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## **Measuring Safety Performance to Achieve Long Term Improvement**

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### **ABSTRACT**

The paper summarizes the types of "event" reporting (near misses, first aid cases, OSHA reportable injuries/illnesses, etc.) and stresses the importance of measuring worker conformance to established systems, as an effective and necessary tool in order to control injuries, process upsets and catastrophic events. Such measurements allow risks to be identified before injuries and process events occur.

A system that identifies and controls non-compliance to established standards is much more effective than one which identifies and corrects errors after an injury or process event occurs. When errors are common, risk is increased. The greater the likelihood of error, the greater the chance of injury and process upsets. If a safety program relies on "after the fact" data to establish safety performance objectives, these goals will be difficult to reach and maintain. If a firm establishes proper methods to perform activities and employees perform as expected, injury performances will continuously improve as risk is reduced. The key is to establish effective safety systems and measure conformance to those systems to ensure activities are performed as expected.

Safety and health system improvements based on injury data and process events alone will produce limited results. Upstream activities that result in non-conformance must be identified and analyzed so that corrective actions can target system defects. Measuring the performance of individuals and the organization as a whole -- in order to identify non-conformance and reduce risks -- will produce long-lasting improvements. Only through continuous improvements is the goal of zero accidents achievable.

The paper outlines a six-step approach which can be utilized to change from the traditional system of "after the fact" injury measurement to a system where upstream activities are measured before the injury or process event occurs. The six steps are:

1. Establish Standards
2. Set Priorities
3. Reach Agreement
4. Establish Accountability
5. Develop Communications
6. MEASURE (audits and observations) Effectiveness

## **MEASURING SAFETY PERFORMANCE TO ACHIEVE LONG TERM IMPROVEMENT**

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Since OSHA was established in 1970, the common measurement for industrial safety performance has been OSHA Recordable Injuries and Illnesses, which includes lost workday and medical treatment cases. Because OSHA requires injury and illness statistics as a measure of performance, many companies identify the need to improve their safety systems when OSHA injury/illness rates are perceived to be higher than expected. Thus, injury/illness rates become the driver of the safety efforts. Program modifications are made as a reaction to OSHA statistics. In reality, OSHA statistics alone are not an accurate indicator to determine the effectiveness of safety and health systems and have little to do with improving safety systems and creating long term performance improvements. Therefore, many of these sincere efforts to improve performance have little, if any, chance of achieving their objective - the continuous reduction of injuries.

While elimination or reduction of injuries is an objective of every safety program, an effective plan to lower injuries must focus on continuing to reduce all potential risks to their lowest level, not only on eliminating the causes of the actual injuries which have occurred. A safety program which only addresses the causes of injuries/illnesses may produce minor safety performance improvements, but such an approach does not significantly reduce overall risk. Unfortunately, many safety and health programs plan their improvement efforts by reacting to OSHA statistics - numbers which in most cases

are not statistically significant and merely tell us how many of a specific class of injury have occurred. These numbers provide little insight into the quality of the safety and health efforts and have no direct, long term relationship on improving safety systems. However, they continue to be used to plan program changes. When the injury/illness rates are low, little change is planned, as the program is judged to be effective. When rates increase, changes are planned as a reaction to what is perceived as poor performance. This is like rolling the dice, since the changes are usually based mostly on perception and not sound, statistically significant data. In some cases, short term improvements might occur, only to see rates rise again. All too often, this cycle continues to repeat itself without a trend of continuous improvement over the long term.

When OSHA statistics drive the safety and health efforts, this rise and fall in performance should not be surprising. Reactions to short term rate increases identify short term solutions at best. While OSHA statistics are the most common measurement of the effectiveness of a safety and health program, they are downstream measures of performance. They document the number of injuries and illnesses resulting from workplace activities. Therefore, basing improvements only on past OSHA injury/illness data will address a small number of deficiencies which have occurred, while doing little to reduce the overall risks. Injury/illness data are a valuable and needed measure of performance, but they do not provide the necessary data to indicate why a specific level of performance was achieved. They are not accurate indicators to identify common deficiencies which have the potential to produce future injuries or events having significant consequences.

