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Aligning Risk Assessment and Risk Mitigation Methodology with Business Processes

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Introduction

Risk identification, evaluation, quantification, and reduction form the underpinning of the safety profession (Liberty Mutual 2009). Why is it then, that safety professionals often struggle to get risk assessment processes recognized and accepted as integral to the health and safety and risk management processes in many organizations?

This paper will provide an overview of risk assessment and risk mitigation concepts, and provide a case study example of how one organization successfully aligned these concepts with their business processes and substantially improved their safety performance.

Risk Assessment Overview

Risk Assessment is defined as the processes for indentifying, analyzing and evaluating risks (ISO 31000:2009). Manuele (2009) states that the entirety of purpose of those responsible for safety, regardless of their titles, is to identify, evaluate, and eliminate or control hazards so that the risks deriving from those hazards are acceptable. Thus, a primary responsibility for any safety and safety practitioner is to help others better understand the risks they face, and make informed judgments on acceptability of risks.

Lowrance (1976) defined risk as the probability and severity of harm. Therefore, understanding the risks of any particular system requires assessing the combination of the probability of occurrence of harm and the severity of harm for the risks within that system.

Risk assessment is the process by which hazards are identified and the level of risk is determined through quantitative or qualitative analysis. As outlined in Eaton and Little (2010), a sound risk assessment methodology will typically include these process steps:

1. Identify the hazards and risks associated with the work system or process.

2. Measure and evaluate the frequency of exposure, severity of the consequence should a loss occur, and the probability of occurrence.

3. Analyze the risks associated with the work system and determine appropriate ways to control the hazards and reduce the risks to an acceptable level.

4. Develop and implement additional mitigating controls, if necessary, to reduce risks to an acceptable level.

5. Monitor the effectiveness of the mitigating controls and periodically observe to identify potential new risk exposures.

While risk is typically associated with harm or damage, utilizing risk assessment methodology enables risk to be viewed in a positive context, and therefore allows organizations to proactively identify and control future potential losses. The goal of the risk assessment process, and the subsequent mitigating controls, is to achieve an acceptable level of risk. The risk assessment and mitigation processes are not complete until acceptable risk levels are achieved (Manuele 2008).

Risk assessment is a foundational element in both risk management and health and safety management programs that is described in many different national (ANSI) and international (ISO) consensus standards. In fact, insightful risk assessment is so crucial to risk management and continuous safety improvement efforts that it is required in many countries around the world. For example, Australia, New Zealand and Canada recently adopted ISO 31000:2009 Risk management - Principles and guidelines into their law. Also, the European Union member states also require risk assessments under Directive 89/391/EEC.

However, at the present time, risk assessment is not required in the United States; where risk assessment is only recommended as a best practice. This may help to explain some of the difficulties that safety professionals encounter when trying to introduce and implement risk management methodologies into their organizations.

Risk Mitigation Concepts

When risk assessment judgments determine that risk is unacceptable, it may be necessary to mitigate the risk to acceptable levels. When mitigating risks, three key risk reduction concepts can be applied to effectively reduce risk. These risk mitigation concepts are outlined below:

Select Risk Mitigation Interventions According to the Hierarchy of Controls

To effectively treat or mitigate risk the hierarchy of controls concept should be understood and applied. The hierarchy of controls prescribes a hierarchical order of effectiveness (from most to

least effective) for risk reduction controls, and that this order should be taken into account when selecting and implementing controls to reduce risk.

The risk reduction process outlined by ANSI/AHIA Z10-2005 Occupational Health and Safety Management Systems recommends a hierarchical pattern of controls (interventions) based on the relative effectiveness of the controls, as follows:

- Elimination. Elimination of the hazard (or reduction of the risk by design) provides the highest degree of risk reduction.

- Substitution. Substituting a high risk hazard (i.e. processes, operations, equipment, etc.) with a less hazardous one can also provide significant levels of risk reduction.

- Engineering Controls. Applying engineering controls to safeguard hazards can also significantly impact the degree of risk reduction and residual risk in the system.

- Warnings. Instituting warnings (i.e. signs, labels, audible alarms, etc.) can help to alert people to the existence of and proximity to hazards and risk.

