DEVELOPING AND MAINTAINING SAFETY PROGRAMS FOR IMPROVED WORKER PERFORMANCE: DON'T FORGET THE BASICS

By Michael J. Klishis[1] and Ronald C. Althouse[2]

ABSTRACT

While mines are safer today than they were in the past, miners are still being injured, maimed, and killed, and the incident and severity rates for the mining industry are still higher than those for most other industries. What's more, fatality rates are higher in the Nation's smaller mines and highest in the smallest mines. What can be done to improve safety in small mines?

One key to improved safety is worker performance. To be effective, companies need proactive safety interventions involving training, changes in policies or procedures, and/or modifications to equipment that address mine-specific needs and eliminate situations where the miner's actions unnecessarily expose him or her to hazards.

While outside resources such as governmental agencies, academic institutions, and equipment manufacturers can provide assistance to mine operators, it is up to individual mines and companies to develop effective safety programs.

This paper reviews the basics of developing safety interventions aimed at improving worker performance and describes approaches for maintaining program effectiveness. This information is based on research conducted at West Virginia University.[3] Emphasis is given to identifying performance discrepancies (hazardous behaviors) by observations (safety sampling), accident data analysis, and input from workers and supervisors.

INTRODUCTION

Recent decades have seen safety regulations, improved mining techniques, safer mining equipment, and mandated safety training. Efforts by governmental agencies, equipment manufacturers, management, labor, and university researchers have resulted in these safer approaches, procedures, and equipment. While mines are safer today than they were in the past, miners are still being injured, maimed, and killed, and the incident and severity rates for the mining industry are still higher than those for most other industries (*1*).[4] What's more, fatality rates are higher in the Nation's smaller mines and highest in the smallest mines (*3*).

Worker performance is the key to improved safety. Unfortunately, small mine operators with minimal resources and safety and training personnel often feel they lack the time, work force, and skills to develop and

[1]Assistant professor, Safety and Environmental Management.
[2]Professor and chair, Sociology and Anthropology.
West Virginia University, Morgantown, WV.

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[4]Italic numbers in parentheses refer to items in the list of references at the end of this paper.

implement effective safety programs. To be effective, companies need proactive safety interventions involving training, changes in policy or procedures, and/or modifications to equipment. These innovations and changes must address specific mine needs and eliminate situations where the miner's actions unnecessarily expose him or her to hazards.

While outside resources such as governmental agencies, academic institutions, and equipment manufacturers can provide assistance to operators, it is up to individual mines and companies to develop and maintain effective safety programs. The effectiveness of any program begins with the information that forms the basis of that program. The primary sources of information for a safety program are—

- Company records.
- Observation of employees.
- Ideas from workers and supervisors.

If safety interventions do not consider information from all of these sources, they may be based on faulty assumptions and fail to identify an organization's underlying safety problems or the most effective ways to eliminate those problems. Mine managers, safety officers, and trainers often do not get this information. This may be a result of inadequate planning, inappropriate information, lack of time, or outdated and inadequate methods of obtaining and maintaining data.

DATA COLLECTION AND RECORDKEEPING

Obviously, company records should be the easiest data to obtain. Company records of value include reportable accident reports, nonreportable accident information, citations, and the mines' roof control plan. Information on equipment modifications or changes, and even maintenance and production data, also may indicate a safety problem.

To be useful, however, such records must be easy to obtain and in a format that is complete and detailed. Often, this is not the case. For example, while companies maintain records of reportable accidents, these records are often inadequate and may be functionally unusable. A cabinet full of accident forms is ineffective as a safety tool since it is difficult to analyze the data to determine problem areas and, if only reportable accident data are maintained, information about many other real or potential hazards may be missed.

Many managers, safety officers, and trainers now have access to easily maintained, computerized accident databases. These databases may be maintained on a personal computer (PC) or a company minicomputer or mainframe. A PC can be purchased at a very modest price, and there are many approaches to keeping accident, violation, maintenance, and production data. They may be off-the-shelf materials such as William's "FingerTips," or The Pennsylvania State University's (PSU's) "Management Incident Reporting System," or they may be developed specifically for your company. In addition, there are many commercial spread sheets and database programs that can be easily adapted for accident and violation recordkeeping.

If it is impossible to obtain the resources needed to establish and maintain a computerized database, some minimal data summarizing can be accomplished with the use of simple forms. The appendix includes several sample forms that might be useful for collecting and summarizing accident data. Once accident information is summarized, it is possible to get an idea about the types of injuries that are occurring, the equipment or job classifications involved, sections or shifts that have a high number of accidents, etc.