Since OSHA data merely provide a measure of the outcome of the effort, they do not provide a sound base for establishing a plan for improvement. Taking preventive action after each injury occurs only addresses a limited number of specific accident producing situations. Such actions rarely produce any changes to the systems which have been responsible for the injury occurrence. Preventive actions based on specific causes of an individual injury/illness may not produce a significantly safer workplace nor reduce a high injury frequency. These corrective actions usually address specific events and overlook the deficiencies in the system which allow injury producing situations to exist. Safety and health programs, which base improvements on OSHA data alone, usually fail to produce long term improvements as such data:

- Usually do not yield a sufficient number of data points to make an analysis statistically significant.
- Identify problem areas after the injury/illness occurs.
- Measure the outcome (statistical performance) of the safety program, not the potential hazards of the operations.
- Identify isolated events, not the overall risks and system deficiencies which allowed the events to occur.

The OSHA log of Injuries and Illnesses and the more detailed injury/illness reports required by OSHA focus on the nature of the injury/illness and provide limited information about the events which caused the injury/illness. A detailed accident investigation will identify the specific causes of the injury or illness. The corrective

action taken should prevent this specific event from recurring. Unless root causes are identified and addressed, injuries and illnesses will continue to occur and the same investigation procedure and corrective action process will take place over and over again. In most of these situations, the actions which resulted in many of the injuries or illnesses, probably were deviations from standard procedures. Such actions may have been performed many times prior to the injury or illness. However, no system was in place to identify these deviations, assess the risk and take preventive action before the injury/illness occurred. Without a system to measure the effectiveness of upstream activities, “after the injury” corrective actions will continue to take place.

Rather than focusing on the individual injuries and the statistical outcome of the safety effort, measuring conformance to established systems will allow risks to be identified prior to an injury occurring. Improving systems based upon the identified system deficiencies will reduce risk and produce an improved statistical performance over time.

Leading systems indicators such as documenting the percentage of unsafe behaviors, monitoring conformance to established standards, determining the effectiveness of safety training and monitoring the resolution of safety recommendations will help to identify and address areas which are “at risk”. These identified areas are where injuries/illnesses are likely to occur. Determining the root causes for these and other system deficiencies and taking corrective actions to improve the systems will produce long term statistical improvements by continuing to lower risks. Preventing injuries and illnesses by identifying and correcting potential causes before the injury or illness occurs is cost

effective. Focusing on corrective actions only after the injury/illness occurs is like closing the barn door after the horses have escaped.

OSHA injury statistics are an important measure of performance. Just as sales and income figures provide us with valuable information about the profitability of the business, OSHA statistics provide us with information about the state of the safety and health program. However, none of these figures by themselves can be used to successfully plan long term improvements. Upstream activities must be identified and measured in order to improve safety and health performance over time. Establishing systems to ensure activities are conducted safely and measuring the performance of such systems will ensure continuous improvement and result in lower injury rates over the long-term. Such efforts will produce a well coordinated program of systems and activities to identify and reduce risks. Reacting to each OSHA injury is a short-sighted, inefficient and ineffective method of reducing risks and will have limited impact on long-term performance improvements.

To change from the traditional system, which bases program improvements on injury/illness occurrence, to a system which emphasizes conformance to established methods and the correction of system deficiencies, will require a cultural change. In order for this change to take place, a plan to satisfactorily implement the new system, must be developed and implemented. A six-step approach (See Exhibit I) is outlined below to facilitate the change.

## IMPLEMENTING AN EFFECTIVE SYSTEM OF MEASUREMENT

### Step #1 - Establish Standards

In order to measure any system, well defined company standards must be established and documented. These standards will specify the agreed upon activities necessary to perform jobs in a safe and efficient manner. The standards will provide clear instructions on how tasks should be performed. In order for these instructions to be followed, they must reflect the everyday work values and requirements insisted upon by management and workers alike. The standards must be made part of the company culture and agreed upon by all employees, or the employees will eventually return to previous work habits, which may increase risk. When standards reflect reasonable, agreed upon work practices and fit the company's culture, measurement is merely an activity required by the system to determine conformance. An analysis of the data produced by such measurements, will indicate how well employees are following accepted work practices. For example, to measure the effectiveness of safety and health training, the training requirements and expected outcomes must be documented. Measuring conformance verifies the methods and activities specified in the safety and health training requirements are being followed. Measuring the expected results, determines the effectiveness of the system.

