

ERGONOMICS: BEYOND COMPLIANCE

D. Caruso, National Institute for Occupational Safety and Health, Pittsburgh, PA
L. Steiner, National Institute for Occupational Safety and Health, Pittsburgh, PA

Abstract

The health and financial costs of cumulative injuries are plaguing the mining industry. Industry leaders are concentrating on reducing the risk of injury to their workers through design and redesign of work environments. While ergonomics is not a currently regulated field, many mines are realizing that the only way to tackle their most costly injuries, cumulative injuries, is to make the proactive choice to understand those injuries, their root causes and to make workplace changes to prevent them from occurring. Reduction of these injuries not only improves the health and morale of the workers but increases productivity and profit for the companies. Knowledge and reporting of ergonomic risk factors by employees and ergonomics committees is key to these changes and to the reduction of cumulative injuries. NIOSH is developing strong relationships with industry associations and equipment manufacturers to leverage their communication abilities to transfer knowledge to their customers and make a difference in the health and safety of U.S. miners. The benefits of a formalized approach to reducing these injuries along with examples will be presented.

Introduction

While ergonomic practices are neither regulated nor enforced in the mining industry, many health and safety professionals have recognized that there are benefits to forward thinking and planning in this area. The foremost of reasons to engage in a program to reduce possible strains, cumulative stress and injuries is cost. Current workman's compensation costs for a cumulative trauma related incident are high while many of the costs to implement solutions are quite low. Given this proposition, logically it makes sense to examine these cost/benefit issues more carefully. Previous NIOSH presentations and published materials have elaborated on ergonomic solutions and their powerful impact on the health and safety of the mining workforce. An approach including how those solutions can be communicated and implemented to reduce the likelihood that workers will have musculoskeletal disorders (MSD) and what some of the potential barriers may be to successfully bring these interventions to mines is discussed.

If it ain't broke....and other barriers

Ergonomic issues have been referred to as "don't fix it if it ain't broke" but how do you know it is not broken? Because workplace injuries are so often thought of as the result of an acute incident and much less often considered the result of a prolonged exposure to a hazard, the dangers of ignoring ergonomic issues is misunderstood. At the core of NIOSH's approach to this problem is the target approach which directs efforts where they can have the greatest impact: risk factors. If you think of it in a similar context as heart disease, where risk factors have been identified (i.e. over consuming fatty foods, lack of exercise, genetic predisposition) then the actions that are necessary become clear. You are looking for potential causes of the eventual injury even before the signs and symptoms occur (it "ain't broke" but you can still fix it).

Companies do not fail to exceed compliance because they do not care about employees, but occupational safety and health (OSH) professionals have many tasks to complete and "wear many hats." When federal mandates and MSHA standards are complied with, they feel like that problem is at least minimally solved and they can move on

to the myriad of tasks that require attention. So who has time to add ergonomic issues to their schedule when we have already established that OSH professionals are busy just meeting the regulatory requirements? Well there are early adopter companies who have seen the rising costs associated with workers' compensation and lost time which result from MSD injuries. Such an economic incentive drives these companies to seek out ways to decrease the potential impact of said injuries by removing hazards and improving problem jobs on their respective worksites. Improving the ergonomics of jobs that result in higher risk for MSD injury is one possible way to reduce future costs.

After deciding to improve occupational ergonomics within the mine, management can choose to involve the entire workforce in the process. By providing training and encouraging participation among all workers, no one person has to observe all tasks all the time. However, the problem of training the entire staff and convincing them that they need to participate in order to achieve a meaningful improvement in the health and safety of everyone is a challenge. Once trained in the ergonomic process, workers will know what the major risk factors are and how to describe them. Since there are so many distinct tasks which workers perform throughout the day, many times the simplest interventions can have a dramatic impact (e.g. moving heavy cable with an assist device rather than dragging it across the ground). A worker may also find it easier to observe others doing something overly strenuous than to realize that the same task is too much to handle when doing it himself. One example of this participatory approach is the use of employee ergonomic concern forms and risk factor report cards' which allow workers to bring attention to workplace conditions that may cause MSDs. Considering how mineworkers are always looking out for their buddies on the job, it should follow that reporting problem job tasks with MSD risk factors could be presented in the same way as machine guarding or any other occupational hazard. Once the concern is raised, action must be taken by management to evaluate the validity of the concern and implement a solution. Then management and employees together use a participatory approach to resolving the concern. Not only does this allow for a more realistic solution but also promotes ownership of the task and the solution making it more acceptable to the employees.