However, simply maintaining accident information is not enough. Many accident reports do not include enough information about the circumstances surrounding the accident to permit managers and/or safety officers to make judgments about methods of preventing future occurrences of such accidents. Consider the following information taken from an actual report of a bolting-related accident:

<u>Example A</u>:

Job Title: **Roof Bolter Helper.** Work at:
Object: **Roof Bolter Galis** Body Parts: **Leg**
Description of Accident: **Bolting roof and strained his leg.**

This description, and others like "hit by rock while bolting," do not provide any clue to the actions of the miner at the time he or she was injured or if any subsequent training, equipment modifications, policy changes, or personnel actions might be appropriate.

The next description provides details about the action of the bolter operator at the time of the accident. This is the first step in gaining enough information to determine if some safety intervention is appropriate.

<u>Example B</u>:

Job Title: **Shuttle Car Opr.** Work at: **Operating bolting machine**
Object: **Roof Bolter** Body Parts: **Finger**
Description of Accident: **Preparing to push resin bolt into hole with machine; as he aligned bolt head & bolt wrench, glove got caught on bolt, wrapped around bolt, pulled finger.**

SAFETY OBSERVATIONS OR BEHAVIOR SAMPLING

Observations of workers performing their normal work routine is a second key to the implementation of safety programs. Called behavior sampling or safety sampling, these observations permit a connection between the accident and the situation and hazards leading to the accident.

The performance discrepancies noted during observations may be quite different from those assumed from a mere analysis of accident data. For example, a large number of back injuries might lead one to believe that training workers on proper lifting procedures is in order. However, on-site observations may reveal that in order to complete certain tasks, miners must twist their bodies while in awkward postures or overextend their reach; therefore, lifting training would not reduce the hazards that led to these accidents.

Another example of the importance of observations concerns injuries from falling roof material. In roof bolting, the most frequently occurring accidents involve injuries to the hands, arms, and shoulders caused by falls of roof material. Observations of bolters show that they often have their hands on the drill steel or drill pod-boom while drilling. This unnecessarily exposed them to falling roof material at a time when they are disturbing and fracturing the top, a situation that is likely to cause falling rocks and/or coal.

Observations can easily be made by managers, safety personnel, and/or supervisors, but there must be some systematic approach to conducting observations to ensure that the data are easy to collect and meaningful. If time permits, the observer could spend half a shift watching the bolting operators at work, but this is not necessary. A face boss could gather similar information by spending 5 min/d at some point when he or she was on the section. A Roof Bolting Observation Sheet (see figure 1) was developed to help when observations of bolter operators are conducted. This checklist allowed the observer to record behavior for the most common actions performed by bolter operators.

CONDENSING AND ANALYZING DATA

Observations must be put in some condensed form to be useful. For example, the Roof Bolting Observation Sheet enabled the authors to make a simple tally of safe and exposed behaviors to determine where problems exist. Table 1 is a simple tally completed from observation sheets collected at a multiple section mine. It was easy to calculate the percentage of operator actions that resulted in hazard exposure (i.e., unsafe acts). It was also possible to determine the number of operators who consistently performed in a manner that left them exposed to hazards.

After collecting the observational data, they must be reviewed and analyzed in light of accident data to determine specific problems. The next task is to determine the best approach for correcting those problems. In many companies, the tendency is to institute a training program that will instruct the miners on how to work in a safer manner. Depending on the nature of the hazard exposure, this may or may not be the most effective approach.

Table 1.—Summary tally of bolter operator observations

Bolting work task	Number of observations	Unsafe acts	% unsafe	Problem bolters[1]
Hands on rotating steel	160	29	18	3
Hands on mast (drilling)	158	94	59	7
Removing steels	159	31	19	4
Pinch points steels	77	1	1	0
Align bolt wrench	75	1	1	0
Hands on bolt wrench	76	25	33	5
Hands on mast (inserting bolts)	73	36	49	6

[1]Number of bolters observed = 12.

ROOF BOLTING OBSERVATION SHEET
(Single Boom Bolter – 20-foot cut)

Observer: ______________________

Date: __________ Crew #: _____ Cut #: ______

Comments on unsafe acts and/or exceptional performance

Drilling (w.starter)

	Row 1	Row 2	Row 3	Row 4	Row 5
Hand on Rotating Steel					
Safe					
Exposed					
Hand on Mast/Drill Head					
Safe					
Exposed					
Removing Steel from Hole					
Safe					
Exposed					

Drilling (w. finisher)

	Row 1	Row 2	Row 3	Row 4	Row 5
Avoid Pinch Points					
Safe					
Exposed					
Hand on Rotating Steel					
Safe					
Exposed					
Hand on Mast/ Drill Head					
Safe					
Exposed					
Removing Steel(s) from Hole					
Safe					
Exposed					

