

**Creating and Sustaining a Safety Conscious Work Environment – 15240**

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**ABSTRACT**

Organizational Culture, Safety Culture, and a Safety Conscious Work Environment (SCWE) are psychological constructs that describe behaviors of organizations, especially with respect to behaviors needed to ensure safe, highly reliable work. These attributes of culture are often singled out in surveys, root cause analyses and management expectations as the basis for being safe or as the cause of an incident. Organizations that wish to improve culture often do not have a framework to measure and act upon tasks or projects that will promote a positive safety culture (and thus a positive SCWE).

Combining the work of organizational behavior pioneers with the ‘blue collar’ approaches to continuous improvement offers framework organizations may use to improve safety culture while devoting efforts to improving conditions that are meaningful and tangible to floor level employees.

The framework consists of the use of Safety Culture and SCWE surveys and focus groups to complement each other and offer topical areas that need improvement or study in the organization. A Safety Culture Improvement Panel will then direct specific improvement projects based on these topic areas and relate these projects to causal variables that effect incremental changes in culture. By applying principles of process improvement to the improvement of culture, the framework is formed to have employees work ‘day-today’ issues while effectively addressing the often vague or abstract notion of improving culture. A case study of the use of these principles is given by following the SCWE Assessment conducted by the Transuranic Waste Processing Center (TWPC) and subsequent improvements derived from data found in the assessment.

The attributes of a SCWE and an effective safety culture accomplish much more than just having a safe place to work. These characteristics result in a high performance, continuously improving organization. The experience of commercial nuclear power, the aviation industry, and other high performing endeavors bear this out. Achieving an effective SCWE is not easy, and sustaining it is even more difficult, but the results are surely worth the effort. The techniques discussed in this presentation are effective, available, and cost-effective; they are easily adaptable for use in other organizations to create, sustain and improve a SCWE.

## INTRODUCTION

Rensis Likert, a research psychologist began a research project (ca. 1946) that lasted more than thirty years. His goal in this project was to discover variables that could indicate an organization's likelihood of success. In the last book of his career (Likert, 1976)<sup>1</sup>, Likert developed the idea of stages of organizational development and demonstrated how his research supported this concept. The more sophisticated and effective organizations (in terms of productivity, satisfaction of members, and retention of members, among many other things) had gentler, more respectful, and more inclusive relationships between members in general, and between the work force and management in particular. Likert reported an increase of as much as 20% in performance attributed to moving up one stage of development.

Likert discovered variables having a consistent effect on the success of organizations; he called these *causal variables*. In his scheme there are two other kinds of variables, *end result variables*, and *intermediate variables*. End result variables are those associated with measuring organizational success, such as profit, quality, safety, employee satisfaction, productivity, *etc.* Intermediate variables are 1) attitudinal, motivational, perceptual variables: e.g., consistency of organizational objectives with personal ones, commitment to objectives, and cooperative attitudes, and 2) behavioral variables: e.g., efforts at innovation, monitoring performance, and peer coaching. Likert found that organizations that tried to manage the end result variables directly usually failed over the long term, because if they paid attention to, for instance, safety, then productivity and quality would decline. Likewise, if the organization tried to manage productivity, safety and employee satisfaction would decline. It is very difficult for organizations to simultaneously sustain attention to two or three end result variables sufficient to change them. Likert found that successful companies instead managed the causal variables. These variables strongly influence the intermediate variables and the end result variables, and are easier to manage as a group, although managing them requires skills that many organizations do not possess. Intermediate variables are difficult to manage for the same reasons, although some can be focused on to effect change, for instance, some behaviors. The seven causal variables are as follows:

1. Management
  - a. Manager's expectations
  - b. Manager's attitude toward employees
  - c. Manager's style and methods of influencing employees, training
  - d. Manager-employee/team relationships
2. Communication & Information
  - a. Quality
  - b. Flow
  - c. Timeliness
  - d. Feedback
3. Problem solving
4. Organizational structure
5. Teams

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<sup>1</sup> *New Ways of Managing Conflict*, Rensis Likert, McGraw-Hill, 1976. In chapter 2, Likert outlines four stages of organizational development and links the relationship of the leaders with members, showing that the leaders of more effective organizations have more respectful, gentler relationships with members. The four stages of development, from least effective to most effective, are (from earlier Likert writings) 1) Exploitive authoritarian, 2) Benevolent authoritarian, 3) Consultative, and 4) Participative. Likert changed the names of the stages to "System 1, 2, 3, and 4", because managers disliked being described the first way. Note that the first descriptions are in terms of the behaviors of the leaders, one of the most important variables.

