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# Empowering Effective Teamwork for Machine Risk Reduction in the Workplace

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## ABSTRACT

The need for teamwork creates new requirements for engineers who use the new ANSI guidelines (B11 TR3-2000) for reducing risks associated with machines. Specifically, the guidelines state that "...a team of involved personnel (e.g., operators, maintenance, engineering) should participate in the risk assessment and reduction effort." The goal of such teams is to achieve tolerable risk. If they are to be effective team members, engineers will need skills in team leadership; identifying tasks and their associated hazards; using risk assessment tools; developing consensus about degree of risk; and selling the team's proposed risk reduction measures to management. This paper describes the stages of the TR3 process and focuses on engineering leadership skill development. Leadership must face the challenges of change and instill a sense of trust in the process so that a machine risk assessment team's injury reduction work can be effective.

## INTRODUCTION

From an injury severity perspective, the risk of fatal and nonfatal injury from machinery in US workplaces is high. Two significant measures of injury severity; 1) number of cases of fatal injury and 2) rate of days-away-from-work for nonfatal injury cases, substantiate this assertion. Between 1996 and 1998, there were 464 occupational fatalities (an average of 155 per year) reported to the U.S. Department of Labor's Bureau of Labor Statistics involving caught-in-running-machinery. For the 1995-97 period, there were 92,932 cases of nonfatal injury of this type involving lost workdays. The majority of these (65%) were in the manufacturing industry. The 1996 total incidence rate (cases involving days-away-from-work/10,000 full-time workers) for the manufacturing industry was 238.3 compared to 212.3 for all private industry. The rate for machinery injury in manufacturing was 27.7 (11% of the total rate.) Using National Safety Council (1996) estimates, the caught-in-running-machinery deaths alone cost the nation $122 million. Design safety experts in the U.S. and Europe agree that machine injury rates are high because protective measures that are only appropriate for low level risks are being applied in situations where the risk involves frequent exposures to fatal or serious traumatic injury hazards (Adams, 1997).

In 2002, ASME issued a position statement on "The Role of Risk Analysis in Decision-making." In the statement, ASME International indicated that it "supports advancing the understanding, use, and acceptance of risk analysis, and encourages the larger community to join

with us in advancing this critical process." Promulgation and use of consistent methods of risk analysis, including cost/benefit analyses, are recommended throughout government (e.g. regulatory agencies) and the private sector, worldwide. Leaders in business and industry must make many decisions that have risk implications for their employees. ASME's position is that it is important that engineers be able to use risk analysis to help make the best decisions. The first step in facilitating this is to develop a broad consensus on appropriate approaches to risk analysis. It will then be important to provide appropriate training in the risk analysis process. Basic principles set forth in the position statement are:

- No course of action, including taking no action, is risk free.
- Stakeholders should be involved in technical risk studies.
- Risk analysis must be open and transparent.
- Consistent methods of risk analysis should be used.
- Free and open discussion of uncertainties must occur.

The ASME position paper on risk assessment reflects current activities in machine injury prevention. In 1995, a Technical Report subcommittee (TR3) was formed under the auspices of the American National Standards Institute (ANSI) B11 Machine Tool Safety Standards Committee. The subcommittee has labor, machine builder, machine user, government and safety consulting representatives. The subcommittee's purpose was to develop a technical guidance document to bring machine tool risk assessment practice in the United States up to or above the level now required by ISO standard 14121 "Safety of Machinery: Risk Assessment". The ISO standard mandates that a process be followed that ensures that safety measures are appropriate to the risks in machine operation and servicing tasks. The ANSI B11 TR3 (2000) document became available for general use in November 2000, adding the benefits of risk assessment to the array of methods already available for preventing injury at machine tools in the United States.

**The TR3 process**

The TR3 process follows the flow chart (Figure 1) that prompts analysts to use the risk reduction hierarchy of: 1) eliminate the hazard by design; 2) apply safeguards and protective devices; and 3) apply administrative controls and other protective measures (e.g., warn, train, use personal protective equipment). The general approach is: task and hazard identification; risk estimation; determine if the risk is tolerable; risk reduction; verification of risk reduction via re-estimation of risk; and documentation. The aim of risk assessment on new machinery is to see that hazards are mitigated before they are introduced into the workplace. Employed judiciously, TR3 can help to locate critical elements in a design, identify associated hazards, evaluate their risks, and prompt decisions to reduce risks to acceptable levels. The risk for a task depends on a two-way relationship between the potential severity of harm (catastrophic, serious moderate, or minor) and probability of occurrence of harm (very likely, likely, unlikely, and remote). These factors are entered on a risk estimation matrix (Table 1) and a risk level is determined.