Bolting

	Row 1	Row 2	Row 3	Row 4	Row 5
Aligning Bolt & Wrench					
Safe					
Exposed					
Hand on Bolt while Inserting (raising/spinning)					
Safe					
Exposed					
Hand on Mast while Inserting Bolt					
Safe					
Exposed					
Bolt Spin Times (fully grouted bolts only) Manufacturer's recommended time:					
Time in seconds					
Bolt torqued Torque range:					
Yes					

Other Observations: circle observations *(use the back of this sheet for additional comments)*

Bolts Bent — not seen a) Jams bolt into ground (like bow) b) Bends over tire c) Bends elsewhere on bolter	Dust Box Emptied — not done a) After bolting place b) When filled c) Due to no suction	Canopy — no canopy a) Inadequate size b) Bolter doesn't stay under	Bolt pattern followed y / n Personal protection worn y / n Scaling done properly y / n
Laying Bolts Out — not done a) On ground b) On bolter c) Against rib	Methane Checks — not done a) Done incorrectly (no extension rod, etc) b) Done correctly	ATRS a) Not properly positioned b) Not pressurized to roof c) Stab jacks not set	Supplying done properly y / n Test Hole (if needed) y / n Tramming properly y / n

Figure 1.—Roof Bolting Observation Sheet.

ANALYZING PERFORMANCE PROBLEMS AND THE DECISION-MAKING FLOWCHART

Performance problems, whether related to safety or productivity, arise from many different sources and, in turn, have differing solutions. A *human performance discrepancy* (i.e., a worker action or behavior that isn't performed in a desired manner) must be examined in light of potential solutions. All too often, managers decide that the only ways to correct a performance discrepancy is to train or terminate workers when neither of these is the most appropriate action.

In the book *"Analyzing Performance Problems or 'You Really Oughta Wanna'"* (2), a procedure is discussed for analyzing performance problems and selecting appropriate solutions. Possible actions are suggested, such as formal training, practice, feedback, removing obstacles, arranging consequences, changing the job, and transferring or terminating personnel. To assist the manager, trainer, or safety officer in determining which solution is best, they developed a decisionmaking flowchart. This flowchart was expanded by Klishis[5] and modified to reflect the "three E's" of safety: engineering, education, and enforcement. The modified version of the flowchart is shown in figure 2. This version describes possible solutions under four basic categories: education (training), engineering (ergonomics), enforcement (policies-procedures), and personnel actions.

To use the flowchart, you begin by identifying the problem, labeled on the chart as a *"performance discrepancy."* Once a performance discrepancy is identified, decide if the problem is important. Just because a worker doesn't perform in the appropriate manner does not mean that it is really a problem. Often, workers will develop their own patterns and routines for performing a task. These "idiosyncratic behaviors" may be as good as, if not better than, those in the operating or training manuals. If the behavior of the worker is safe, efficient, and productive, it is probably not a problem and should be ignored. To use a sports analogy, if a batter has the wrong batting stance, doesn't keep his eye on the ball, "puts his foot in the bucket," etc., but manages to bat .300 with power and doesn't strike out, does his form really matter? Getting the job done is the important thing.

However, if the worker's performance is unsafe or results in inefficiencies that hurt production, then this is a performance problem that should be corrected. The next step is to determine the cause of the discrepancy. Determine if the problem is a skill deficiency. That is, is the worker's failure to perform the task correctly because he or she doesn't know how to do the job? If the worker has just been assigned to a new job, or must use a piece of equipment that operates in a manner very differently from the old equipment, training is the best solution.

On the other hand, perhaps the skill deficiency is a result of disuse of the skill. For instance, a miner who used to be a bolting machine operator months or years ago, but has been working as a continuous miner operator or as a shuttle car operator, is reassigned as a roof bolter. The worker's skills are "rusty" and he or she doesn't perform in the manner expected. In this case, it is practice, not training that is needed to get him or her "up to snuff."

Sometimes a worker may be performing in an unacceptable manner and not realize it. No one has told the worker that he or she is performing in an unsafe or unproductive manner. The worker is doing what he or she thinks is right and will continue to do so until someone gives him or her appropriate feedback about his or her performance. Many of our skills or approaches will change over time, and perhaps we pick up an unfortunate habit or maneuver that isn't safe, event though it gets the job done and seems okay to us. If we aren't told we are performing a task incorrectly, we can't be expected to correct our errors.

Perhaps the problem is not a skill deficiency; perhaps the task, as it is planned or designed, is not appropriate. That is, no matter how carefully the worker performs the task, there is unnecessary exposure to a hazard or inefficient production. Then the solution is an engineering one.