- Administrative Controls. Administrative controls include procedural and training controls. As the hierarchy of controls illustrates, administrative controls are less effective than the Elimination, Substitution and Engineering Controls. Examples of administrative controls would include training for workers and supervisors, safe work methods, safety rules, disciplinary programs, close supervision, etc.

- Personal Protective Equipment (PPE). Personal Protective Equipment includes controls such as safety glasses, hearing protection, protective eye wear, safety harnesses/lanyards, gloves, respirators, etc. Because the use of PPE is intended to mitigate severity should a harmful event occur, the hierarchy of controls considers PPE to be the least effective type of control. As such, PPE should be the last avenue of protection after the previous methods have been considered.

When applying the hierarchy of controls, is critical to ensure the most effective controls will provide the intended risk reductions, there must be recognition that some inherent risk will always exist in any work system. Regardless of what safeguarding system is implemented, it is still necessary to look closely at organizational forces and the knowledge and training of users and supervisors, as well as the behaviors and errors of users that can degrade or bypass the engineering controls (Liberty Mutual 2009). Exhibit 1 below illustrates the concept of the hierarchy of controls and the order of relative effectiveness of types of control.

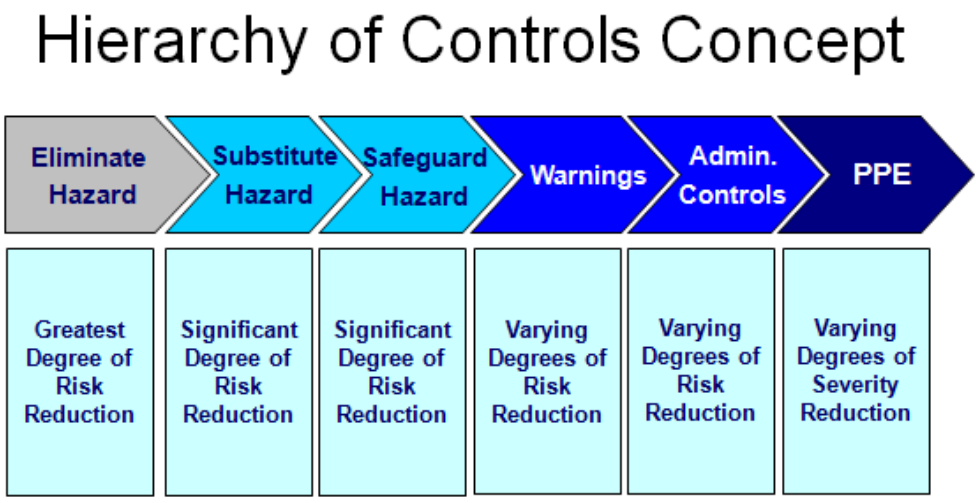
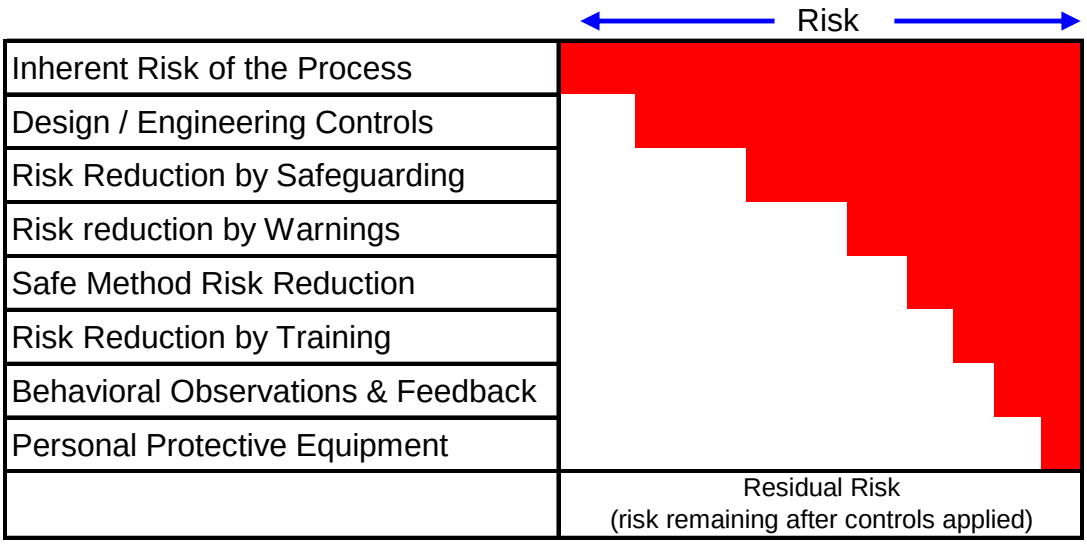


Exhibit 1. Concept of the Hierarchy of Controls.