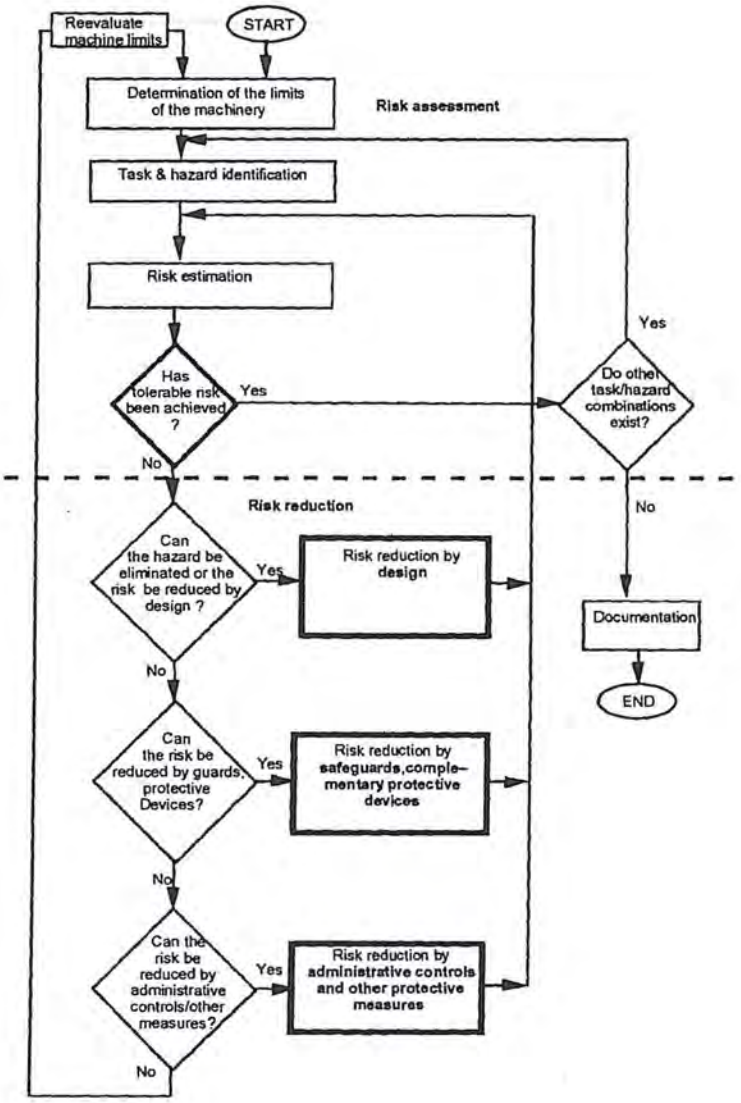


Figure 1

| Probability of Occurrence of Harm | Severity of Harm | | | |
|---|---|---|---|---|
| | Catastrophic | Serious | Moderate | Minor |
| Very Likely | High | High | High | Medium |
| Likely | High | High | Medium | Low |
| Unlikely | Medium | Medium | Low | Negligible |
| Remote | Low | Low | Negligible | Negligible |

**Table 1: Risk Estimation Matrix**

**The evaluation study**

The National Institute for Occupational Safety and Health (NIOSH) has successfully trained five teams in a 2-½ day workshop titled "Machine Risk Reduction" based on the new ANSI B11 TR3 "A Guide to Estimate, Evaluate, & Reduce Risks Associated with Machine Tools." The workshop was the first step in a NIOSH research project to evaluate the effectiveness of this new consensus guideline that tailors the concepts of ISO 14121, "Safety of Machinery - Principles of Risk Assessment" to the U.S. workplace. The workshop was designed to educate team participants from a variety of industries (automotive, industrial and consumer products, metal stamping, and medical devices) on the TR3 risk assessment process. Software tailored to the TR3 process was used to facilitate and document assessments. As the TR3 study proceeds, participating companies focus on two machinery systems for study; one will have the TR3 risk assessment process applied, and the other will remain in use without utilizing the TR3 risk assessment process. At the end of one year, these two machinery systems will be evaluated by NIOSH for safety and productivity improvements. Upon completion of the workshop, participant teams were able to communicate the organization and use of the TR3 document and risk assessment process; understand maintenance risk assessment applications; lead a risk assessment team through a TR3 risk assessment; and comprehend risk assessment implementation issues.