Perhaps the problem is not a skill deficiency; perhaps there are obstacles that prevent the task from being performed correctly. If a bolter operator doesn't have a torque wrench, or the methanometer is inoperative or missing the extension rod, the operator cannot perform the work safely. If there have been requests for a new torque wrench or methanometer, and none is forthcoming, it is not the operator's fault. In this situation, it is up to the manager, supervisor, or safety officer to ensure that the obstacle to performing a task correctly (lack of appropriate or functioning equipment) is removed (the miner is given needed equipment).

At other times, the problem may be a case of "inappropriate consequences." Consider the situation where the worker's performance on a specific task may not matter, thus the task doesn't get performed. For example, if it is part of the bolter operators' job to rock dust the workplace after bolting it, but the supervisor ignores this task unless an inspector is around, or has general inside laborers dust it on the next shift, why would the bolter operators perform the task? It doesn't matter to them if they do it or not. In this case, it is up to the supervisor to

[5]OFR 113g-93. Coal Mine Injury Analysis: A Model for Reduction Through Training. Vol. III—Accident Risk During the Roof Bolting Cycle: Analysis of Problems and Potential Solutions, by M. J. Klishis, R. C. Althouse, T. J. Stobbe, R. W. Plummer, R. L. Grayson, L. A. Payne, and G. M. Lies.

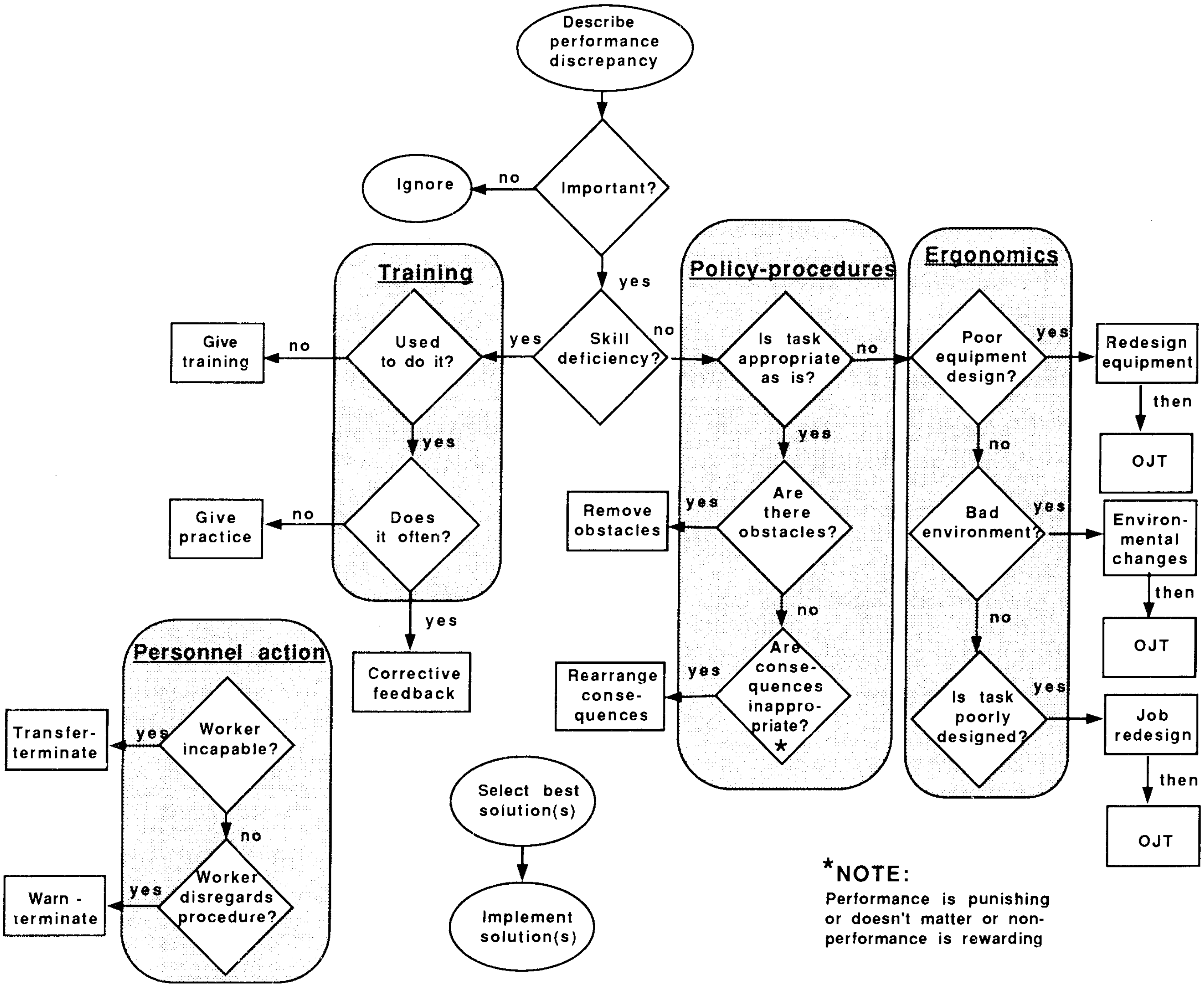

Figure 2.—Decisionmaking flowchart. [Adapted from Mager and Pipe (2)]

"consequate" the behavior, perhaps by "getting on" the bolters if they fail to rock dust.