Integrate Risk Mitigation Controls to Achieve Maximum Residual Risk Reduction

In certain circumstances, integrating (or combining) controls within the hierarchy of controls, can lead to increased residual risk reduction within systems. The impact of applying integrated controls and the hierarchy of control concept has been outlined by the Association for Manufacturing Technology (AMT) in the publication Risk Assessment and Reduction: A Guide to Estimate, Evaluate and Reduce Risks Associated with Machine Tools (AMT 2000). Exhibit 2 below illustrates the concept of the hierarchy of controls and the resultant impact in reducing residual risk in work systems.

Hierarchy of Controls to Reduce Risk



Adapted from ANSI B11 TR3

Exhibit 2. Illustration of Hierarchy of Controls to Reduce Risk.

Ensure Risk Mitigation Controls Are Appropriately Applied to Identified System Discrepancies

Simply defined, a system is a group of interacting, interrelated, or interdependent components that form a complex and unified whole.

A system's parts must be present (and arranged in a specific way) for the system to carry out its purpose optimally (Anderson and Johnson, 1997). When the system is properly designed to begin with, and is working optimally to support associated work processes, they will produce the desired output. However, when the system is improperly designed, or deteriorates over time, system discrepancies can occur and introduce risk into the system. System risk can lead to process failures, which in turn, can ultimately lead to harmful events (i.e. worker injuries, property damage, etc.) and loss.

Systems in which people work can be described in three sets of characteristics (Tolbert, 2005):

1) Environment: Environmental system characteristics encompass anything that can be designed, built, or assembled. Environmental system components can both be physical or intangible, and include everything physical in the workplace, as well as all methods and management systems. Natural physical influences such as weather, temperature, and other natural phenomena (not originating from human activity) are considered to be environmental system characteristics.

2) Capability: Capability system characteristics involve what people are able to do. This includes the skill, knowledge and education of people in the work place. In addition, people's physical ability to perform (i.e. workforce fitness) is a capability component.

3) Motivation: System characteristics that motivate people to act when they operate within the system are also important considerations. Behavioral consequence management, which influence behavior through discipline, incentives, recognition and rewards, are important Motivation system characteristics within the workplace. Even the most well engineered physical environments, with the most capable people operating in them, must rely on motivational factors to actually get the performance that produces the outputs desired.

Systems analysis is required to evaluate the effectiveness of the systems supporting work processes, and to identify system discrepancies and potential sources of risk. When systems discrepancies are identified, it is important that risk mitigation controls be properly applied to, and aligned with, the appropriate part of the system to adequately correct the discrepancies in the system and reduce risk. For example, conducting safety training may be an effective risk mitigation control to correct a worker skill deficiency (i.e. system capability discrepancy). However, if workers are already properly trained (i.e. have the proper skill), but are observed performing at-risk behaviors, risk mitigation controls may be needed to correct motivation and/or environment discrepancies within the system. Exhibit 3 below illustrates the concept of appropriately applying integrated controls within systems to correct identified system discrepancies and reduce risk.