The activities necessary to reach the goals and objectives must be established and defined in order to develop a common measurement system. Without documented activities and common measuring systems, measurements are subject to interpretation. Such interpretations can be questioned, thereby rendering the measurement system ineffective. Identifying and documenting requirements also ensure employees know and understand how they are expected to perform their assigned tasks.

## Step #2 - Prioritize

Once the instructions and procedures for the various systems are documented, a decision must be made relative to “how” and “what” to measure. The areas where the greatest reduction in risk can be achieved should be prioritized. Unsafe behaviors would be a common area to measure for most safety and health programs. By measuring unsafe behaviors, safety critical behaviors can be identified. Safety critical behaviors are actions which have a high injury/illness potential or those actions which have produced severe injuries or a high injury/illness frequency. For example, the activities associated with lockout/tagout and entering confined spaces have a severe injury potential, if not performed according to established standards. Measuring conformance to established standards relative to lockout/tagout and confined space entry should be high on the priority list of most safety programs.

Any system or activity can be measured. No one safety and health program will produce the desired result for every facility. Therefore, selecting the activities to measure will be program specific. When selecting the appropriate systems to measure, the following items should be considered.

- Systems/activities which can produce the most desired outcomes, if performed according to the established standard.
- Systems/activities which can produce or have produced serious injuries/illnesses.
- Systems/activities which have the potential to significantly increase injury/illness frequency.

The Safety Performance Pyramid (Exhibit IV) illustrates the relationship between controls and consequences. A few elements of safety and health programs are identified at the base of the pyramid. Controls are adequate for a specific element when

1. Written instructions on how to perform the activities are developed;
2. A system to measure conformance/non-conformance to the activities is established; and
3. Preventive actions to address measured non-conformance are taken.

When all of the above steps are taken, the likelihood (frequency) of any consequence occurring is low. If controls are not implemented, non-conformance may routinely occur, and the likelihood of consequences taking place increases. By measuring conformance, the degree of risk can be estimated. When conformance is high, risk is low and consequences unlikely. When non-conformance is identified, preventive actions can be taken to reduce risk prior to the occurrence of consequences. The severity of the consequences, which might occur, will depend on the hazards associated with the activities being performed.

Measurements can be made by either observations or system audits. In either case, the measurements must be documented. Without documentation, there is no data to determine conformance to the existing instructions and procedures. Observations can be made by supervisors, safety personnel, operators and/or technicians. These observations can measure conformance to any documented instructions, such as personal protective equipment requirements, fork truck operations and confined space entry procedures.

This data will indicate the risks involved in performing the measured activities and

identify areas of non-conformance. Addressing the reasons why non-conformance occurs will reduce risks and improve long term statistical performance. Conformance to these up-stream activities ensures that control measures are being carried out to reduce risks. Over a period of time, the data from these observations can be analyzed to determine the percentage of observed conformance to the established procedures. The base of the pyramid in Exhibit IV identifies some common areas where conformance should be measured.

Audits are a more comprehensive and systematic method than observations and usually require that a specific number of observations be made for the purpose of determining conformance. For example, an audit to determine conformance to the personal protective equipment procedures may require a specific number of observations relative to eye protection, hand protection and/or foot protection to be conducted. When statistically significant numbers of observations have been conducted, a determination relative to conformance can be made.

### Step #3 - Agreement

Once standards of performance are established and prioritized, the success of the system will depend on the commitment of each and every employee to follow the standards.