There are other types of inappropriate consequences. The most common situation involves a task that is "punishing" to perform correctly. Bolting a potted-out place where the automatic temporary roof support (ATRS) won't reach is a good example of this situation. If the ATRS won't reach, the roof still has to be bolted. The proper procedure in this situation would be to set jacks, build a ramp, add a crib block to the top of the ATRS, or use the ATRS extenders to gain the height necessary to get the ATRS to support the roof. Unfortunately, each of these choices requires considerable work, and most bolter operators admit that rather than go to all of this effort, including slowing down work on the production section, they will simply ignore the problem and bolt while under unsupported top. In this case, only a strongly enforced company policy that demands that the task be performed safely will counteract the aversive effects of performing it correctly.

In other cases, the task may not be appropriate. That is, no matter how the worker tries, the task can't be performed safely. In these situations, the problem is an ergonomic one and the solution is an engineering one. To get the desired performance, the equipment will have to be redesigned, the environment changed, or the job redesigned before the worker can perform safely. For example, if the bolter operator can't stay under the drill canopy because it is too small, the canopy will have to be enlarged. If the bolter operator usually cannot reach the top to insert the glue and bolt and has to climb on top of the drill pod to get the necessary height, the bolting machine is obviously too small for the seam and only a more appropriate model will really solve the problem. However, an interim step may be to add a "step-up" device to the machine to permit the bolter operator to climb up on the drill pod in a safer manner.

Another example might be an environmental problem. If an operation is plagued with bad ribs and bolter operators are getting injured by rib rolls, then rib bolting may be one solution, purchasing a walk-through bolting machine another, or perhaps both solutions are needed.

The final alternative is a personnel action. If, after addressing the situation with the recommendations suggested above, the worker is still incapable of performing the task correctly, he or she should be transferred to a different job where it is possible to perform in an appropriate manner. If the employee is capable of performing the task, but simply not willing to perform it correctly, a transfer may also be in order. In either case, if the employee won't perform or is incapable of performing tasks correctly, termination should be considered, but only as a last option. Terminations are always a hassle, but may need to be considered if the safety of the employee and other workers is at stake.

After going through the flowchart and looking at the various possibilities, there may be more than one solution to the problem. At this point, the best solution is selected and implemented. The best solution is determined by the nature of the problem, the time and resources available to correct the problem, and legal or contractual responsibilities.

COMMUNICATION AND EMPLOYEE FEEDBACK

Good interactive communication and employee feedback are also essential in identifying, designing, and implementing any type of safety innovation. The workers are an important resource and their knowledge can be critical in identifying potential problem areas that have an impact on safety and efficiency. Today we hear much about total quality management and quality circles. These techniques are effective because they rely on employees for input and direction. Workers have many ideas on how to improve safety and productivity. Often an individual employee will have developed a "gizmo" or procedure to make work easier, faster, and/or safer; unfortunately, these ideas usually don't go beyond the worker or a crew in the mine.

Involving the workers themselves in the process will allow you access to these ideas, techniques, and modifications. Of course it is best to review these suggestions with experts who are knowledgeable about the process or equipment such as Federal or State agents, equipment manufacturers, representatives from educational institutions, or the U.S. Bureau of Mines (USBM) from the standpoint of safety and efficiency, but usually these suggestions are very valuable and can be easily implemented.

Another benefit gained by involving the miners themselves is that they are usually more receptive to changes in their jobs or work routines when they are involved in planning and/or designing those changes. The changes then become "their" changes rather than changes mandated by management.

When a change is implemented, it is also important to be sure that the "message" gets through to the employees. Effective communication requires reaching all the employees and informing them not only of the change, but the reason for that change. If not, they may not understand why a change was made and may ignore or even subvert the intervention. For example, one operation decided to weld a small piece of pipe to the bolting machine. This pipe was supposed to serve as an "aid" when bending bolts. The change was agreed upon at a meeting that included the safety director and the union safety committee chairperson. Unfortunately, all of the bolter operators were not informed of the reason for this "modification." As a result, one operator had the pipe removed. Another oper-ator determined that the pipe was mounted at the wrong angle, but instead of having the angle corrected, he or she also had the pipe cut off. As a result of the failure of management to communicate with the work force and of a worker to communicate with management, the well-designed intervention was a failure.

