Session No. 710

Achieving World Class Safety Performance Through Metrics

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Introduction

Metrics are a powerful tool for the achievement of excellence in safety and health management. The combination of leading and lagging indicators can provide an evaluation of current system operations and also a prediction of future performance.

This paper will discuss the use of metrics to help your organization reach a higher level of safety and health performance that includes: 1. Developing measures based on validated hypotheses, 2. Using a "Loss – Cost" sequence that provides a relationship between measurement and return on investment and 3. Using the insight gained from these actions to establish a foundation for risk assessment at your organization.

It is interesting that most safety performance conversations end up being a discussion about frequency rates, severity rates and possibly disability rates. The problem with this perspective on safety performance is that these types of measures are lagging in nature. They talk more about what happened yesterday and may not be entirely consistent with what is happening today and what you can predict about tomorrow. The combination of these leading and lagging measures will provide a better prediction of future outcomes in that they balance what has occurred with the present and what is changing over time.

Loss-Cost Sequence

In the past, it has been common to focus more on Claims and their costs instead of identifying System Variance that poses Risk. Figure 1 shows the relationship between different elements that range from System Variance to Cost. Whether you call them discrepancies, differences or even deficiencies, all systems have some variance and it is that variance that creates risk.

Risk creates the opportunity for process failures or deviations from what would have been done under ideal circumstances. It is these deviations that result in incidents and incidents cause harm, claims and incurred costs.

From a safety perspective, the further upstream the intervention strategy, the greater the return on investment. Although it is more difficult to measure, the more productive the measurement will be.

Conversely, the further downstream the strategy, the more easily the effects can be measured; however, the less effective the intervention will be at resolving the source of the issue. One example involves providing first aid after an injury occurs compared to performing risk assessments to identify and reduce risk upstream. Bottom line, systems are the key to understanding the potential for loss and therefore the prediction of loss.

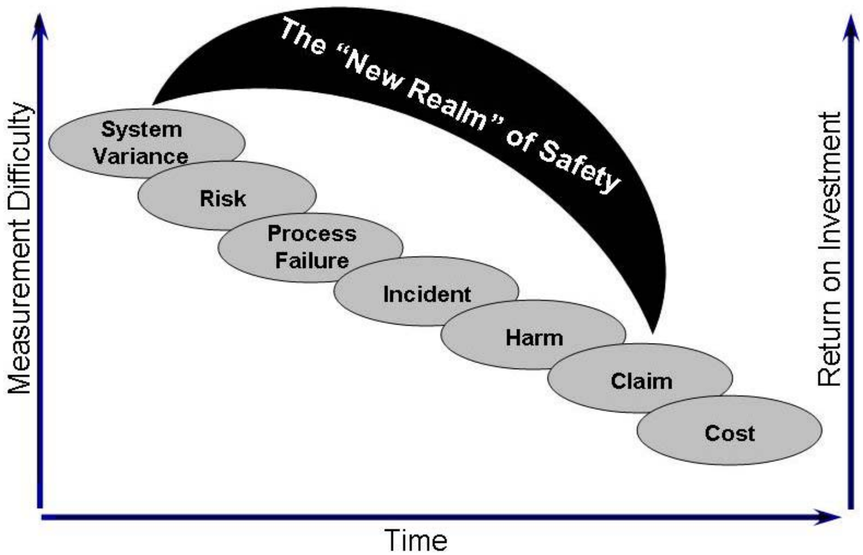


Figure 1. Loss- Cost Sequence

In order to be better able to identify and measure system variance and risk, a predictive and prescriptive approach was developed. The following discusses this process:

- It begins with hypothetical relationships between what can be done and what might be achieved
- Requires development of diagnostic tools to assess situations and gather data
- Draws on identifying trends in the data gathered to test the hypotheses
- Depends on prescriptive actions that affect situations

Figure 2 shows the relationship between assessment, prediction and prescription. As you can see, there is a continuous improvement flow between all three areas. Assessments are completed to understand specific situations and they can include quantitative measurement, qualitative observation, informed judgment and diagnosis.

Prediction involves understanding the effects of changing situations. Pooled data allows testing of hypothetical relationships. As the database grows, the assessment is refined and prescription improves. As the quality of assessment and prescription increases, so does predictability.

Prescription involves changing a situation by using specific interventions, an integrated strategy, effect and progress measurement, and continuous improvement.