- a. Teamwork, cooperation, collaboration, group processes
  - b. Team members' aims, involvement, and commitment
  - c. Team members' affect, interpersonal relationships, trust
6. Goals & planning
7. Decision making

In fact, these causal variables are the concepts at the heart of organizational culture, safety culture, and SCWE. The research the Likert and his organization performed provides a conformal map of how to change culture. He relates behaviors in each of the four stages of an organization *to that stage*. That is, for each stage of organizational development, Likert's research indicates which set of behaviors, behaviors for each of the causal variables, exists for each stage. From this we can determine what behaviors need to change, in what ways, and by how much for each step into more sophisticated stage of development.

Study of the characteristics of the four levels of organizational development indicates that the first stage of development that can develop and sustain an effective SCWE, or Safety Culture, and a consistent organizational culture, the Stage 3, or what Likert also called the Consultative stage. (I use the word Consultive because it is shorter and means the same thing, as far as I can tell.) The primary reason this is the case is because Consultive is the first stage in which management understands that the work force has knowledge about work being done that is helpful in making decisions, problem-solving, planning, and establishing goals. Although management only *consults* the work force, that is, management reserves the decision-making to themselves, at least they open lines of communication with the work force. This is a fundamental change in management's attitude toward the work force (see footnote 2), and all four elements of communication begin to improve

Likert's research indicated that most organizations (65% to 70%) in the USA then were stage 2, or Benevolent Authoritarian, or lower (Stage 1 or Exploitive Authoritarian). That still appears to be the case, in this author's experience. Below are brief descriptions of the "Management" behaviors for Benevolent Authoritarian and for Consultive stages:

**Benevolent Authoritarian** - Wants all to follow rules, regards employees as needing detailed direction, parent-child relationship management to worker, no lasting teams. Managers want production, don't know how to get it and follow rules.

**Consultive** - Sees employees as effective if managers lead them well; sees them as knowing how to do work, consults them for input, decides what to do, then persuades them it is the right thing. Management very productivity oriented.

In parallel with the work of Likert, Shewhart (Shewhart, 1931) and Deming (Deming, 1986) began study of the basic principles that underlie continually improving organizations and that offer competitive advantage, ability to adapt to changing market conditions and, the emphasis of this paper, develop a culture that fosters a questioning attitude with direct feedback to management. Specifically, Deming's 14 points are as follows:

1. Create constancy of purpose toward improvement of product and service, with the aim to become competitive and to stay in business, and to provide jobs.
2. Adopt the new philosophy. We are in a new economic age. Western management must awaken to the challenge, must learn their responsibilities, and take on leadership for change.
3. Cease dependence on inspection to achieve quality. Eliminate the need for inspection on a mass basis by building quality into the product in the first place.
4. End the practice of awarding business on the basis of price tag. Instead, minimize total cost.

- Move toward a single supplier for any one item, on a long-term relationship of loyalty and trust.
5. Improve constantly and forever the system of production and service, to improve quality and productivity, and thus constantly decrease costs.
  6. Institute training on the job.
  7. Institute leadership (see Point 12 and Ch. 8). The aim of supervision should be to help people and machines and gadgets to do a better job. Supervision of management is in need of overhaul, as well as supervision of production workers.
  8. Drive out fear, so that everyone may work effectively for the company (see Ch. 3).
  9. Break down barriers between departments. People in research, design, sales, and production must work as a team, to foresee problems of production and in use that may be encountered with the product or service.
  10. Eliminate slogans, exhortations, and targets for the work force asking for zero defects and new levels of productivity. Such exhortations only create adversarial relationships, as the bulk of the causes of low quality and low productivity belong to the system and thus lie beyond the power of the work force.
    - a. Eliminate work standards (quotas) on the factory floor. Substitute leadership.
    - b. Eliminate management by objective. Eliminate management by numbers, numerical goals. Substitute leadership.
  11. Remove barriers that rob the hourly worker of his right to pride of workmanship. The responsibility of supervisors must be changed from sheer numbers to quality.
  12. Remove barriers that rob people in management and in engineering of their right to pride of workmanship. This means, inter alia, abolishment of the annual or merit rating and of management by objective (see Ch. 3).
  13. Institute a vigorous program of education and self-improvement. Put everybody in the company to work to accomplish the transformation. The transformation is everybody's job.

Many of Deming's 14 points are exactly the points required to have a positive safety culture. Emphasis on lack of fear, questioning attitude, breaking down departmental and managerial barriers to communication and employee engagement all are basic principles required for a positive safety culture.