Improved communication also means the transfer of ideas between sections of the same mine and/or other mines in the same company. In working with "umbrella" companies with several small mines, researchers have observed safety improvements installed in one mine but not in other mines of the same company. They have even observed improvements in one section of a mine but not in another.

Communication also means keeping employees informed about what is happening in the mine. What kind of information does the face boss and/or the workers get when they start a shift? Are they told about safety-related problems or bad conditions? Have any changes or innovations designed as a safety intervention be initiated? If so, what are they and why were they made?

PROBLEMS FACED WHEN BUILDING AND MAINTAINING A SAFETY PROGRAM

Small operations, even "umbrella" operations that service several single unit mines, usually do not have enough data on accidents to make well-informed choices on safety and training interventions. Fortunately, accidents are a rare occurrence in any operation, but this results in a database that consists of a few, highly scattered incidences. It is difficult, if not impossible, to draw conclusions from such limited information.

To have enough information to make decisions, small operations need a database and hazard inventory built on a large accident pool. An example of one such database is the roof bolting accident database developed by researchers at West Virginia University's (WVU's) Mining Extension Service.[6] This database and the resulting hazards inventory served as a guideline for making observations and taking actions to improve bolting safety at several small operations.

Another problem safety personnel at smaller operations face is the need to make safety sampling observations with limited time and resources. Ideally, observations should be made by face bosses, but problems abound. There never seems to be any time to train face bosses to make observations, and if they are trained, they have so many demands on their time that they don't feel that they have time to make observations.

Supervisors required to make observations face another dilemma. They don't want to look bad or have their section or people look bad, so they are hesitant of making "accurate" (truthful) observation reports for fear of actions against them and/or job loss.

Although supervisors are the best persons to make safety observations, we cannot forget the safety manager. It is important that safety officers go underground, learn what is really happening in the mine, and identify potential problem areas.

TRAINING AS A SAFETY INNOVATION

Another problem faced by operators of small mines is making effective use of mandated health and safety training. Too often, training is done for compliance, not for safety. Training done by well-meaning, knowledgeable entrepreneurs who have little knowledge of the operation's specific safety problems serve to comply with the law but do little to meet the "true" safety training needs of the operation. When these entrepreneurs are finished training, the operator has a 5000-23 form with the correct boxes checked, but the safety level of the operation is at best maintained at an ongoing level, not improved. If training is to be an effective approach to improving safety, the trainer must treat training as an opportunity for improvement, not just as an activity needed to comply with governmental regulations.

To be effective, training must be tailored to identified, specific company or mine needs. Canned or generic programs may include good information and many valid points, but do they really meet the needs of your organization? Training should also go beyond mandated requirements. If a problem exists with a certain piece of equipment or job classification, take the time to give appropriate training on that area. It is easy to cut training to the bare minimum, but in the long run this is not cost effective.

Finally, management must not view safety as a "one-shot" deal. Once there has been a successful implementation of a safety intervention, the job is not over. Management must consider safety as a continuous process that requires constant attention and effective communications to maintain quality and safety on all working sections. Effective training involves the entire organization in an attempt to keep the workers safe and productive.

Management must demonstrate its support for the training effort. This means taking interest in the training program, meeting with workers during annual refresher training sessions, and encouraging them to work in a safe manner. It means demanding that supervisors work in a safe manner and that they ensure that work crews and individual miners are also working safely.

OTHER INITIATIVES

While mine operators have the primary responsibility for maintaining a safe workplace, it is difficult for them to "go it alone." Safety and training assistance for small operators is needed from Federal and State agencies, technical schools, junior colleges, and major mining institutions with "outreach" services (WVU, PSU, etc.). In 1980, a report by John Short & Associates (*4*) suggested that the most effective approach to work force

[6]Work cited in footnote 5.

development and training in the mining industry would be a national mining extension service. Perhaps it is time to reexamine that idea and strengthen the service to small operators. In this light, WVU's Mining Extension Service has recently stepped up and expanded its service to small mine operators in West Virginia.

The USBM has long been involved in research that has been a tremendous assistance to the mining industry. To be most effective, the USBM should continue to place an increased emphasis on human factors and training for small mine operators while maintaining its traditional research orientation for equipment and mining techniques.

The interchange of information is one key to successful safety and training programs. All governmental agencies should encourage and support local, regional, and national meetings of safety and training personnel, such as the Holmes Safety Association, State grants meetings, training resources applied to mining, and the National Mine Instructors Conference.