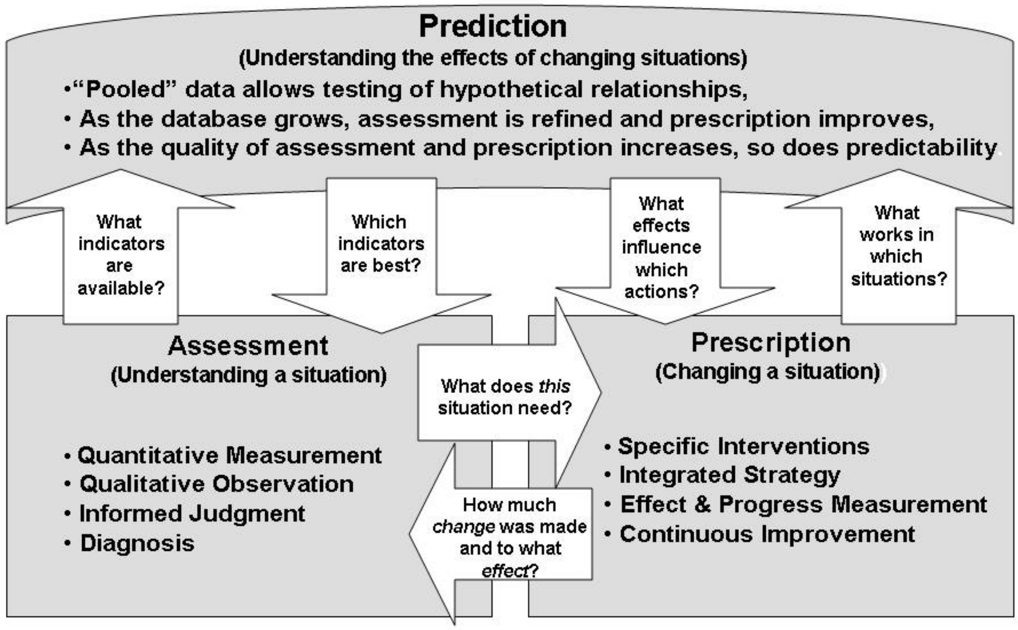


Figure 2. Assessment, Prediction & Prescription

Measuring World Class

World Class is a term for a high level of competitive performance as defined by benchmarking and the use of best practices. It is also describes organizations that are recognized as the best for at least one critical business process and are held as models for other organizations.

Since all sustainable improvement is incremental, measurement of process and progress is integral to world-class pursuit. Baseline and subsequent performance measurements are required to assess process improvement. Assessment methodology effectively measures continuous improvement and supports prediction.

The following lists World Class values:

- Accept no level of harm as a cost of doing business
- Measure success against your baseline versus industry benchmarks
- Management and non-management are mutually supportive functions
- People are the source of solutions
- No opportunity to improve is "off limits"
- Program continuous improvement into everything
- Reinforce and reward deliberate incremental improvement

Optimized Systems

Figure 3 shows how systems work. The inputs include environment, capability and motivation. The process is where the work actually is done. The outputs can be productive or nonproductive which includes acceptable and unacceptable.

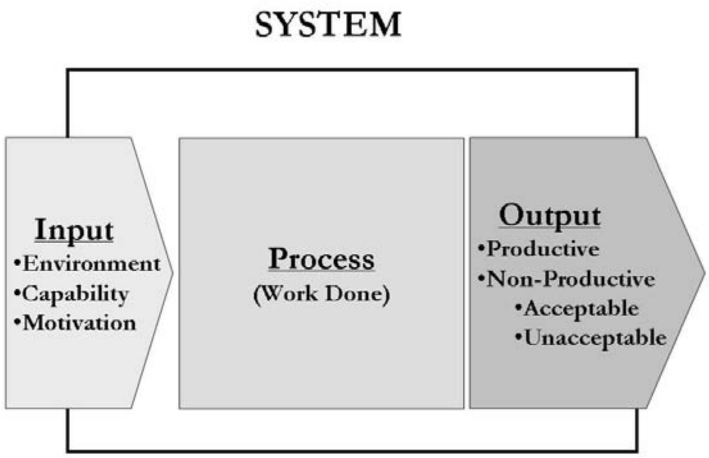


Figure 3. How Systems Work

Figure 4 shows the productive output in the center of the bell curve distribution. The unproductive and unacceptable outputs are located to the left and the right of the center areas. Depending on the situation, the unproductive and unacceptable outputs to the right of the center could be acceptable. One example would be the distribution of SAT scores. Although the majority of the scores are in the middle and the lower scores are located to the left, the higher scores on the right would be desirable and acceptable.