The myth that says that employers have no control over what their workers do outside of the job relates easily to the problem of MSDs. Since there is really no way to tell what amount of cumulative strain the worker places on his or her body on or off the job, the employer is left little option but to consider all of it to be of his concern. To that end, training the worker to recognize what constitutes a strain and what makes a task an MSD risk factor becomes very important to the company. Not only do the OSH professionals need to know the latest information in the advancement of MSD prevention research, but workers need to be vigilant of the ever present hazards posed by the improper design of their daily work. Bridger Coal's implementation of an ergonomic process shows that by making it a company-wide effort involving every employee boosted participation and helped them improve safety and health overall. During the first 3 years using the ergonomic process, Bridger's ergonomics committee has implemented over 20 job improvements². Other companies including Badger Mining, Vulcan Materials and Unimin Corporation have successfully followed suit.

A Path to a Generative Approach

A model originally developed by Westrum^{3,4} and then later broadened by Hudson⁵ describes the evolution of risk management strategies and the stages as a company moves from pathological to generative (Fig. 1). In summary, the *pathological* stage can be thought of as the stage in which safety problems arise from the workers, and that the main driving force is the business and to not get caught by regulators. The *reactive* stage is the point where companies consider safety seriously; however only intervene following the occurrence of accidents. At the *calculative* stage, safety is driven by management systems, however is still imposed by management and not sought for by the workforce. In the *proactive* stage the workforce is becoming increasingly active in risk management, reducing the purely top-down approach. Finally, in a *generative* stage, everyone is involved in risk management and trying to maintain the well being of themselves as well as their coworkers.

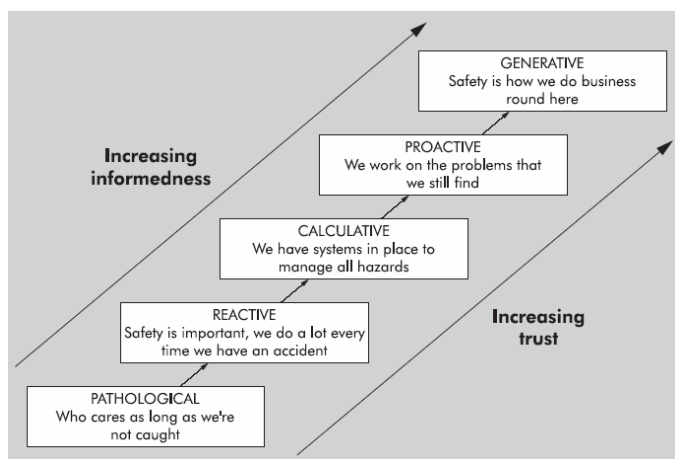


Figure 1. Hudson's Risk Management Strategy for Health Safety and Environment (HSE) (Hudson 2003)

This risk management hierarchy can be thought of as an ergonomics risk management process where the company and the workforce integrate ergonomics principles into their risk assessment process. In this case the approach follows the same path but with a focus on eliminating cumulative trauma injuries.

During the *pathological* stage, workers and companies are unaware of how musculoskeletal injuries occur and let workers look out for themselves. Employees may have the signs and symptoms of an impending injury but no changes are made to the workplace. Since employees are not educated, they may not know how to help themselves. No formal job safety analysis techniques are used and productivity is the primary focus.