Of course the U.S. Mine Safety and Health Administration (MSHA) has an important function and can be a key agency in the improvement of safety in small mines. It should continue its efforts to develop easy access of Safety and Health Technical Center (SHTC) data for all operators (such as data on diskettes and user-friendly programs), but it can also provide much needed data to the small operator and academic researchers by conducting finer grained, more useful analyses of accidents in the SHTC database. These analyses should be similar to the "microanalysis" conducted at WVU.[7]

What does this have to do with small mine operators? Simply put, while government agencies and educational institutions strive to provide the assistance and services needed most by the mining industry, small mine operators need to make their needs and wishes known to these agencies and encourage the support and funding of programs that are beneficial and practical.

CONCLUSIONS

The safety program basics suggested here involve identifying situations and conditions under which miners are injured and using that information to develop interventions for critical areas in the job task. The key steps in this process are the analysis of accident and injury data, observations of employees performing tasks, communications between workers and supervisors, and development of appropriate training.

Although governmental agencies can provide assistance to operators in the form of research, especially in the area of human factors, and assistance in the interchange of ideas, it is up to the operator to place the appropriate emphasis on safety and training at his or her operation. This means management's involvement in the effort and viewing safety and training as an ongoing, ever-changing, integrated process.

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[7]Work cited in footnote 5.

APPENDIX.—ACCIDENT DATA COLLECTION AND SUMMARY FORMS

When building a safety program that will permit the development and implementation of safety interventions, one resource is company data such as accident and injury information. Other company records of value include citations of the roof control plan, information on equipment modifications or changes, and even maintenance and production data. To be useful, however, such records must be easily obtainable and in a format that is complete and appropriately detailed, which means establishing a comprehensive and useful database.

The focus of any safety program begins with accident and injury data. Unfortunately, these accident records are often inadequate or unusable. While accident information is required by regulatory agencies (MSHA and State mining departments) and for insurance purposes (Worker's Compensation), it is often maintained as a number of reports in a filing cabinet. These reports may not be an effective safety tool since (1) they are designed to meet the needs of outside agencies, not company safety and training personnel, and (2) it is difficult to analyze data that are in raw report form.

The first step in establishing an effective database begins with the collection of accident data that are useful to a safety program. While the information required by government agencies may be of some use, there are many "nonreportable" accidents that should be considered. In addition, the most important information in an accident report is the description of the situation or circumstances that surround the accident: What was the worker doing just before and when he or she got injured; how did he or she get into the situation; if there was any warning before the incident occurred, how did the worker react; and what can be done to prevent such an incident in the future?

To get this information you need an accident form that specifies the reporting of incidents in enough detail and a company policy requiring the reporting of all incidents where a worker is injured. This requires getting a report from the victim and/or the victim's supervisor, as well as a followup visit, especially in the case of nonfatal days lost (NFDL's), to discuss the accident with the victim, the supervisor, and any witnesses. The two-page mine accident form with its accompanying supplemental third page for evaluation by a safety officer is an example of such a method of collecting accident information (see figure A-1). You may find it useful for your operation.

The key to this form is the narrative description of the accident (second page) and the accident assessment (third page). Getting detailed information on the incident rather than simplistic descriptions such as "hit by rock" will give you an idea of the kind of problems that may exist and a starting point for observations.

The second step in maintaining accident data is consolidation into a useful summary that permits safety officials and mine management to maintain a "handle" on accidents. Such a form may be similar to the mine's production reports. There are two forms in this package that may be useful. The first, called the Accident Summary Sheet (fig. A-2), is designed to keep a running tally of accidents. The second, called the Lost Time Accident Summary Sheet (fig. A-3), serves as a simple way to summarize accidents on a monthly and yearly basis.

Once the mine's accident data has been summarized, the mine operator can look for trends or problem areas. Remember, it is necessary to couple the analysis of accident data with a review of the narrative descriptions of the accidents and on-site observations to be able to pinpoint both the problem and its cause, as well as to identify potential corrective actions.

Don't forget the other company data. Citations for safety violations from Federal and State inspectors or writeups from company compliance officers can help to pinpoint problem areas. As with accident information, there has to be some organization of the information. A simple listing made on a form such as the Violation Summary Sheet (fig. A-4) might be helpful in identifying repeated violations that can be a sign of a problem.

