvement. Some specific areas for future work include:

- Improved analysis of data to identify continuous improvement opportunities.
- Improved training to assist sites in understanding the characteristics of operational discipline and evaluating their current level of performance.
- Further extension of operational discipline activities beyond PSM.

Ultimately, better guidance needs to be developed to help sites improve operational discipline performance when opportunities have been identified and when efficiency efforts and retirements may affect the availability of experienced resources. New acquisitions and business growth globally may also present challenges due to the different corporate safety cultures of acquired companies and due to different customs in other parts of the world. What is effective in the United States may not be effective elsewhere, and efforts to establish and continuously improve operational discipline must recognize these differences. This will likely require continued focus on safety culture, behavioral safety, and human error. The goal is to continue to motivate all employees to develop and maintain a deeply rooted dedication and commitment to carry out each task, the right way, each time. The result will be continued safe operations and the prevention of serious injuries and incidents.

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