During the *reactive* stage, analysis of the incident is after the report of an injury or several injuries and frequently the solution or correction to prevent the problem is individualistic. Others doing similar jobs may or may not be considered as it is thought to be that employee's problem. For MSD related issues, often the workers believe that aches and pains are just part of their jobs or the aging process. Workers often do not know that these recurring aches and pains are precursors to cumulative injuries and that these injuries can be prevented through planning of jobs, work environment and equipment purchasing.

Characteristics of a *calculative* stage are described by a company accusing workers of being "hurt at home" or by "their hobbies" rather than work environment or poor work task design or planning. Some management may use some outside training for proper lifting techniques or purchase "ergonomically designed" PPE such as back belts to resolve issues. In some cases, the company may fix very specific problems successfully through training and procedural approaches. These interventions have positive impact on the situation but the more global philosophy of prevention is not brought about. Also, there is no formal follow up to see if the problem was resolved or

if any other problems have resulted. In this stage, management may be aware of the cumulative injury process but employees are not. Safety is still in the hands of management and not pushed down to the employee level. Management believes that the system they have in place works well to address issues brought to their attention.

At the *proactive* stage, employees are educated about ergonomics principles, cumulative injury progression, and techniques to identify and reduce risk factors associated with MSDs. Management relies on employees to bring issues to them and to resolve them together. Management may also seek to provide periodic observations of all tasks or establish a wellness or fit for duty program. Ergonomic principles are used when evaluating and redesigning jobs. Management and workers are not waiting for injuries to occur but rather they are looking for indicators (risk factors) that point to a potential injury and then reduce or eliminate that indicator. In some cases, a professional ergonomist may be hired or an ergonomics committee formed. Risk factors and injury reporting investigates for why (root causes) instead of what or when. The company takes responsibility for employees' health during and outside of work and lays less blame on the employee. Job safety analysis techniques include the evaluation of risk factors at each step in the standard operating procedures to ensure that they are considered. Then a procedure is in place to follow up to ensure that the solutions worked and to investigate other issues. Workers appreciate these analyses and believe it is in their own interest and not just the company's interest. Most solutions are off the shelf and lessons learned are communicated throughout the mine and even company wide. Still, the value (cost/benefit) of these interventions may be underreported.

In the *generative* stage, there is anticipation of issues with regard to old and new processes and equipment. The ergonomic principles are integrated into the designing and planning processes and this occurs in the beginning along with and equally important as other engineering and purchasing decisions. Employees are trusted to make decisions about their jobs and recognize situations where changes need to be made. At this point, the employees are empowered with resources to make changes and inform management of needs. Investigation of risk factors, signs, and symptoms of MSDs is driven by an understanding of their root causes. The solutions are cost effective and creative and follow ups are done automatically. A database of all reported issues and changes to workplace and equipment is available to all the company and serves as an informational base from which to make the best purchasing and planning decisions. Safety is once again in the hands of the employees, however, a better educated and respected employee. The cost of MSDs or cumulative injuries is reduced and profits are increased, the workforce retires healthy, operating procedures include ergonomic principles, better habits are passed on to new recruits, and management and employees together see the overall interaction of systems and people. Less time is being spent on addressing health and safety issues because they are under control and are of interest to all.

There are many characteristics of these stages not addressed here but this is a summary of what a company might expect as it moves towards a more generative risk management approach. A company can use these to measure where they are and how to get to where they want to be⁶. The first step to achieving generative status is to understand what information is needed and how to educate employees to help themselves and their coworkers.

Using Health and Safety Information: Communications Mapping

In order to use health and safety information effectively, it is essential that we define the following communication pathways: 1) how health and safety information is obtained, 2) who processes it and 3) what they do to disseminate it to the appropriate audience within the mine (and if you are part of a multi-site operation, your company).

Most current information travels the information superhighway and mining health and safety information is no different. There are many sources online for obtaining useful materials for most topics. However there are also offline sources like contractors, seminars, workshops and conferences where this information can be transferred

person-to-person. Then, there are materials that can be produced in-house or ordered ready for classroom use.