The study is currently in the intervention stage as the 2-person teams return to their workplace to form and train their machine risk reduction team with additional engineering, maintenance, and operating personnel. Facilitating the five teams requires frequent communication and keeping management informed and supportive. Team engineers must get constant feedback to develop the motivation to continue (Mitchell, 1998). And, constant evaluation not only lets supervisors know where they are, but it also does the same for team engineers. NIOSH anticipates that engineers will be vital to the success of these machine risk reduction teams.

**Using TR3 can lead to change**

In the teamwork phase of the activity, special attention must be given to the human side of the risk assessment process. People may be reluctant to join in on a new process that can bring about changes in the workplace. The team engineers must be ready to handle the challenges of initiating change. Senge (1999) has identified four challenges of initiating change:

- ***Time flexibility***. Do people have sufficient control of their own time? If they don't, they will not have enough time for significant change-initiatives.
  - *TR3 example*. In the early stages of the TR3 evaluation it has become very apparent that this activity is being done within other competing time demands. Weak business conditions have led to focus on other concerns. Teams have had to be flexible in when to start and complete tasks.
- ***Help***. Do people have the coaching support they need? If not, they will

flounder in initiatives that require new skills and capabilities.

- *TR3 example.* Calls to the NIOSH support center provide feedback on using software and tips for avoiding excess analysis.

- ***Relevance.*** Is a compelling case made for change? If not, people will conclude that the change initiative is not relevant.
  - *TR3 example.* The champions in the TR3 study were able to engage their management to be supportive of the activity. In spite of weak business conditions, the teams have been able to maintain focus on TR3 goals. Having workers themselves on the teams has ensured relevance.
- ***Personal alignment.*** Are management's values and goals perceived as authentic and aligned with its actions? If not, people will see that management is not "walking the talk."
  - *TR3 example.* The safety programs at these sites are strong programs and the teams do get good support. Given the slow business climate and production demands, it is clear that the success of the project to-date has been due to the strong safety values of the champions and management.

**Building trust in the TR3 process**

Building an atmosphere of trust in the process is a leadership skill that engineers must bring to their team activities (Covey, 1994). And trust in the process is a precondition to team success. Empowerment of the team and individual team members must be cultivated, much like providing favorable conditions for the growth of a good agricultural crop. It is a matter of nurturing the conditions that create empowerment. In particular, establishing a culture of trust requires the engineering leader to nurture both character and competence among team members (Deming, 1993).

- ***Character***:
  - *Integrity* – Integrity means that safety principles are adhered to continually.
  - *Maturity* – Maturity implies a balance of courage and consideration that enables you to say what needs to be said about a hazardous condition, to address issues in a straightforward way, but with consideration and respect for the feelings, thoughts, and opinions of others.
  - *Abundance mentality* – Leaders should seek alternatives that avoid the zero-sum game approach that the pie is only so large and if a safety improvement gets resources that is less for something else.
- ***Competence:***
  - *Technical competence* – the safety knowledge and technical skill to complete a thorough assessment and reduced risk.
  - *Conceptual competence* – the ability to see the big picture, to examine the we-have-always-done-it-that-way modality; and to see things from the perspective of others.
  - *Interdependent competence* – the ability to interact effectively with others. That is, to communicate, listen, and create win-win agreements.

Covey (1994) proposes that occasional questioning by leadership can raise team meetings, such as TR3 meetings, to a higher level of awareness and insight.

- What led us to our mission?
  - A vision of safer conditions for the machine operators and maintenance personnel who work here would be a good answer.
- What led us away?
  - Time constraints are often a hindrance.
- What processes got in the way of accomplishing our mission?
  - The viability of the TR3 approach must not be hindered by factors that are external to it.
- Were we true to principles centered on people, trust, learning, industry?
  - Feedback on these factors by team members, whether formally or informally, can keep the team's TR3 process practical.
- How can we create better alignment with principles?
  - Focusing on finding the way out of dilemmas with principles can lead to valuable safety solutions.

**Conclusion**

This research on the effectiveness of the ANSI B11-TR3 process is contributing to the ASME goal to promote risk analysis as a technically sound and socially responsible way to help in decision-making by industry, government, and the general public. Teamwork and leadership within teams are essential to the success of TR3 implementation. Partnerships between NIOSH and industry are ensuring that a businesslike approach is followed in conducting the current machine system risk assessment evaluation. In the early stages of this evaluation of the TR3 process, it is evident that engineering leadership skill development is vital for meeting the challenges of change and instilling a sense of trust in the process needed to make a machine risk assessment team's work products effective in injury reduction.

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