Mine Accident Form

Name:______________________________ Date of Accident:____________

Witness:____________________________ Time of Accident:___________

Mine:______________________________ Date Reported:_____________

Age:____ Sex:_M / F_

Days Lost From Work: Was there time lost from work (or) time lost and restricted work?_Y / N_

Total lost days from work (if any) _____

Occupational Information

Regular Job Title:____

Job/Activity When Injured:_____________________________________

Total Years Mining Experience:_____ Years at Present Mine:______

Years at Present Job title:_________

Accident Information

Location of Accident in the Mine: (Circle all appropriate choices)

Underground / Surface

1. Face
2. Intersection
3. Haulageway
4. Mantrip / transportation
5. Underground shop or office
6. Belt area
7. Other_________________________

Source of Injury:____
What Object/Material caused the injury, i.e., drill steel, falling roof, electrical cable, crib...etc.)

Body Parts Injured and Type of Injury (list as many as applicable):

Body Part Injured	Type of Injury (cut, fracture, etc.)
____________	____________________
____________	____________________
____________	____________________

Figure A-1.—Mine Accident Form.

Description of Accident

Instructions:

Please give a detailed description of the accident. The purpose of this form is to help in the development of safety and training materials to make it safer to work in this mine. The more information you give the more useful it will be to you and your fellow workers.

Thank you.

Figure A-1.—Mine Accident Form—Continued.

Accident Form Supplement
(To be completed by safety officer)

Name:________________________________ Date of Accident:____________

Mine:________________________________ Date Reported: ____________

Is there safety/training material that is related to this accident on hand? Y / N

If YES, is the material current? Y / N

Has the injured received safety/training material related to this accident in the last year? Y / N

Personal observations from accident site:

Comments from supervisor/witnesses:

Provide an assessment of the accident including what actions can be taken to prevent the reoccurence of this type of accident:

Figure A-1.—Mine Accident Form—Continued.

ACCIDENT SUMMARY SHEET

Date	Regular Job Classification	Job at Time of Accident	Accident Type	Details of Accident

TOTALS (per accident type):

HANDLING MATERIALS ________
HAULAGE ________
MACHINERY ________
SLIPS and FALLS ________
HAND TOOLS ________
ROOF FALLS ________
STEPPING or KNEELING on OBJECTS ________
ELECTRICITY ________
FALL of FACE or RIB ________
FALLING or SLIPPING OBJECTS ________
OTHERS ________

Figure A-2.—Accident Summary Sheet.

LOST TIME ACCIDENT SUMMARY SHEET

Operations With LTA	
Operation	No.
TOTAL	

TOTAL INJURIES

HEAD ____
EYE ____
NECK ____
SHOULDER ____
ARM ____
HAND ____
FINGERS ____
CHEST ____
BACK ____
ABDOMEN ____
LEG ____
FOOT ____
TOES ____

THE
RIGHT WAY
IS THE
SAFE WAY

Occupations With LTA	
Occupation	No.

Occupations With LTA	
Occupation	No.
TOTAL	

SHIFT	NO.
DAY	
AFTERNOON	
MIDNIGHT	
TOTAL	

LOCATION	NO.
SECTION	
NON-SECTION	
SURFACE	
TOTAL	

AGE	
YEARS	NO.
To 20	
21 - 25	
26 - 30	
31 - 35	
36 - 40	
41 - 45	
46 - 50	
51 - 55	
56 - 60	
OVER 60	
TOTAL	

EXPERIENCE		
0 - 1 mo	CURRENT JOB	TOTAL MINING
2 - 12 mo		
1 - 2 yrs		
2 - 3 yrs		
3 - 4 yrs		
4 - 5 yrs		
3 - 4 yrs		
5 - 10 yrs		
10 - 15 yrs		
15 - 20 yrs		
over 20 yrs		
TOTAL		

ACCIDENT CATEGORY	NO.
MAT'LHAND	
SLIP/FALL	
HAULAGE	
MACHINERY	
ROOF FALL	
RIB FALL	
ELECTRICAL	
HAND TOOLS	
OTHER	
TOTAL	

NATURE/INJURY	NO.
STRAIN	
SPRAIN	
FRACTURE	
LACERATION	
CONTUSION	
AMPUTATION	
ELECT. SHOCK	
BURN	
OTHER	
TOTAL	

MONTH

MONTH/FY ___ TO DATE	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	FYTD Comparisons	
TOTAL EMPLOYEES														
TOTAL LTA'S														
TOTAL INCIDENT RATES														

Figure A-3.—Lost Time Accident Summary Sheet.

VIOLATION SUMMARY SHEET

DATE	SUBJECT OF VIOLATION	STATE/FEDERAL REGULATION	DESCRIPTION

Figure A-4.—Violation Summary Sheet.

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Compiled by Robert H. Peters

United States Department of the Interior
Bureau of Mines
1994

U.S. Department of the Interior Mission Statement

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally-owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

Special Publication 18-94

Improving Safety at Small Underground Mines

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UNITED STATES DEPARTMENT OF THE INTERIOR
Bruce Babbitt, Secretary

BUREAU OF MINES