Once the mine acquires this information, someone must process it to make it appropriate for the intended audience and situation (annual refresher training vs. incident tailgate talk, supervisors vs. rank-and-file). This may require some careful thought and planning if the information is highly technical, or perhaps, if the materials are in a suitable format, just some photocopying or putting a DVD in the player. Since most OSH professionals perform many functions within an organization, it is understandable that they seek the most ready-to-use information available (i.e. MASHA training courses⁷). If there are funds available, training might be purchased from a contractor who will provide the requisite training to meet applicable standards; however, there is still some dialogue between the local OSH professionals and the trainer to ensure appropriate content (e.g. local problems can be used as examples and miners can apply what is discussed to their daily work).

The decision of how to disseminate the new content to the worker may be informed by urgency of a particular situation which may require immediate attention or the mandate of the Mine Safety and Health Administration (MSHA) that all mines include specific topics in annual refresher training.

During focus group sessions held with members of the Industrial Minerals Association – North America (IMA-NA) NIOSH discussed using trade associations as a possible conduit for transmission of new information and training materials as they emerge from the mining research laboratories. In these scenarios (Fig. 2), getting information to the mine level is the most detail we see; however, the same principle could be applied within the mine where the director of health and safety (DHS) would receive the information (either through active searching or passive notification) and then have to decide what was relevant to his operation. If relevant, by what means should it be disseminated and by what media (tailgate talk, formal instructor-led training, video, demonstration). If the delivery of the information went well, those receiving the training could provide feedback to the DHS, who in turn could let others within his company know lessons learned and make recommendations to colleagues both internal and external through appropriate channels. Understanding how their research is being applied in practice will help guide NIOSH in strategically planning future research endeavors to better serve the mining workforce.

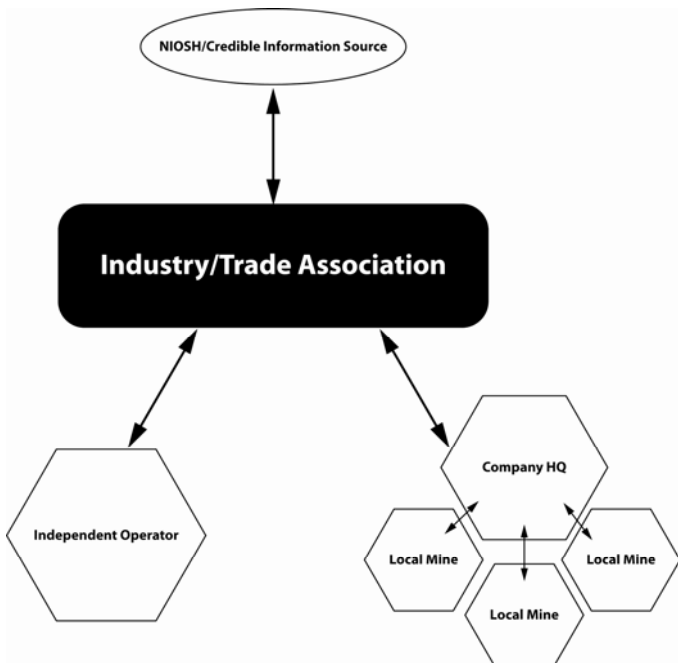


Figure 2. Proposed model of communications where information travels from NIOSH or another credible source through the industry

association to the member companies. Note that this is reciprocal with feedback flowing back to the association and source.

The Next Steps

While a large commitment and responsibility has been placed on the employees and the company to resolve ergonomic issues and integrate an ergonomics way of thinking, it is not solely their responsibility. Many issues result from poor machine and tool design as well as supply handling issues. For this reason, NIOSH is currently working with original equipment manufacturers (OEMs) and with suppliers to both educate them on ergonomics principles and training for their workforce, as well as developing the science to standardize and recommend better design. For example, supplies are often delivered to mines in a format that is beneficial to the manufacturers of the materials rather than to specifications that would reduce manual materials handling issues such as inadequate handles or excessive weight. Equipment manufacturers design ingress/egress systems that may or may not be based on scientific data. The idea is not to point out that manufacturers are purposely providing poor design features, but rather in some cases they are not educated to know what potential problems a design decision can have. They may not have educated their distributors (the interface between the mine company and the OEM) as to the benefits of available options or alternatives so that good communication can take place between the mine representatives and the manufacturers (Fig 3).