Shewhart is credited with developing the "Plan-Do-Check-Act" system that forms the basis of statistical process control. Deming furthered this approach with the "Plan-Do-Study-Act" approach that forms the basis of management systems such as Lean, Six Sigma, Total Quality Management, etc. that drive organizations to embrace a continually improving culture beyond that of purely statistical process improvement. This cycle is shown in Figure 1.

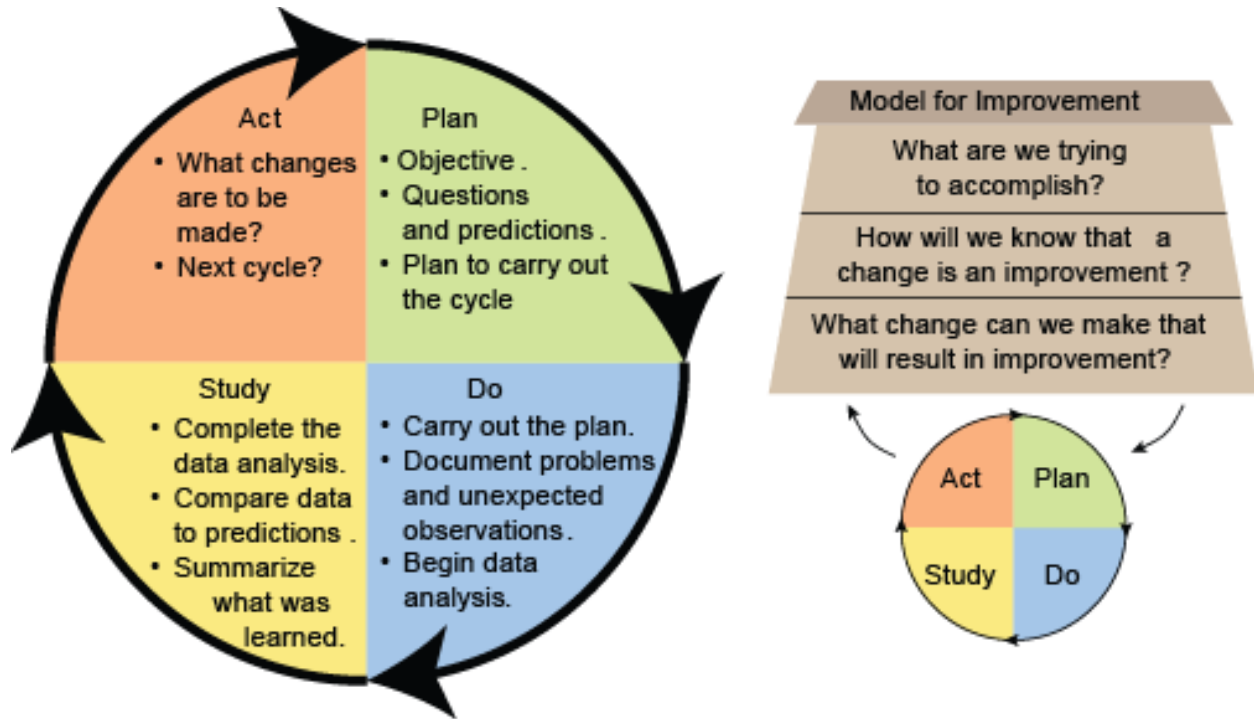


Fig. 1. Shewhart/Deming PDSA Cycle and Model for Improvement 1991, 1994

The work of Likert and Deming, a psychologist and an engineer respectively, form the basis of the methods suggested in this paper to measure, sustain and improve the safety culture of a given site or organization. Likert provides the conformal map showing how to change culture in the correct direction and Deming provides the process used at the point of the work to effect change and improvement. Figure 2 shows a schematic representation of how the research of Likert and Deming are used to create changes in organizational culture.

The Likert causal variables and selected points from Deming thus give the means and the map to sustain and improve safety culture. Both systems require employee engagement and a questioning attitude without fear of reprisal from management. Both systems require the entire workforce to participate and remain engaged in the process of sustaining and improving and require management and employees to constantly upgrade their education and training and to remain able to perform the components of the PDSA cycle effectively and across organizational boundaries. This requires constant feedback and listening between management and employees and management allowing employees the authority to act on and test improvements that can raise the organization to a new level.

