THE EVOLVING MINING WORKFORCE: TRAINING ISSUES

Kathleen M. Kowalski, Ph.D., Research Psychologist
Charles Vaught, Ph.D., C.M.S.P., Sociologist
with (in alphabetical order)
Michael J. Brnich, Jr., C.M.S.P., Mining Engineer
Launa Mallett, Ph.D., Sociologist
Dana Reinke, Social Science Technician
Lynn Rethi, C.M.S.P., Safety Engineer
Lisa Steiner, C.P.E., Ergonomist
William Wiehagen, C.M.S.P., Industrial Engineer

National Institute for Occupational Safety and Health
Pittsburgh Research Laboratory
626 Cochrans Mill Road
Pittsburgh, PA 15236

contact:kkowalski@cdc.gov

ABSTRACT

Safety and health professionals from all sectors of industry recognize that training is a critical element of an effective safety and health program. A major concern in the mining industry today is how to train the present aging workforce, plus the expected influx of new and less experienced miners and mine operators as the cohort of older workers retires. This paper defines this problem, offers a model to structure the inquiry, and presents the key issues identified by a multi-disciplinary team of NIOSH researchers, based on an extensive review of the current literature in relevant areas. Issues include differences among cohorts, such as the newer workers (Nexters) and present workers (Veterans/Boomers/Xers), with respect to their physical, social, psychological, and cultural characteristics, their learning styles, and their work expectations. Specific issues for an aging workforce are discussed and some preliminary recommendations are offered for discussion on the type of training needed for the evolving mining workforce.

INTRODUCTION

The average age of the American worker is increasing. In the federal government alone by 2006, 493,000 employees in the top 24 federal agencies will be eligible to retire. According to Sen. Fred D. Thompson, R-Tennessee, agencies without the right mix of employees are at risk of not being able to carry out their missions or deliver services (Federal Employees News Digest, 2001). Over the past six months, a number of articles in the *Wall Street Journal* have appeared concerning the retirement of so-called "baby-boomers" and the impact on various industries nationwide (WSJ Jan. - June 2001). This trend is not limited to the United States. For example, facing a shortage of highly-

skilled professionals, scientists, technicians, and an aging and shrinking work force, Germany is enacting new policies to attract foreign workers in order to fill the country's future employment needs (WSJ July 2, 2001, p. A8).

The mining industry is a microcosm of this international and national trend of the aging, soon-to-retire worker. In fact, in the mining industry the trend is amplified due to a boom in the seventies when a large number of mine workers, mainly in their twenties, were hired. The 1980s and '90s brought a downturn in the market with downsizing and layoffs resulting in a lack of "new, younger hires" over the past years. Recently, the Bituminous Coal Operators of America (BCOA), the United Mine Workers of America (UMWA), and industry leaders have joined together in expressing concern for the future of the mining workforce.

Data indicate that the percentage of injured or ill or older workers has been steadily increasing over the ten-year period from 1988 - 1998 (Fotta, 2000). Fotta reviewed Mine Safety and Health Administration (MSHA) injury and illness data over this ten-year period and found that regardless of occupation or type of operation, the median number of days lost from work due to injury was higher for older workers than for younger workers. She concluded that given the relatively high proportions of older injured/ill workers in the mining industry, particularly in coal, occupational health and safety programs need to specifically address the problems of an aging workforce, and designing and applying effective interventions for older workers should be of critical importance in mining health and safety.

In addition, the issue is not simply a matter of developing appropriate interventions and training for older workers and new hires. A problem of recruitment is also looming. Recently an Associated Press article in the Kentucky Post noted that young people are shunning mining careers, opting for less dangerous jobs (Associated Press, Kentucky Post, April 17, 2001). An article in the New York Times, reprinted in the Pittsburgh Post Gazette on June 24, 2001 (Cines, 2001), discussed a proposal to import Ukrainians to work in the mines in West Virginia. Although the focus of this paper is not on recruiting, but on training an evolving mining workforce, the two issues are related.

Almost no research has been conducted on the effects that continually changing, dynamic, physically demanding workplaces such as mines, have on the way aging workers interact with their jobs. Further, little attention has been given to the kinds of educational interventions that could help workers cope with their changing circumstances. Similarly, little research has been conducted on the actual experience of young workers in dynamic work settings. Accident statistics in coal mining (1968-1978) suggest that being young and inexperienced leads to higher injury rates among workers. Data also suggest that older workers, while injured less often, sustain more serious injuries with more lost time from the job (Fotta, 2000). Clearly, safety is a significant issue for all mine workers, regardless of age.

Little is known about the kinds of education and training experiences that are most useful for the aging mine worker, or the best way to prepare young people for work in a mining environment. Indeed, there is no accepted model for the transfer of experience from older to younger workers. In addition, due to a dwindling supply of younger workers, it is possible that former miners laid off in the past ten to fifteen years may return to mining for the remainder of their work lives. Thus, the evolving mining workforce is very different from that of the influx of generally same-age miners in the 1970s. The mining workforce may comprise older workers (over 45), middle-aged workers returning to mining, and younger, inexperienced workers.