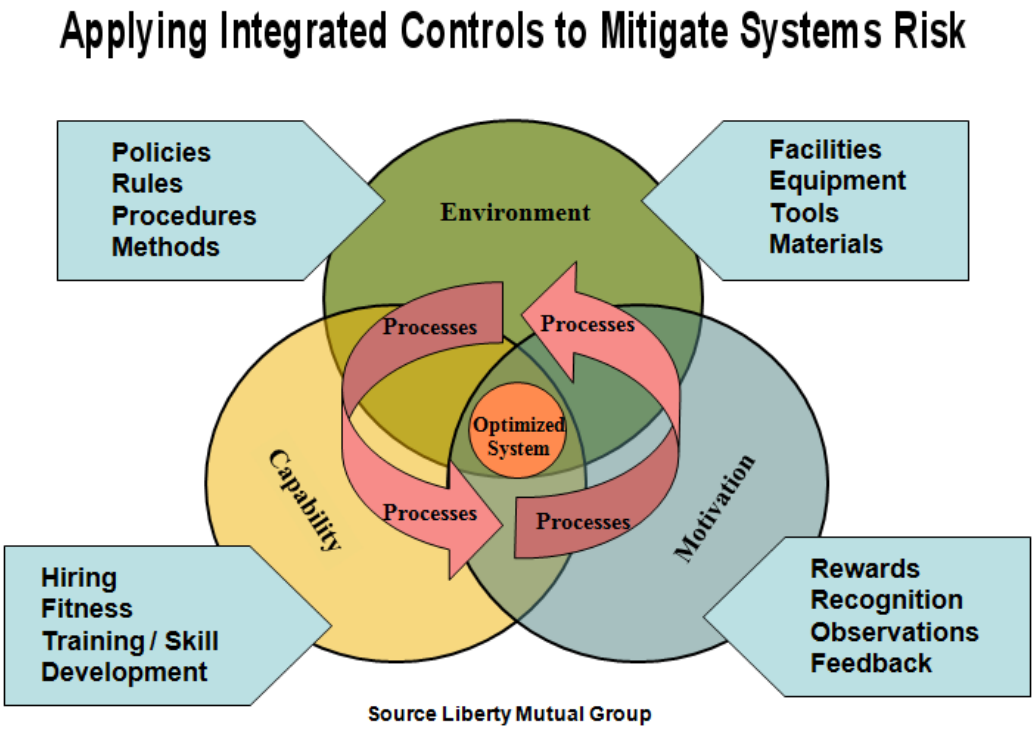


Exhibit 3. Illustration of Application of Integrated Controls to Mitigate Systems Risk.

Aligning Risk Assessment with Business Processes

How an organization views and approaches safety is an important consideration when aligning risk reduction methodology to business process. Some traditional safety approaches tend to focus on the reduction of incident frequency and/or incident severity (i.e. loss costs, lost time, etc.). While this is certainly a valid approach to reduce incident frequency and severity rates, it is also a reactive approach to safety management in the sense that the focus is predominately on risks that have actually resulted in incidents, and these risk exposures are being addressed after incidents have already occurred.

Effective integration of risk reduction methodologies requires a more proactive approach to identify and assess significant risk exposures that have the potential to result in the occurrence of an incident. Accomplishing this requires an organization to turn the focus on measuring and mitigating inherent risk which occurs in work systems and processes. Transitioning from the traditional reactive approach to safety and developing a culture whereby risk assessment is a key foundation of safety management systems can be challenging. You don't just wake up one morning and say, "I'm going to implement a risk assessment program today."

The Risk Manager at ABC Company faced some key challenges to be able to implement risk assessment processes within his organization. The Risk Manager had to develop strategies to remove barriers and integrate risk assessment methodology as a way to proactively drive continuous improvement in safety performance by seeking to reduce risks in systems or processes which allowed injuries to occur. Strategies utilized by the Risk Manager to remove barriers and effectively integrate risk reduction and mitigation techniques into the organization's work systems were focused on obtaining leadership commitment, communicating risk exposures using the language of the business, and establishing a standard methodology for measuring acceptable risk.

Obtain Leadership Commitment

Successful risk improvement initiatives which deliver sustainable business results all have one common fundamental element – Leadership Commitment. Companies which have been successful with integrating Total Quality Management (TQM) systems, LEAN Manufacturing programs, Six Sigma quality process control systems and other business improvement processes into the culture of the organization, had to begin by engaging leadership early in the process to obtain buy in to the changes required to drive continuous improvement.

Leadership demonstrates their commitment by removing the real (time and resources) and perceived barriers (attitudes come from the top down) that impede performance. An effective way to engage leadership is to establish a vision for the future state of safety within the organization. When the vision of the future state of safety is documented in a vision statement endorsed by senior leadership, the vision statement serves as the framework for building an organizational culture in which safety becomes "the way we operate".