It is essential that employees have input into developing the procedures they will be expected to follow. Procedures which document how activities are to be performed must be developed by those who will monitor conformance to the system (management) and those who will be expected to conform (operators, technicians, etc.). Once agreed upon, each employee must be held accountable to conform to the standard and to recommend

continuous improvements to the system. Any deviations from the agreed upon work practices or standards, places personnel at risk and increases the likelihood of an injury /illness occurring. Whenever such deviations occur, appropriate corrective actions must be taken.

#### Step #4 - Accountability

To achieve and maintain long term improvement, the following two rules are mandatory

1. Each employee must perform all assigned tasks according to the established and agreed upon standards each and every time, and
2. Each employee must be held accountable for conformance

In addition, supervisory personnel must ensure their subordinates understand what is expected of them. Supervision must be held accountable to ensure conformance, including enforcement and disciplinary actions, where necessary.

The base of the pyramid illustrated in Exhibit IV shows a few of the various program elements that can be measured to eliminate the undesirable outcomes which result when tasks are not performed according to the agreed upon standards. Outcomes closer to the base of the pyramid are more likely to occur than those closer to the top. The base of the pyramid contains only a few of the many program elements necessary to reduce risk and thereby prevent injuries and illnesses. The elements identified at the base will vary depending upon the specific safety program and its objectives, priorities and past accident history. (See Step #2 above). Resources usually do not permit all systems to be

evaluated and improved at the same time. Therefore, priorities must be established.

When measurements indicate that the objectives of the program elements identified at the base of the pyramid (Exhibit IV) are being met, they can be replaced by other systems or activities which are in need of improvement.

The elements selected for measurement must have written instructions prior to being placed at the base of the pyramid. These work instructions clearly define activities, state how the activities are to be performed, and indicate the expected outcome of the system. They should be agreed upon by all personnel - management as well as employees who are expected to carry out the activities - and should be approved by management personnel who must be held accountable for the system's success.

Safety and health is a shared responsibility among all personnel. Conformance to agreed upon and established work practices should be part of every employee's performance review. Line management is not only required to show employees how to perform their assigned tasks, but management must ensure that such instructions are followed by monitoring activities and taking corrective action, as appropriate. Serious and/or recurrent violations of established safety and health work practices are not acceptable. Such non-conformance should be treated the same as any work rule violation. In such cases, appropriate disciplinary action, up to and including termination, should be taken.

Step # 5 - Communications

Injury/illness prevention depends on the active participation of all personnel. This involves performing all activities according to agreed upon standards, providing feedback to improve current systems and taking an active role to resolve safety and health issues. All personnel share the responsibility to ensure operations are performed in a safe and efficient manner, events of non-conformance are identified and preventive actions are taken to continuously improve safety and health.

To ensure all personnel understand the objectives of the safety and health effort, they must understand their roles in carrying out the objectives, their responsibilities, and how they are expected to perform their assignments safely and efficiently. These items must be part of the routine communications to each and every employee. In addition, employees must understand:

- the short term and long term objectives of the safety and health program,
- the strategy for achieving the objectives, and
- the organization's commitment to achieve safety and health performance excellence.

It is necessary to communicate all elements of the plan outlined herein, as part of the strategy to improve safety and health performance. Each employee should understand the elements of the plan and how the plan will be carried out. Periodic progress reports should provide updates towards achieving objectives and report the current level of performance. Individual departments or business areas should communicate progress towards achieving the department's/area's objectives at meetings or through other communications, as appropriate.

Non-conformance can result from different types of system failures. These failures include the lack of adequate instructions to employees on how to perform their assignments and the failure to ensure that communications are understood.

#### Step # 6 - Measurement

Once the system has been designed, documented and communicated, conformance to the specifications listed in the instructions can be accurately measured. Whether or not injuries/illnesses occur will depend on performing activities according to the specifications and the inherent hazards associated with the performance of the activities. When evaluating safety systems, priority should be given to those activities which produce the greatest risk. Hazard identification and reduction (elimination) are recognized as critical to the success of safety and health programs. Measuring conformance to established standards is part of the continuous improvement process and is essential to identify and reduce risk.