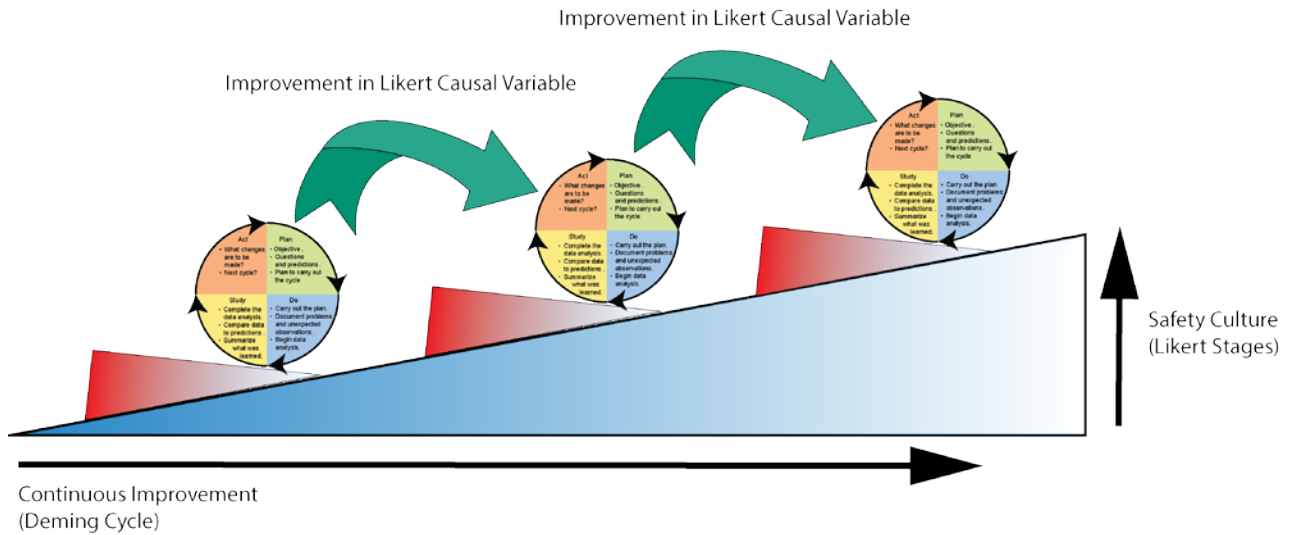


Fig. 1. Relationship between Continuous Improvement and Safety Culture Change

Figure 2 further implies, as has been the experience of the authors of this paper, that if the continuous improvement cycle breaks or even rests, the momentum of the safety culture will naturally tend to reverse “downhill”. This means that considerable effort is needed to sustain as well as improve culture as there is a constant pull toward practices of the past or a culture that is not aligned with the strategic direction desired.

The methods presented in this paper are a case study in the translation of this research into real-world assessment and improvement of the safety culture at a Department of Energy (DOE) facility that is part of the Oak Ridge Reservation (Oak Ridge, TN). This facility is the Transuranic Waste Processing Center (TWPC), a Category 2 nuclear facility that has been operating for nearly 10 years. Methods discussed in this paper are presented as an example of cost-effective, well-known processes for Assessment and Improvement of organizational culture that are combined in a novel way to effect a positive change in the safety culture of an organization. Further, the methods presented here strive to offer an example of processes that can help organizations change a sites culture—which is often perceived as an existing, academic construct and not a tangible characteristic of workforce that can be changed.

## DISCUSSION

The first step in utilizing the process shown in Figure 2 is gathering of data needed for the “Plan” portion the cycle. The methods used to gather this data are most likely the same methods used to evaluate the “Study” portion of the cycle to determine if prior improvements are viable and giving the outcomes expected of them. TWPC used a multi-faceted approach to data collection and analysis to determine the state of safety culture, Safety Conscious Work Environment (SCWE) at the site, and opportunities for improvement that exist to promote a continually improving safety culture at TWPC. These analytical methods are as follows:

1. TWPC Employee Survey. Likert-type survey given to a randomly selected sample of 50% of site workers.
2. Independent Expert Interviews. Individual or small group interviews of 20% of site workers



Use of surveys is common and recommended in numerous DOE and other nuclear industry guides for evaluating the state of a safety culture. Surveys provide the advantage of providing quantitative data from respondents and the ability to track these responses in a time series to discern trends. General constructs such as employee satisfaction are well-suited for surveys. The confidentiality of anonymous surveys also allows the opportunity gauge attributes such as fear of reprisal and trust in your supervisor. These responses may be blunted in face to face interviews, especially if a negative safety culture exists in the organization.

Surveys, however, are limited to measuring and visualizing the effects of social phenomenon and interpretation as to the cause of the phenomenon is left to the investigator via the survey design (Wolff, 1993). Surveys are often used incorrectly to infer causes (i.e. discern causal variables) that are of a finer detail than the survey design allows. Surveys also do not take into account context specific settings that may influence responses. This inference can lead the investigator to a false conclusion especially when evaluating social phenomenon.