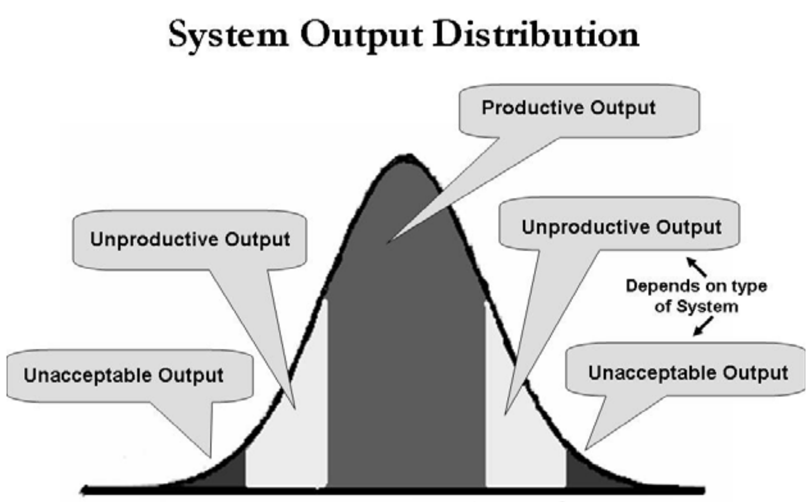


Figure 4. System Output Distribution

Figure 5 shows the relationship of Quality, Safety and Efficiency in Optimized Systems. The concept of Quality, which includes Six Sigma, deals with output variance reduction. Safety which includes risk reduction techniques such as R3™ (Residual Risk Reduction) is the second of the three important elements. Efficiency, which includes Lean Manufacturing, focuses on waste reduction.

Optimized systems provide:

1. Work products that people want,
2. Workplaces people want to be in,
3. Futures people want to invest in,
4. Business partners that vendors want and
5. Corporate neighbors that communities want.

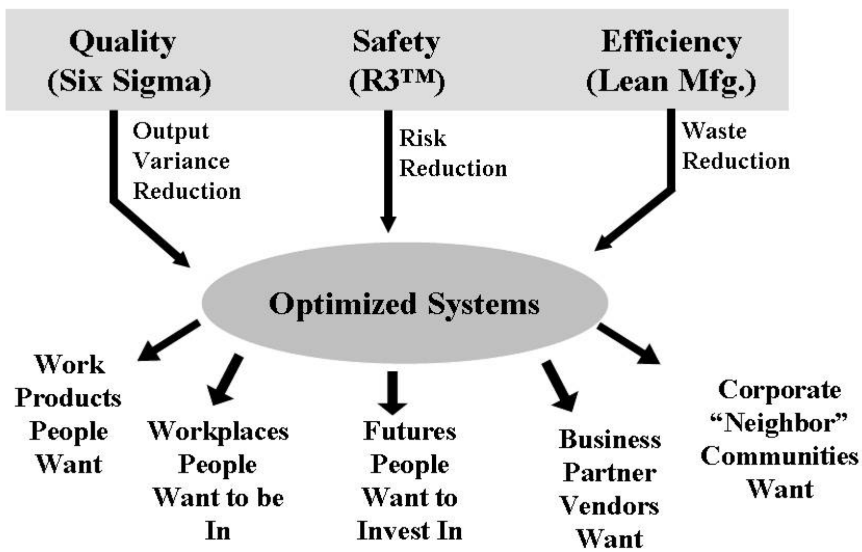


Figure 5. Optimized Systems

Predictive & Prescriptive Approach

Figure 6 shows the importance of the predictive and prescriptive approach which is based on assessment, diagnosis, research and evidence. One example of illustrating this approach is to examine the doctor – patient relationship. If you went to a doctor with a problem and the physician did not ask any questions about your health history / symptoms or recommend tests and immediately gave you a prescription, you probably would feel that you did not receive excellent medical care.

Predictive & Prescriptive Approach Based on Assessment, Diagnosis, Research & Evidence

Figure 6. Doctor – Patient Relationship

The same situation applies in the area of safety. If the risk manager, safety manager or insurance safety consultant did not examine your organization's past history, ask questions or conduct assessments and immediately prescribed improvements, you probably would not feel very confident about the action plan. That is why it is important to assess, diagnosis, research and study evidence in order to predict and prescribe effective safety interventions.

To start the process, it is important to first ask the question: "What do you want to achieve in the short and long range?" It sets the stage for the follow-up question: "How will you measure the achievement?" Some potential goals / objectives could involve producing more pieces per hour, performing more deliveries per hour, achieving lower cost per item, etc.

This leads to the discussion of what can be done to affect the measures of success, given that measures of success (outcomes) cannot be directly managed; they are dependent variables. They can only be affected by changing the independent variables which are vast in number.

Stakeholder Discussions

There are a variety of individuals with something at stake in the success of every enterprise. Measuring success, and what is done to achieve it, assures that all stakeholders are informed. It is critical to determine how management will know if they have shown success. It is also important to involve employees in safety decision–making. Without employee involvement, valuable ideas and support will not be achieved.

It is essential to discuss the desire to impact safety metrics such as:

- Risk versus Loss focus
- Experience Modification Rate (EMR)
- Frequency rates
- Loss rates
- Severity ($)

- Severity (lost time days), etc.

The reasons for measurement include:

1. Finding out how the performance of one entity compares to others or to itself over time.
2. Knowing when change is needed and what needs to change in order to achieve improvement.
3. Finding out whether interventions work and how well.
4. Knowing when use of reinforcement, and what type, is advantageous.