Determining the specific elements to measure can be obtained from several sources, including:

- incident/accident investigation reports
- past observations and deficiencies
- employee suggestions
- site safety and health inspections
- safety and health audits

Measuring conformance will not produce results unless the areas of conformance and non-conformance are analyzed, root causes for deviations are identified and preventive actions are taken so that conformance to established systems can be increased. When non-conformance is common and/or can produce significant consequences, preventive actions should be identified and incorporated into future plans to improve the system, not only the individual non-conformance. Periodic reports measuring conformance and non-conformance should be prepared and the results communicated to the affected employees. Employees should provide feedback on why actions of non-conformance occur and methods to increase conformance.

The importance of improving system conformance can be illustrated by the following example. An employee handles a substance which is mildly irritating to the skin. An assessment of personal protection equipment has been made. The assessment has been documented and discussed with the employees. There is agreement that gloves are necessary to safely handle the substance. The written personal protective equipment requirements, which are the program's standard of conformance, clearly indicate that gloves are required while performing the task. If an employee does not conform to the established hand protection requirements, contact with the material may occur on occasion and no injury may result for a period of time. However, continuing this unsafe behavior will place the employee at risk and increase the probability of an injury or illness occurring. When the injury or illness occurs, it will be investigated and classified,

probably as a first aid or OSHA recordable injury/illness and corrective actions taken to prevent a recurrence.

However, if the conformance to agreed upon specifications was measured through observations, the non-conformance (lack of required protection) should have been identified, and if properly addressed, the potential for an injury/illness would have been significantly reduced or eliminated by addressing the “at risk” behavior prior to the injury/illness.

The root causes for the non-conformance should also be identified. In the above example, additional assessments and observations should determine if the lack of required and agreed upon protection is an isolated incident involving one individual, or if non-conformance is common practice among the workforce in a specific area or throughout the site. Conducting root cause analyses will allow the system deficiencies, rather than only the cause of the specific event, to be identified and addressed. Through measurement of these upstream events of non-conformance, injuries/illnesses can be prevented by taking corrective action based upon measured non-conformance. When a non-conformance is observed, additional measurements will determine if this is an isolated occurrence or if an inherent problem within the system exists.

The traditional approach to safety management has been to wait for the injury/illness to occur before initiating the measurement system and then implementing corrective action. Usually, such corrective actions only address the specific event and not the system

deficiencies which allowed the injury/illness to occur. Such an approach only identifies the specific non-conformance which produced the injury and takes place after the injury occurrence. This is an inherent problem with an “after the injury” management program. This basic management problem was recognized by Philip Crosby in his book “Let’s Talk Quality”. Crosby states, “Quality management is a systematic way of guaranteeing that organized activities happen the way they are planned”. He further states that conformance to the established activities will prevent “problems from occurring by creating the attitudes and controls that make prevention possible”. By measuring planned activities, we can evaluate conformance and take appropriate preventive actions, when non-conformance is identified.

Before any system can be effectively measured, it must be clearly defined. Therefore, it is necessary to ensure that a system has been established and the expected methods to perform activities within the system have been documented. Well designed systems will contain clearly stated objectives; as well as define how activities are to be performed to meet the objectives. Required activities should be agreed upon by the personnel who must perform the activities, as well as the personnel who must supervise the activities. If either agreement on the activities has not been reached or the activities have not been well defined and documented, measurements can be questioned, thereby rendering the measurement system ineffective.

To produce the desired outcome, it is necessary to determine what activities need to be measured and what data must be recorded. Each system must have an objective. It is

desirable to measure the effectiveness of the system's activities towards achieving its objective. For example, measuring the performance of department safety meetings may be part of the measurement system. One measure of performance might be to monitor the number of meetings conducted relative to the established standards. However, ensuring meetings are conducted does not ensure they are effective and all objectives are being achieved. Such meetings usually have several objectives including:

- obtaining employee suggestions to improve workplace safety.
- communicating new work practices.
- reviewing existing work practices.
- monitoring the status of safety and health recommendations.
- reviewing incidents, their causes and necessary preventive action

Therefore, several measurements for determining the effectiveness of safety meetings can be identified. These include measuring:

1. the number of meetings conducted
2. the number, validity and impact of suggestions received
3. the number of issues and problems discussed and resolved
4. worker input to improve current activities, and/or
5. system improvements resulting from suggestions.