The senior leadership at ABC Company had signed off on a safety vision statement which included the value statement, "We think first of Zero Harm". This sentence in the safety vision statement established the expectation that risks will be identified and evaluated when making decisions, and this enabled a risk assessment process which identified and measured opportunities to reduce inherent risk to be integrated in to the organization's work systems. It is important to

note that words in a vision statement do not automatically translate to effective action, as a structured framework such as a safety management system provides the management processes (i.e. risk assessment process) that the organization adopts and embraces to deliver the desired levels of performance.

In the case of ABC Company, once senior leadership bought into the vision of the future state of safety within the organization and the vision statement was communicated broadly across the organization, the framework for development of an effective safety management system was outlined by creating a safety policy statement. The safety policy statement established the minimum performance standards of the organization to comply with regulatory requirements, continuously improve safety management processes, and proactively identify and measure risks. Additionally, the safety policy statement required the engagement of employees at all levels of the organization and set the expectation for transfer of best practices.

Senior leadership's endorsement of the safety vision statement and safety policy statement provided the foundation for tactical execution of the development of a risk assessment process. The risk assessment process was designed to involve employees at all levels of the organization to proactively identify and measure risk concerns and to engage employees in the development of recommendations and solutions to reduce risks in the workplace which could cause injury.

Speak the Business Language to Implement Risk Reduction Processes

An organization's success in integrating any new process or methodology ultimately depends on how well the organization understands and adopts the new process or methodology. Aligning with existing business processes and using the business language established within the organization will facilitate this integration. The same applies when integrating risk assessment methodology into the safety management system.

ABC Company recognized that its traditional safety management processes had reached maturity as safety performance began to plateau. To drive continuous improvement in safety performance, the risk management department at ABC Company sought to integrate safety management processes with the organization's continuous improvement processes - LEAN and Six Sigma. It was necessary to take this integrated approach as the risk management department was competing for the same resources which were being used in Six Sigma and LEAN process improvement projects, while working to implement a strategic initiative to deploy a standardized process for conducting risk assessments.

The Risk Manager at ABC Company was trained in Six Sigma and LEAN, and realized the risk assessment process aligns very well with the Six Sigma DMAIC problem solving methodology used by many businesses. DMAIC is an acronym for the five phases of process improvement utilized in Six Sigma - Define, Measure, Analyze, Improve and Control. In order to demonstrate the value proposition for implementing risk assessment methodology at ABC Company, the risk manager developed a graphic (Exhibit 4 below) to show the alignment of risk assessment with the Six Sigma DMAIC methodology. This graphic was integrated into safety training presentations to educate the organization in the principals of risk assessment and risk management methodologies.

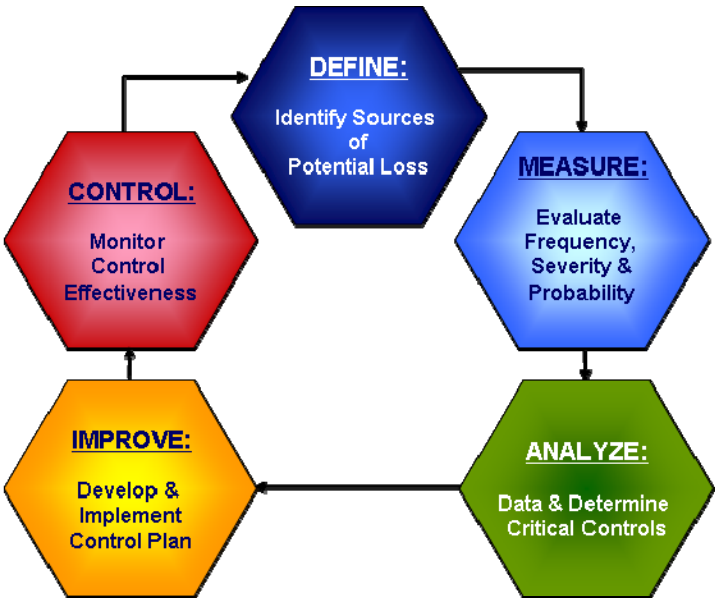


Exhibit 4. DMAIC Risk Management Model.