Identifying & Selecting Metrics

The following lists important concepts concerning identifying and/or selecting organizational, location, department, team, managerial, supervisory and individual employee metrics:

- Group vs. individual data
- Importance of the performer having the ability to affect the metric
- Behavior-based and result-based measures
- Objective vs. subjective; Representative
- Safety measurements are feasible, clearly understood and determine the presence of safety
- Understanding the upstream factors that may affect the solutions and the downstream effects of the solutions

Figure 7 lists three types of metrics that can be used for measuring safety performance. The first are outcome metrics or the measures of results achieved which include frequency, severity and disability rates. Next are process metrics or measures of how a process is working. Examples include program audits and workplace observation of safety practices measured as percent safe, which is the ratio of observed safe practices to total observations.

The third type of metrics is progress metrics or measures of how much progress or improvement has been made over time. This is defined as incremental improvement over time or percent improvement over baseline. Progress metrics are an important part of understanding safety performance and therefore prediction of outcomes. One such progress metric is the measure of risk and risk reduction over time.

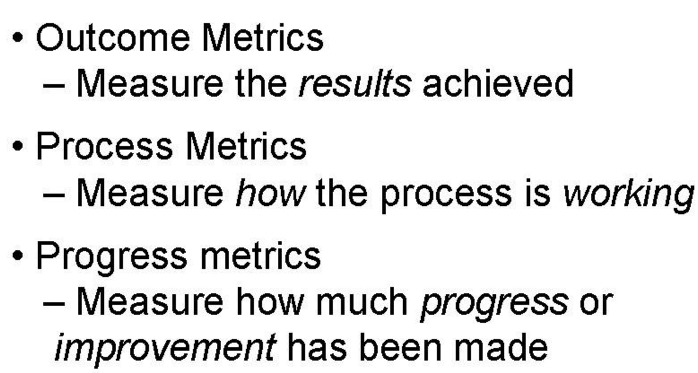


Figure 7. Three Types of Metrics

Figure 8 illustrates the relationship between process metrics and outcome metrics. It shows a cascade of processes that contribute to the outcomes produced by any endeavor. While it may be difficult or impossible to predict or manage all of the factors that influence the outcomes we experience, it is possible to identify critical indicators of process effectiveness. By managing these factors, we can influence the outcomes we are seeking.

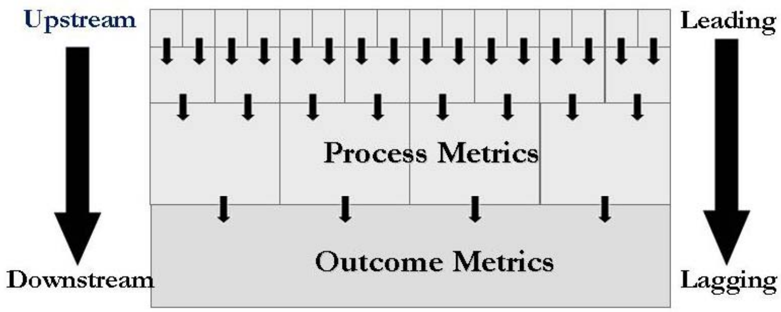


Figure 8. Process & Outcome Metrics Relationship

It is important to note that outcome measures have a tendency to flow out of our endeavors. Some outcome measures (including undesirable ones) are available without much investment to achieve them. Conversely, process measurement involves some effort or resource. Rigorous discipline is required to understand the process, to find what to measure and then collect and analyze that process data. Without this, the data can be non-factual and misleading. Or more simply stated, bad data is usually worse than no data at all.

From a Workers Compensation perspective, frequency and severity outcomes can be calculated without a large amount of time or investment. But to measure a work process and what an employee does during a work day and work week requires time, effort, discipline and resources such as technology to capture and manage the data.

Figure 9 shows an example of metrics using the theme of baseball. Process metrics include strikes thrown, batting average, earned run average and games won. Outcome metrics include television revenue, fan attendance and franchise profit.