### **Independent Expert Interviews**

Independent Expert Interviews were used to validate data from the TWPC survey, especially given the shortcomings of surveys noted with respect to inferring causal variables. A team of independent industry experts designed a confidential interview process that tested the TWPC survey results and validated data therein. Their method of data collection used a structured interview technique with a team of interviewers performing group and individual interviews. Approximately 20% of the TWPC survey respondents were interviewed to provide a sample size large enough to validate results.

### **TWPC Focus Groups**

Focus groups are often perceived as (1) a qualitative endeavor with a sample size too small to draw extrapolate conclusions that is only good for survey validation (triangulation) or (2) a small group fraught with errors from bias caused by group leadership or group dynamics. When used as part of an experimental design that includes surveys, focus groups can allow the investigator to determine casual variables within the current contextual setting (Golafshani, 2003) and to determine causal variables that are not inferable by statistical methods (as often occurs in evaluating social phenomenon). This use of focus groups is used as an elaboration of survey data and is required to get to a level of detail required for actionable improvements to be discovered.

Follow-on focus groups were performed after analysis of the results obtained by survey. The results of the TWPC and Independent surveys correlated well and led to development of six questions used in the focus group interviews. Those six questions are as follows:

1. How does TWPC identify problems?
2. Do you think people willing to report issues and observations? Why or why not?
3. Does TWPC find solutions that work?
4. Are there any issues about safety we should know about that aren't reported?
5. How effective is communication with Senior Management?
6. How effective is communication with Line Management?

At the end of each session the open-ended question, "Is there anything else you would like to discuss?" was asked. Responses were either verbal or written on note cards for confidentiality.

The six questions were derived from survey analysis that showed either a greater standard deviation in responses from prior years or a decline in the average score from prior years. The TWPC survey also had



room for respondents to comment each question and these comments were grouped into categories and further explored in focus groups.

Focus groups were also conducted vertically by organization to determine any mismatch in perceptions, data quality, mission objectives, etc. from line employees to senior managers. Figure 4 shows the organizational levels that were asked the six focus groups questions derived from the survey.

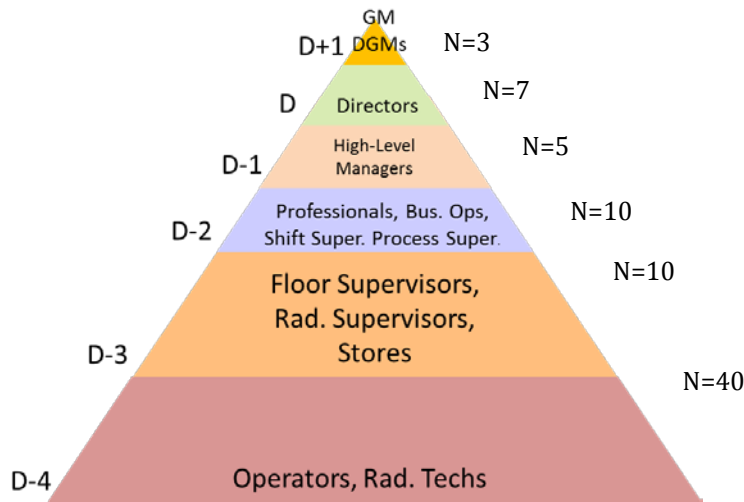


Fig. 2. Vertical use of Focus Groups to Test Safety Culture (N=#of Respondents)

Each group level interviewed provided feedback about the level above them as well as their responses to the six questions. For each higher level, feedback from lower levels was provided at the end of each interview. This informed the higher levels, elicited some informative conversations, and gave some indications about the efficacy of communications up and down the chain of command.

**Safety Culture Assessment Results**

Combined results of Survey Data and Focus Group Data are summarized as follows:

TWPC Survey Result	Focus Group Elaboration
TWPC has greater than 90% employee satisfaction.	Validated
TWPC has a strong safety culture that is being sustained	Validated
Trust in direct supervisors is strong	Validated;
Potential Threats to TWPC Safety Culture (Can Move TWPC “Downhill”)	