The acceptance and use of risk assessment methodology at ABC Company increased as a result of the integration of risk assessment with existing process improvement methodology utilized by the business. Development of the DMAIC Risk Management Model enabled safety processes to be measured more effectively by proactively measuring risk exposures in existing work systems instead of measuring the frequency and severity of incidents. ABC Company utilized a risk assessment process which provides a qualitative measurement of the frequency and severity of risk exposures and the probability of occurrence. The DMAIC process enabled ABC Company's Risk Manager to measure safety process improvement drivers in a language the business understood.

Establish Acceptable Levels for Risk Tolerance

Lowrance (1976) stated *"a thing is safe if its risks are judged to be acceptable."* Sounds easy, but how do you establish the criteria for acceptable risks? ABC Company utilized a risk management process which was aligned with the Australian/New Zealand standard for risk management (AS/NZS 4360) to measure and evaluate risks and to establish acceptable risk guidelines for the organization. The AS/NZS 4360 standard is equivalent to ISO 31000 Risk Management Standard, and outlines a process for conducting qualitative risk assessment which utilizes a five-by-five matrix to evaluate the consequence and probability of each identified risk exposure. Exhibit 5 below provides an illustration of the qualitative measurement of risk utilizing a five-by-five matrix as outlined in ISO 31000 Risk Management Standard.

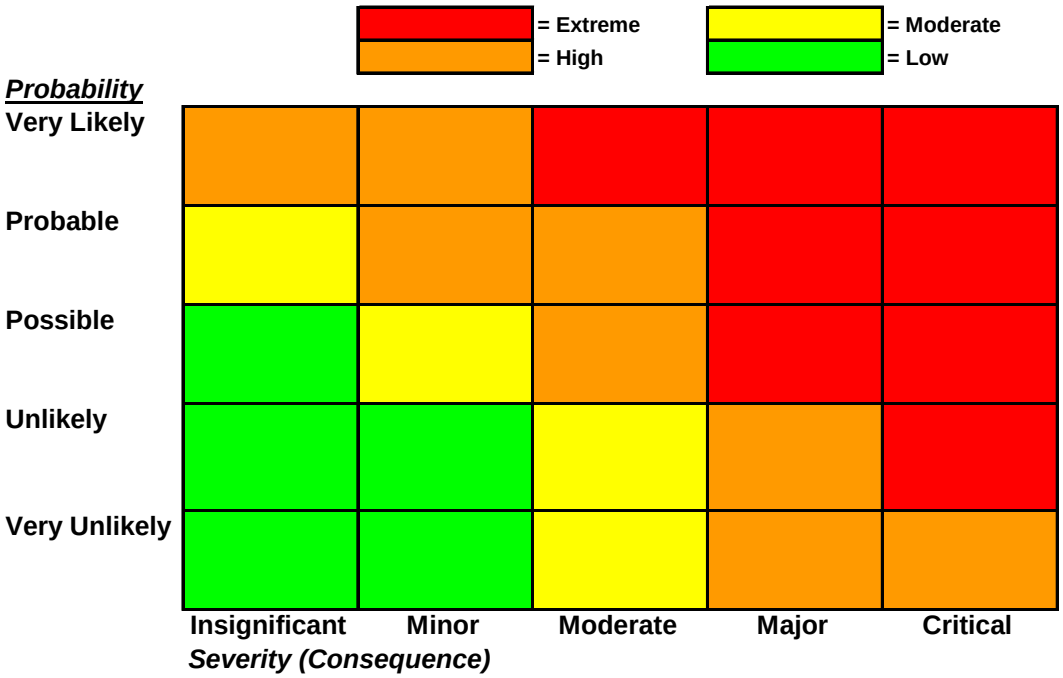


Exhibit 5. Qualitative Risk Assessment Matrix.

As illustrated in Exhibit 5, risks which are qualitatively assessed and determined to be in red and in the upper right quadrant of the risk matrix were considered to be unacceptable risks which required further mitigation or elimination.