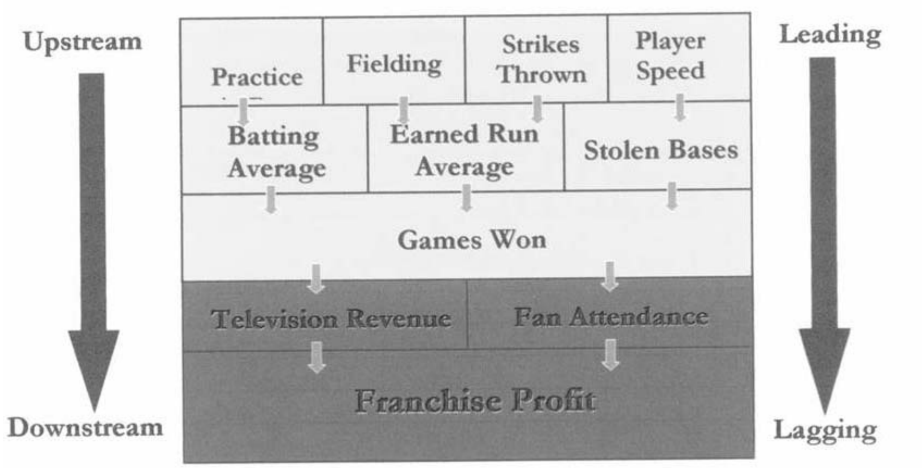


Figure 9. Process & Outcome Metrics Baseball Example

If it is possible to measure and relate process to outcome, then it is possible to also look at progress or the extent to which there is gap closure or progress in closing the gap between current performance and that identified as optimal. This concept of gap and gap closure is an important one in considering additional means of predicting outcomes.

An organization that understands its current risk and the gap between current risk and acceptable risk (and can measure gap closure), will be better able to say something about outcomes than an organization that knows little about risk and unknowingly accepts it.

One important measure of progress is Percent Improvement Over Baseline or PIOB. (Figure 10) It indicates how much improvement has occurred and is calculated as follows:

Percent Improvement Over Baseline = (Current Level - Baseline) / (Optimum – Baseline) x 100 or Actual Improvements / Maximum Improvement Opportunity x 100.

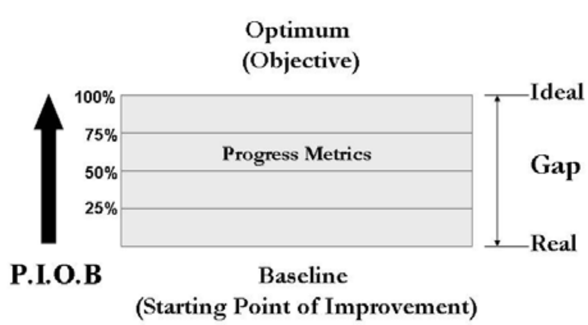


Figure 10. Progress Metrics

This metric has utility in the area of process and outcome metrics, and is particularly useful in measuring performance change. For example, consider a situation in which the baseline performance for a behavior is determined to be 60%. At this starting point, there is a maximum improvement opportunity of 40 percentage points. By increasing performance to 80%, a 20% point gain, half of the maximum improvement opportunity has been achieved. (80 – 60) / (100 – 60) x 100 = 50%

By considering the resources expended to make the incremental improvement, efficiency of the improvement project can be measured and used comparatively to identify best practices and opportunities to improve future improvement efforts. The project score is another progress metric and can be calculated as follows:

Project score = PIOB / Time invested in the improvement = PIOB's / $'s invested in the improvement. This measure of the improvement over baseline and the efficiency with which the gains were achieved can be correlated to outcomes.

It is important to remember the big picture which includes effect and process efficiency. Two questions concerning effect are: 1. Are the outcomes identified as important moving in the right direction? and 2. Is the improvement related to process?

Two other questions concerning process efficiency are: 1. Are our improvement projects being completed? and 2. Are our resources being utilized optimally?

Some examples of lagging safety metrics are:

- Number of claims/100 employees (200,000 employee hours)
- Claims dollars/100 employees (200,000 employee hours)
- Number of days away from work/100 employees (200,000 employee hours).

These metrics can be used for various areas such as Workers Compensation, General Liability, Fleet, etc.

Figure 11 shows a robotic work cell and you are asked to develop some examples of potential leading safety metrics.

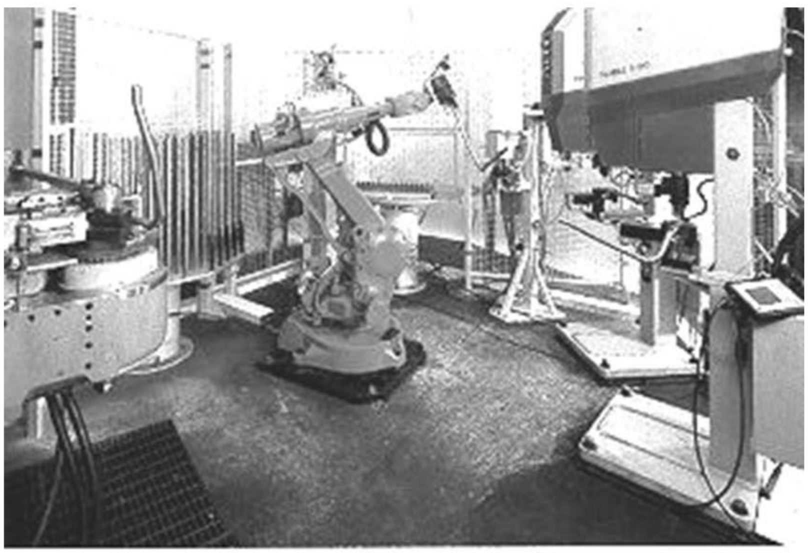


Figure 11. Robotic Cell – Examples of Leading Safety Metrics?