In some cases, OEMs have ergonomists or consult with ergonomists but the information link to their distributor is not strong. As more mines become educated on how to reduce MSDs, they will put more pressure on the OEMs to provide those better designs. If the OEMs are more generative, they can provide designs that eliminate or reduce MSDs now, which will give them a market advantage. For many issues, the principles are already available. If the purchasing decision making process is supported by the educated OEM, better and more appropriate equipment will result and not just be “labeled” ergonomically designed. As they better understand that it is the way the worker interacts with the equipment or tool that determines its ergonomic value and that there is no “one size fits all” answer, the designs will be more adaptable to worker capabilities and limitations. Adjustability and accessibility are the keys to good ergonomics.

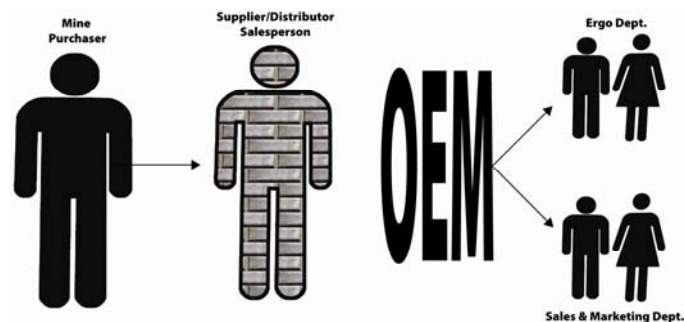


Figure 3. Visual depiction of typical relationships relative to equipment purchasing. The supplier/distributor salesperson is represented as a potential barrier because he may not communicate the needs of the customer to the appropriate departments within his company.

Consequence to Inaction

Supervisors of workers who engage in as much manual labor as mineworkers do should think about their MSD problems and consider that there are consequences from doing nothing. If you are not a vigilant watchdog for the risk factors associated with back injuries for example, the potential pain and suffering to the worker and the lost time and cost to your company can be enormous. But if you are thinking how to make each task more conducive to proper posture, reach and load consideration, then you will catch problems before they result in an injury and work to “build better jobs.”

Conclusion

Ergonomics is not regulated and may never be, but we know it is the right approach for the workforce. Does it give the mine companies and OEMs the opportunity to reduce costs while improving worker safety, health and productivity? Yes. The generative approach will allow ergonomics to be integrated with other health and safety goals. Better communications will allow operations across commodities to share information and methods that work via their respective industry associations and NIOSH.

References

1. Torma-Krajewski, J., Steiner, L. Lewis, P., Gust, P. Johnson, K. (2006), *Ergonomics and Mining: Charting a Path to a Safer Workplace*. NIOSH IC#9491, p. 12.
2. Torma-Krajewski, J., Steiner, L. Lewis, P., Gust, P. Johnson, K. (2006), *Ergonomics and Mining: Charting a Path to a Safer Workplace*. NIOSH IC#9491, p. 19.
3. Westrum R. (1991), "Cultures with requisite imagination." In: Wise J, Stager P, Hopkin J, ed. *Verification and validation in complex man-machine systems*. New York: Springer.
4. Westrum R, Adamski AJ. (1999), "Organizational Factors Associated with Safety and Mission Success in Aviation Environments." In: Garland DJ, Wise JA, Hopkin VD, ed. *Handbook of Aviation Human Factors*. Mahwah, NJ: Lawrence Erlbaum.
5. Hudson, P. (2003), "Applying the lessons of high risk industries to health care", *Quality and Safety in Health Care*, pp. 7-12.
6. <http://www.energyinst.org.uk/heartsandminds/index.cfm>
7. <http://www.masha.on.ca/courses.aspx>