<p>12% of respondents observed or experienced reprisal, chilling or chose not to answer the question.</p>	<p>Elaborated:</p> <ol style="list-style-type: none"> <li>1. Most of the ‘chilling’ or reprisal reported in surveys were associated with raising issues or making suggestions for improvement. Some of this feeling was associated with lack of feedback or no action taken on reports.</li> <li>2. Line supervisors often did not know how to handle suggestions for improvement or did not how to find answers to employee’s questions because TWPC business processes are not transparent.</li> <li>3. Senior managers use electronic communication more; line supervisors and employees tend toward verbal communication creating a knowledge gap</li> </ol>
<p>Negative survey trend: Processes available for personnel to raise concerns are not always well understood or fully effective and are declining in use.</p>	<p>Elaborated:</p> <p>Processes to raise concerns or report are often not used because barriers exist that prevent a true reporting culture. These barriers include lack of feedback, lack of importance tied to report, perception that processing is more important than stopping to report, disjoint in verbal reporting used by floor employees vs. electronic communication used by managers.</p>
<p>The Employee Concerns Program (ECP) is seldom used, and its value is not fully realized</p>	<p>Elaborated:</p> <p>TWPC respondents noted that ECP personnel have changed numerous times over the past few years and this creates the perception of inconsistency and chilling.</p>

TABLE 1. Selected TWPC Survey Results and Elaboration of Result with Focus Group Data

### Sustain and Improve

Now that Likert causal variables that may threaten safety culture are known in the context specific situations at TWPC, and OFIs surrounding these variables have been determined or can be determined from the data given, the actions to sustain or improve safety culture can be taken in a targeted manner. Deming and Likert both discovered a team approach to improvement was more efficient and served to further the culture as a “side effect” of the teams implementing improvements. This is reflected in responses to the TWPC survey where employees noted that potential threats to culture surrounded vertical and inter-departmental transparency (communication). Further, line employees noted that management engagement with employees could be improved and that corrective actions could be determined by those closer to the work.

The implementing process used by TWPC is by the formation of a Safety Culture Improvement Team (SCIP). This team was designed to provide both a reporting and data analysis function as suggested by various nuclear agencies (Nuclear Energy Institute, 2014) and to provide the leadership in an organization required to implement improvement projects and facilitate a continually improving, leaning culture. The TWPC framework for the team is given in Figure 5.

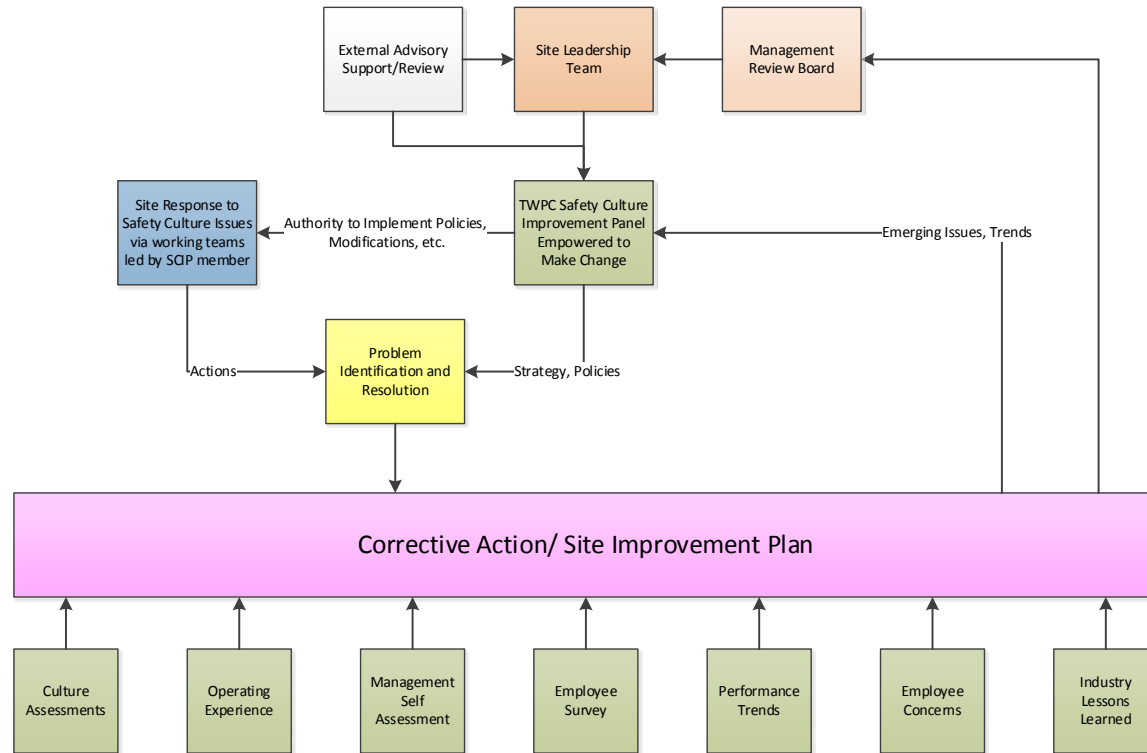


Fig. 3. TWPC Safety Culture Improvement Framework

The SCIP and its sub-teams are responsible for implementing the PDSA process to improve actionable items that were found to be threat to sustainment of a safety culture. The SCIP membership is comprised of employees from all levels or the organization and across departments. Specifically, the roles of the SCIP members are as follows:

1. Ensure that action is taken to maintain and improve safety culture at TWPC.
2. Ensure that actions needed have adequate resources to succeed
3. Select both the actions taken and the teams to implement the actions to preserve safety culture.
4. Provide frank and honest feedback to TWPC employees about safety culture, what actions are being taken to improve safety culture and the status and results of those actions.
5. Assure that the sub teams and anyone else trying to improve safety culture has the resources and authority required to succeed.

The SCIP is sponsored by a Senior Manager that has authority to allocate resources to improvement projects and has the entire SCIP has reporting authority directly to the General Manager. In this manner the SCIP mirrors both a traditional Safety Culture Monitoring Panel and a Process Improvement steering committee. Because the SCIP members are from all levels of the organization vertically, they become peer ambassadors for safety culture improvement and cultural mentors in their organizations. SCIP members are trained extensively in safety culture and process improvement techniques. By leading sub

teams they can effect change across the entire organization by leadership, by communicating with peers as to the progress and status of projects and by formal reporting mechanisms.

Following the given framework to improve safety culture, the SCIP is the team that applies the PDSA cycle to a specific survey result and/or focus group elaboration given in Table 1. The elaboration will improve a Deming principle which will thus aid the organization in improving a Likert causal variable (i.e. improve safety culture).

Working through an example of how to use the above concepts in developing a way to address a specific issue or set of issues may help understanding. Take the item under “Potential Threats to TWPC Safety Culture” that says “12% of respondents observed or experienced reprisal, chilling, or chose not to answer the question” and the Elaborated portion that says:

1. Most of the “chilling” or reprisal reported in surveys was associated with raising issues or making suggestions for improvement. Some of this feeling was associated with lack of feedback or no action taken on reports.

The Deming points that apply to this issue are 7 and 8 (and 12, by reference):

7. Institute leadership (see point 12). The aim of supervision should be to help people and machines and gadgets to do a better job. Supervision of management is in need of overhaul, as well as supervision of production workers.
8. Drive out fear, so that everyone may work effectively for the company.
12. Remove barriers that rob people in management and in engineering of their right to pride of workmanship. This means abolishment of the annual or merit rating and of management by objective.

Understanding the Deming point applicable to the issue helps the organization focus on the Likert causal factors that need to be examined. In this case, the Deming points focus on:

1. Management: Management’s attitude toward employees
2. Problem solving

Under the Likert survey heading “Leadership Processes used” (in this instance, the Deming point helped a lot to figure this out), we find a survey question:

6. *Extent to which your supervisor, in solving job problems, generally tries to get subordinates’ ideas and opinions and make constructive use of them.*

The behavior for **Exploitive Authoritarian** (Coercive in my naming scheme) is:

*Virtually never gets ideas and opinions of subordinates in solving job problems.*

The behavior for **Benevolent Authoritarian** (Rules and Roles in my naming scheme) is:

*Occasionally gets ideas and opinions of subordinates in solving job problems.*

The behavior for **Consultive** is:

*Usually gets ideas and opinions and usually tries to make constructive use of them.*

In this case the organization as surveyed behaves as in Coercive or Rules and Roles above, and the task is to change the behavior to Consultive behavior. In this way, the system described above helps focus on the specific behavior that must change and the group whose members must change it. It should be pointed out that it is nearly impossible to move from Coercive behavior to Consultive behavior without

going first, for some period of time, into Rules and Roles. You cannot jump stages of development unless you fire and hire people.

Specifically, the TWPC SCIP guides the improvement teams (and the organization) toward improvement in culture by improving topics found in specific survey responses and focus group elaboration. So a given improvement will focus on, for example, how to get supervisors information they need to answer questions and not come off as ‘chilling’ to employees. Improvements in these tangible aspects will incrementally move the organization in a direction of positive safety culture. Figure 6 shows the application of the improvement process to better this ‘chilling’ aspect of culture.