When determining what is an acceptable risk it is necessary to recognize that acceptability is a moving target. As knowledge about a particular risk increases, so does the capability to make a more informed judgment or determination of the acceptability of that risk. Therefore what is determined to be an acceptable risk today may become an unacceptable risk in the future. When the risk assessment process is utilized as a continuous improvement process, residual risks can be reduced over time, delivering improvements in safety performance which can be sustained over time.

Practical Approach for Implementing Risk Assessment Process

Once senior leadership was engaged and the barriers for implementing a risk assessment process were removed, ABC Company developed a tactical plan to integrate the risk assessment process into the operations. The tactical implementation plan included development of the risk assessment methodology, training of employees to conduct risk assessments and utilize the risk assessment tools, conducting baseline and subsequent assessments, and a monitoring program to measure the effectiveness of the new controls.

There were eight major milestones in the tactical plan which ABC Company utilized to implement an integrated risk assessment process. These eight milestones served as the roadmap for a successful implementation of a risk assessment program and included:

- *Introduced risk assessment methodology:* ABC Company selected the Liberty Mutual R3™ risk assessment process because it is easy to understand, it utilizes consistent criteria to measure and quantify risks, it is able to be used by front-line employees, it requires a cross-functional team approach, and it aligns well with Six Sigma and LEAN continuous improvement processes. R3™ enables a risk improvement team to perform a baseline of the current state of the work system being evaluated, measure risk exposures quantitatively and qualitatively, evaluate the effectiveness of existing mitigating controls and develop a list of proactive improvement actions which will reduce risk. Additionally, R3™ provides a measurement of the future state of a work process once additional mitigating controls have been implemented. This approach enabled ABC Company to prioritize limited resources to systematically reduce and control risks by continuously working in the areas with the greatest risk concerns.

- *Conducted R3™ training workshops:* ABC Company developed a training program to teach front-line employees how to conduct and document risk assessments using the R3™ process. The training consisted of part classroom training and hands on training through observation of the work system which was identified as requiring improvement. Training also was conducted on how to enter the information into the R3™ workbook which provided the baseline assessment to measure the potential risk exposures within the work system.

- *Identified work systems to be assessed:* ABC Company had started to introduce LEAN as a process improvement to increase efficiencies and reduce costs in the operations. It was important and necessary to begin to conduct baseline risk assessments of the processes the business had targeted for LEAN process improvements. This enabled risk assessments to be carried out using the same resources utilized to implement the LEAN program, and show demonstrable value by supporting the initiatives the business was working on.

- *Created cross-functional risk assessment teams:* At ABC Company, risk assessments are performed by a team of employees which includes front-line employees involved in the work process and other interested parties such as the engineering department, maintenance, and safety and health professionals. Due to the diversity of experience in the cross-functional teams, different points of view for identification of risks and creative solutions for mitigation of risk were generated.

- *Involved front-line employees:* Operating under the premise that no one knows how the job is currently performed better than front-line employees. Front-line employees were becoming involved in LEAN Kaizen events, and during these events, unsafe conditions were identified and addressed as part of the Kaizen process. It was only natural to involve front-line employees as members of the risk assessment team.

- *Conducted base-line assessments:* The R3™ process required the team of employees to identify risk concerns for each work system, determine the number of employees exposed to each risk concern, and then identify and evaluate the effectiveness of existing risk mitigation controls. The team conducted a qualitative assessment of each risk concern using a five point rating scale rating the Frequency, Likelihood and Severity of each risk concern to calculate a baseline risk score or index of inherent risk.

Baseline Risk Assessment

Concerns (Injury + Event + Causation, e.g. Head injury from falling from ladder when foot slipped)	**Existing Controls**	**No. of Employees Exposed**	**Frequency** (Rate Frequency of Activity)	**Likelihood** (Rate Likelihood of Concern)	**Severity** (Rate Severity of Concern)	**Risk**
Concern for indvertant startup of equipment during maintenance	Operators and maintenance personnel trained and certified in Equipment operation. Radio communication between maintenance operators. Isolation switches and E-Stop cord operable and available. LOTO procedures in place.	2	**2**	**4**	**5**	**40**
Accidental contact with equipment by passers by	Operators and maintenance personnel trained and certified in Equipment operation. Isolation switches and E-Stop cord operable and available. Machine guarding at point of operation. LOTO procedures in place.	2	**3**	**4**	**5**	**60**
					Risk Index	**100**

Exhibit 6. Example Baseline Risk Assessment.