Some possibilities could include: Number of employees receiving robot safety training/month, Number of supervisors receiving ergonomics training/month, Number of positive behavioral observations/month, and Number of process hazard reviews/month (or quarter).

It is important to also discuss the desire to impact other metrics such as:

- Production
  - Units per hour produced
  - Cost per unit produced

- Quality
  - Defects per million units produced
  - Returns per million units shipped

- Human resource
  - Turnover
  - Attendance

It is essential that none of these metrics conflict with each other, or with safety measures. Example: As units per hour produced increases, the number of defects per million units increases.

Hypotheses Concerning World Class Safety Performance

There are six essential categories
:
Core drivers (organizational imperatives)

- Management direction
- Employee involvement

Cornerstones (operational imperatives)

- Risk assessment
- System analysis
- Integrated solutions
- Progress measurement

From a global perspective, there are several standards that apply to occupational safety and health. One is ANSI/AIHA Z10 – 2005: Occupational Safety and Health Management Systems. This is a United States consensus standard on safety process management and administration. Another is OHSAS 18000: International Occupational Health and Safety Management System. It incorporates numerous EU and other safety process documents.

Figure 12 shows different types of assessment instruments that range from opinion based to consensus-based to evidence-based. Surveys and questionnaires tend to be opinion based and take a lower amount of resource investment to complete; however, the quality of predictive and actionable output is also low.

Qualitative assessments are more consensus-based and take an average amount of resource investment and provide an average quality of predictive and actual output. Specific process assessments and qualitative/quantitative assessments are normally more evidence-based and take a higher amount of resource investment to complete. The quality of the predictive and actionable output is much higher.

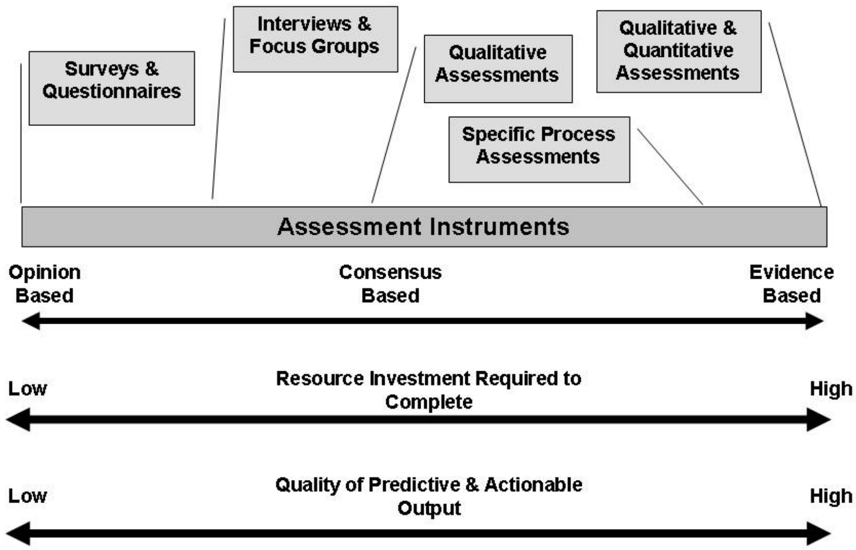


Figure 12. Examples of Assessment Tools

Diagnostic Tools

In order to design the diagnostics, it is necessary to decide what we want to examine, along with what indicators are available and which are the best. Hypotheses need to be developed and tested for validity using data that is reliable. The results can be used for predictive and prescriptive modeling which will help achieve repeatable reductions in risk / losses and improvement in morale, productivity and efficiency.

World Class Safety Assessment (WCSA™) – Background and History

The project scope was to develop an assessment instrument that would:

- Measure safety outcomes (lagging metrics)
- Measure safety processes (leading metrics)
- Assess the relation between safety processes and safety outcomes (validate hypotheses)
- Lead to actionable suggestions to close the gap toward world-class safety

The World Class Safety Assessment (WCSA™) consists of a core assessment and multiple sub – assessments. It provides "evidence-based" assessment of performance and is completed by a loss prevention assessment team. It includes a mix of interview questions, documentation review questions and behavioral observations. Question scoring uses absolute, frequency and categorized responses. It provides prescriptive actions for improvement opportunities and includes methodology to prioritize prescriptive actions.

Figure 13 shows that there is a core assessment that is universally applicable and addresses six essential categories. The process assessments provide specific drill down as needed and include customized assessment of customer specific loss sources.