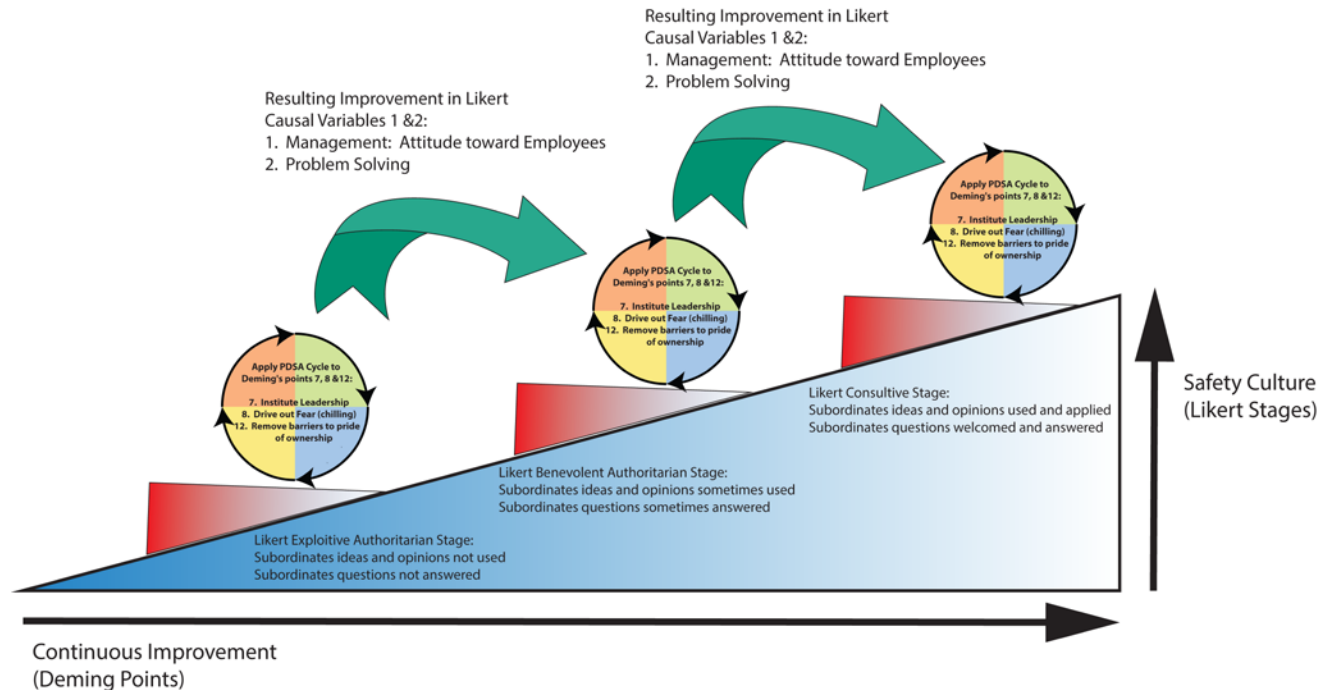


Fig. 4. Application of the Improvement Process to Advance Safety Culture: How to Improve ‘Chilling’ Effects

The TWPC improvement process found, for example, that a floor “rep” or spokesman was initially needed to take employees questions to management. The venue for this was a meeting held by a floor level employee but with full support of the Director of Operations. Initial meetings were comprised of these floor reps and management. In the meetings improvements topics, safety topics, etc. were discussed an actions take to improve conditions or clear feedback given as to why an improvement wasn’t possible or justified. This feedback was, on the next day, given to floor employees by the meeting chair (also a peer). This improvement moved the organization up a ‘step’ in Figure 6 toward Benevolent and more toward consultive. The success of this ‘step’ relied upon using the ideas given and ensuring feedback was provided.

These meetings have always been open to all floor level employees. As ideas were used and feedback given, more employees showed up to the meeting in person to offer questions and suggest improvements. Meeting attendance tripled over the course of three months. This is exactly the goal represented by improving the Likert factors to get to a Consultive stage: direct communication between management and floor employees. The increase in attendance and numbers of open questions given is a metric used to

measure the change. Qualitatively, the participation is signal that the culture has incrementally changed for the better.

## CONCLUSION

This paper provides a framework for implementing safety culture change by using traditional process improvement methodologies applied to research performed by psychologists on the subject of organizational culture. The traits of culture outlined by Rensis Likert can be directly affected by evaluating and improving points of work outlined by Deming. It is these points that are more tangible to most employees and managers than the relatively abstract nature of changing “the culture”. Improving these tangible points (with guidance from Likert concerning the end goal of the improvement) offers a way for organizations to begin the process of culture change and a way for organizations to visualize what a positive safety culture looks like in their specific situation. The use of surveys and focus groups are recommended means to gather opportunities for improvement. These opportunities are then worked by employees close to the work and results fed back to management. In performing the improvements, the organization incrementally improves its safety culture as the act of improvement facilitates a more positive safety culture.

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