- *Implemented risk mitigation plans:* For risks which were identified as out of the range of acceptability, or which required additional controls, risk mitigation plans were created utilizing the hierarchy of controls to reduce potential risk exposures to as low as reasonably practicable. Then a subsequent risk assessment was conducted to measure the reduction in residual risk achieved with the implementation of additional risk mitigation controls.

Subsequent Risk Assessment

Concerns (Injury + Event + Causation, e.g. Head injury from falling from ladder when foot slipped)	**Existing Controls**	**No. of Employees Exposed**	**Frequency** (Rate Frequency of Activity)	**Likelihood** (Rate Likelihood of Concern)	**Severity** (Rate Severity of Concern)	**Risk**
Concern for indvertant startup of equipment during maintenance	Install operator security protocol on touch screen monitors - defined by zones. Conduct touch screen monitor training at point of operation. Create Safe Work Procedures for Operators and Maintenance.	2	**2**	**2**	**5**	**20**
Accidental contact with equipment by passers by	Install operator security protocol on touch screen monitors - defined by zones. Label areas which are restricted to authorized personnel. Impelement an intelock inspection system to ensure interlocks on perimeter guarding are functioning properly.	2	**3**	**2**	**5**	**30**
					Risk Index	**50**

Residual Risk Reduction (R3) = **50%**

Exhibit 7. Example Subsequent Risk Assessment.

- *Monitored effectiveness of new controls:* Inherent risk in a work system can only be reduced if effective controls for reducing risk exposures are implemented. While the subsequent risk assessment is a qualitative measurement of how effective new controls can be to reduce potential for an incident to occur, if the controls are not implemented, then the assumptions of

reduced risk measured can be overstated. Therefore, it is necessary to conduct follow up observations of the work system after the subsequent controls have been implemented to validate the controls are effective, and to identify if other risks have been created through the implementation of the new controls. Additionally, as the work system evolves and changes in the future, the latest version of the risk assessment needs to be reviewed to ensure the existing controls are adequate to mitigate new risk exposures which may arise as a result of work system enhancements.

Summary

To deliver safety performance which can be sustained over time, it is necessary to work proactively to identify and evaluate risk exposures and hazards before an incident which causes harm can occur. Organizations which have been effective in integrating risk management methodology into their safety management processes are progressive in their approach to safety management and realize the benefits of managing risks which are inherent in any work system will deliver the desired results. When applied as an on-going process, risk assessment methodology can help organizations redefine the nature, extent and level of risk that is acceptable for their business model and deliver world class levels of performance.

Bibliography

Anderson, V. and Johnson, L. (1997). *Systems Thinking Basics: From Concepts to Causal Loops*, Waltham, MA: Pegasus Communications, Inc.

Association for Manufacturing Technology (AMT). Risk Assessment and Reduction: A Guide to Estimate, Evaluate and Reduce Risks Associated with Machine Tools. ANSI Technical Report for Machine Tools. B11.TR3. McLean, VA: AMT, 2000.

Eaton, G. H., and Little, D. E. (2010). Assessing and Mitigating Risks to Deliver Sustainable
Safety Performance. In Proceedings of the 2010 ASSE Professional Development Conference, Session 513.

ISO. (2009). Risk management - Principles and guidelines (ISO 31000). Geneva, Switzerland: Author.

Liberty Mutual Group. Loss Control Reference Note LC 5348 R2. *Assessing the Risk of Machine Injuries.* Oct. 2009.

Lowrance, W. Of Acceptable Risk: Science and Determination of Safety. Los Altos, CA: William Kaufman Inc. 1976.

Manuele, F. “Leading & Lagging Indicators: Do they add value to the practice of safety?” *Professional Safety*. Dec. 2009: 28-33.

Manuele, F. “Prevention Through Design: Addressing occupational risks in the design and redesign processes.” *Professional Safety*. Oct. 2008: 28-40.

Tolbert, George D. Residual Risk Reduction: Systematically Deciding what is “Safe.” *Professional Safety*. Nov. 2005: 25-33.