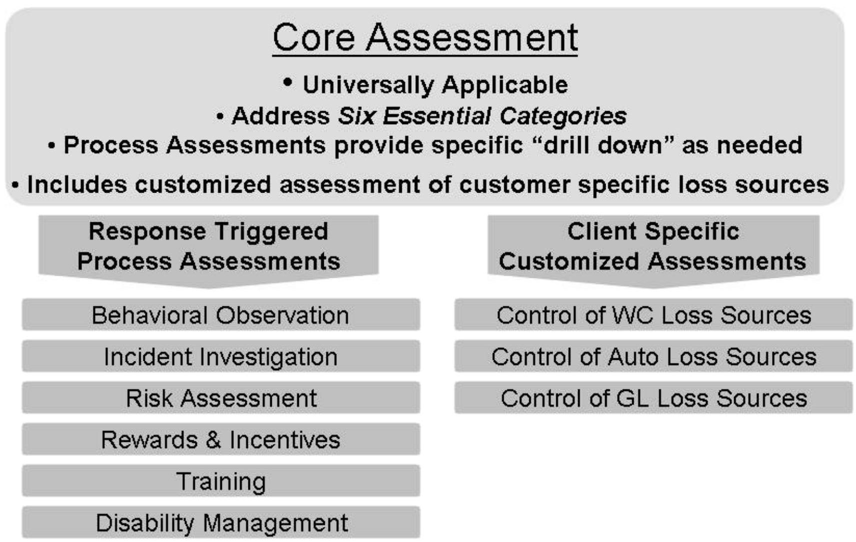


Figure 13. WCSA™ Assessment

Figure 14 shows a sample Management Commitment question with the hypothesis, interview question and response categories.

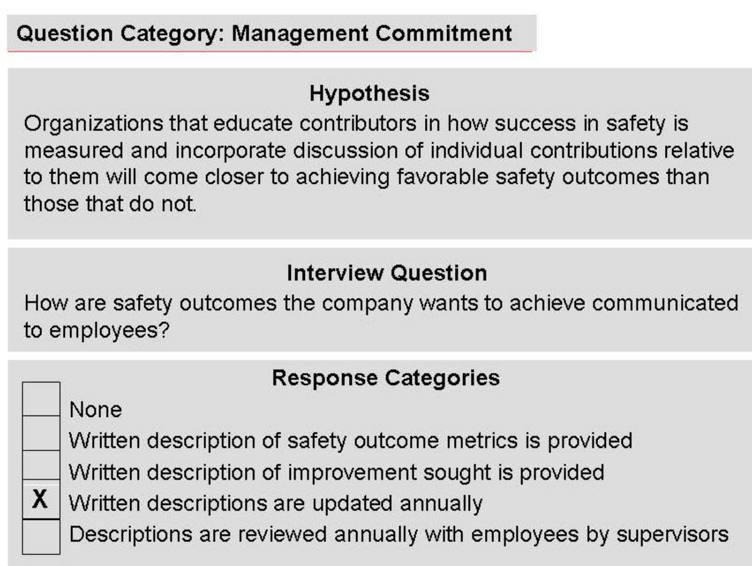


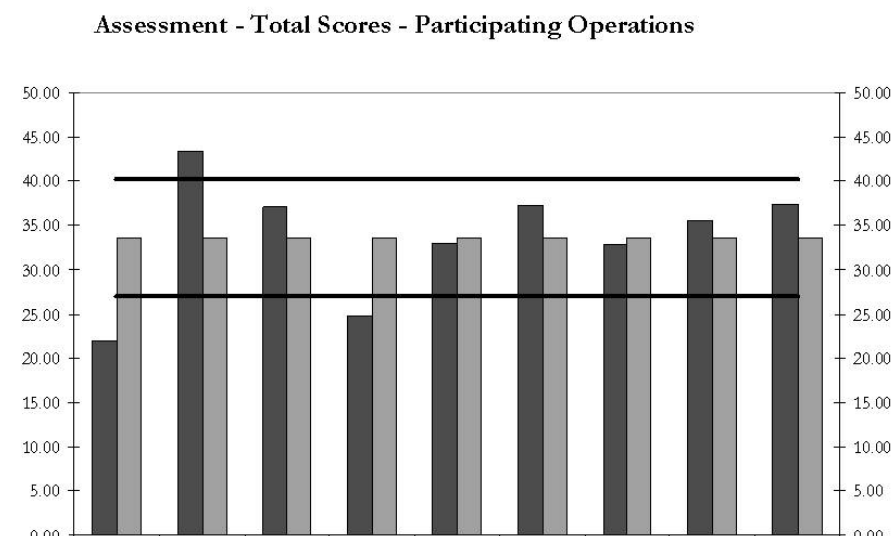
Figure 14. WCSA™ Sample Hypothesis & Question

Technology

Technology is very important and is used to collect the data using a reliable means for gathering facts. It is also used to aggregate the data for accurately pulling facts from different sources together and to analyze the data by using an efficient means for determining what the data indicates. This can involve distribution, comparative, correlation, trend and forecast analysis. Technology is also used as an adaptable means for communicating actionable information to various stakeholders.