Monitoring the above items, gathering the data and analyzing the data relative to the established requirements and objectives for department safety meetings will provide a clear measure of the status and effectiveness of such meetings. The effectiveness of any one of the above items could not be objectively measured unless safety meeting

requirements are defined and documented and a measurement system is established.

Such a system must indicate the frequency of meetings, how they are to be conducted and the meeting objectives. Without such standards, any measurements would be subjective and with little or no meaning. There would be no common measurements, and the effectiveness of the system towards reaching its goals would be unknown. Exhibit II provides additional information on measuring systems.

The objective of the measurement system is to determine conformance to established and agreed upon standards in order to continuously improve the system. The primary objective is not to serve as an enforcement tool or to determine disciplinary actions. However, when flagrant or repeated events of non-conformance occur, disciplinary action is necessary.

Conformance measurements can be made on any documented element of a safety and health program. It is important to set a quantitative measure for each element. When personnel clearly understand the objectives of the system, they will strive to reach them. When the objectives are quantified, everyone knows when they have been achieved. For example, if the objective for each supervisor is to conduct a monthly safety meeting, at the end of the year, he/she has either met the goal by conducting twelve meetings or has not met the goal. This is not a matter of opinion, but a matter of fact supported by data from the measuring system. It is a good example of how quantitative goals can be used to measure the success of the system. Quantitative goals are important because they

clarify and communicate what good performance means. Thus, they provide guidance to achieve the objective and move the program in the desired direction.

Quantitative goals provide an excellent mechanism to support change by identifying the activities which have produced desired results, as well as those activities which have not been effective. The above mentioned department safety meeting goal can be used as an example. If the objective is to conduct a monthly safety meeting, and a measurement system, which provides a periodic status report toward achieving this goal, is provided, on-going progress can be readily determined. With the current status of the system's objective identified, a clear understanding of performance and of what has been accomplished, as well as what needs to be accomplished, is evident. Exhibit III lists some of the benefits of measuring conformance to established systems.

## CONCLUSION

To maximize performance improvements and effectively reduce risks, safety and health measurements must focus on conformance to system activities prior to the injury, not on the final outcome of the system - injury performance. A system which identifies and controls non-conformance to established standards of performance is significantly more effective than a system which identifies and corrects errors after the injury occurs. When errors (non-conformance) are common, risk is increased. The greater the likelihood of an error, the greater is the chance for an injury to occur.

If the proper methods to perform activities are established and employees perform the activities as expected and agreed upon, injury performance will continuously improve as risk is reduced. Measurements must be performed to assess how well the systems are being followed and to establish plans to continuously improve the systems. When effective systems are established, implemented and measured for conformance, safety statistics will improve. If the safety program relies on “after the injury” data to establish safety performance improvements, the performance goals will be difficult to reach or maintain and risk reduction will be limited.

Safety and health system improvements based on injury/illness data alone will produce limited results. Upstream activities, which result in non-conformance, must be identified and analyzed so that corrective actions may address system defects prior to the injury. Measuring the performance of individuals and the organization, as a whole, will produce long lasting performance improvements, by continuously identifying non-conformance and reducing risks to their lowest levels. Only through continuous improvement is a goal of zero accidents achievable.

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## **BIOGRAPHY**

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## **Description of Presentation**

Analyzing only OSHA injury data is an inefficient and ineffective method to predict and prevent future injuries/illnesses. By use of a six-step system of quality management principles, an effective method to measure performance and improve safety, as well as operational effectiveness, can be established. This “up-stream” measurement system can be used to identify areas of non-conformance and take corrective actions before such situations result in incidents and injuries. This allows future plans to be based on actual performance data, thereby making long-lasting improvements in areas where deficiencies can produce personal injuries/illnesses and process events.