Data Analysis

Figure 15 shows the total score for each of nine locations that participated in the initial assessment. The mean score and standard deviations are also shown and the chart shows Locations 1 and 4 have the largest opportunities for improvement. Location 2 has the highest score and the remainder of the location scores is within plus or minus one standard deviation.



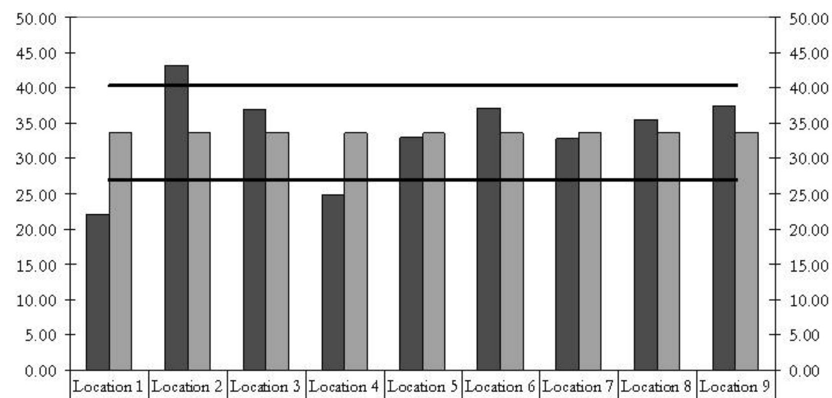
	Location 1	Location 2	Location 3	Location 4	Location 5	Location 6	Location 7	Location 8	Location 9
Total Score	21.97	43.31	37.00	24.80	32.95	37.15	32.86	35.49	37.39
Total Mean Score	33.66	33.66	33.66	33.66	33.66	33.66	33.66	33.66	33.66
Mean + 1 SD	40.28	40.28	40.28	40.28	40.28	40.28	40.28	40.28	40.28
Mean - 1 SD	27.04	27.04	27.04	27.04	27.04	27.04	27.04	27.04	27.04

Figure 15. WCSA™ Total Scores

Analyzing the data showed a statistical relationship between higher WCSA™ performance and improved safety outcomes. Baseline performance levels were established for each operation assessed, and continuous improvement has been measured going forward. Follow – up assessments allow for statistical comparisons of the changes in performance to the changes in outcomes achieved.

Figure 16 shows the outcome measures and correlation coefficients. Correlation is the measure of relation between two or more variables. It is expressed as coefficients with ranges between -1.0 and + 1.0. A -1.0 represents a perfect negative correlation (as one variable increases, the other decreases at the same rate or degree). A +1.0 represents a perfect positive correlation (as one variable increases, the other increases at the same rate or degree). Zero represents no correlation between the variables.

Assessment - Total Scores - Participating Operations



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Mean + 1 SD	40.28	40.28	40.28	40.28	40.28	40.28	40.28	40.28	40.28
Mean - 1 SD	27.04	27.04	27.04	27.04	27.04	27.04	27.04	27.04	27.04

Outcome Measure	Correlation Coefficient (Pearson "r") to Assessment Total Score
Current Year Frequency Rate	**- 0.61**
Current Year DART Frequency Rate	**- 0.42**

Figure 16. WCSA™ Outcome Measures & Correlation Coefficients

The current year Frequency Rate Correlation Coefficient was -0.61 and the current year DART (Days Away Restricted Transferred) Frequency Rate Correlation Coefficient was -0.42. This shows that as the assessment scores increased, the frequency rates decreased. Each hypothesis and question were studied for validation.

The following is a WCSA™ Value Summary:

- Performance strengths and best practices that correlate to improved results are identified, and these can be transferred to other operations
- Management is assisted in making informed business decisions on which safety activities are actually producing results and should take priority
- Safety strategies and support needed from higher levels in the organization (i.e. corporate, region, division, etc.) are identified
- Each operation is provided with "prioritized" prescriptive actions to improve performance (even the highest performers).

Conclusion

Metrics are a powerful tool for the achievement of excellence in safety and health management. The combination of leading and lagging indicators can provide an evaluation of current system operations and also a prediction of future performance.

Your organization can reach a higher level of safety and health performance by following these principles:

1. Developing measures based on validated hypotheses,
2. Using a "Loss – Cost" sequence that provides you with a relationship between measurement and return on investment and
3. Using the insight gained from these actions to establish a foundation for risk assessment conducted at your organization.

The combination of these leading and lagging measures will provide a better prediction of future outcomes in that they balance what has occurred with the present and what is changing over time.

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