NIOSH is presently conducting an inquiry into this issue of an evolving mining workforce with a multi-disciplinary team made up of sociologists, psychologists, industrial, safety, and mining engineers, ergonomists, and education and training experts. Tieger (1994) stressed the importance of a multi-disciplinary approach to

address the problems of age and work conditions. The authors recognize that there are interventions other than training interventions to address the concern of the changing mining workforce, i.e., engineering controls, recruitment approaches, labor/management input, and others. This paper focuses on training and discusses the beginning phases of the inquiry on how best to train the future mining workforce. Selected results from an extensive review of the literature and suggested preliminary recommendations for training are presented.

THE RESEARCH MODEL

Researchers have developed a model to guide the exploration of the problem of the evolving mining workforce (**Figure 1**). Initially, of course, the population must be identified and defined. Various cohorts represent the workforce. A cohort is a group of individuals who are born at approximately the same time and therefore have common experiences as they pass through life. "The common experiences of a generation create a specific sensibility that connects its members in some way (Ruch, 2000, p.41)." It is proposed that identification and definition of these different cohorts will lead to better communication, understanding of learning styles, and the development of targeted training.

The psychological, social, and physical similarities and differences of cohorts are basic to understanding the composition, characteristics, and needs of the present and future workers in the mining industry. Clearly, present and past training methods need to be observed, and training approaches require evaluation within the context of the various cohorts. With this information, training needs may be identified and appropriate evaluation techniques incorporated into training recommendations for the future. This paper focuses on the first and second aspects of the model—the characteristics of the present and future mining workforce and a discussion of training approaches.

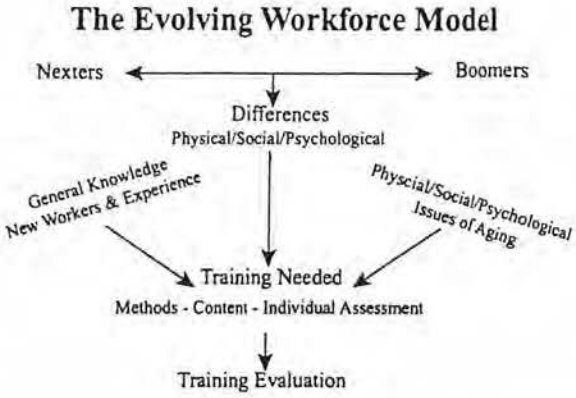


Figure 1 Model for an Evolving Workforce

CHARACTERISTICS OF THE MINING WORKFORCE

Cohorts, as defined earlier, provide a means of organizing and defining the present and future mining workforce. Authors suggest that cohorts are quantitatively and qualitatively distinct, i.e., the social, economic, and cultural circumstances for each cohort differ and partially account for differing characteristics and needs. Willis (1985) suggests that cohort differences seem to have some distinctly different educational implications for the various age groups. As an example, Wyld (1994) states that Generation Xers embrace different perspectives on careers than their predecessors due to the changes in the economic scene during their lives.

To conduct research and develop training for the U.S. mining workforce, four generational groups must be considered. The population numbers for each group relate to the total U.S. population. The traits for the four cohorts, as summarized by Salopek (2000) from the definitions developed by Zemke, et al. (2000) are:

> **The Veterans** 1922-1943 (52 million people). Those born prior to World War II and those whose earliest memories and influences are associated with that world-engulfing event. The traits associated with this group are: patriotism, loyalty, conservative fiscal practices, and faith in institutions.

The Baby Boomers 1943-1960 (73.2 million people). Those born during or after World War II and raised in the era of extreme optimism, opportunity, and progress. The traits associated with this group are: idealism, competitiveness, a tendency to question authority, and an attitude of the "me" generation.

Generation Xers 1960-1980 (70.1 million people). Those born after the blush of the Baby Boom who came of age deep in the shadow of the Boomers and the rise of the Asian tiger. The traits associated with this group are: technological savvy, diversity, independence, skepticism, and an entrepreneurial spirit.

Generation Nexters 1980-2000 (69.7 million people to date). Those children of the Baby Boomers and early Xers born into our current high-tech, neo-optimistic time. The traits associated with this group are: independent spending, global consciousness, health consciousness, and cyber literacy.

Clearly, there is overlap in these group designations. Zemke, et al. (2000) indicate that they would have overlapped the groups, but were concerned about confusing the reader. In fact, other authors use different terms to refer to the same cohorts. For simplicity and continuity, the NIOSH researchers have chosen to use the Zemke, et al. definitions. Using these definitions, the majority of miners in the current workforce are either Baby Boomers or Generation Xers.

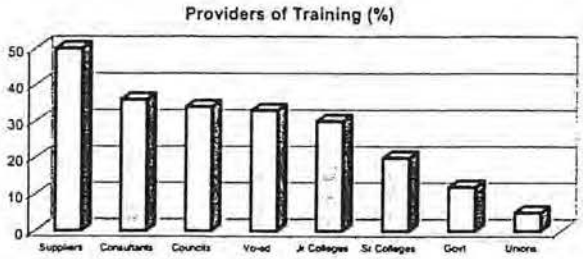
Cohort differences are important to observe from a research perspective, but it must be noted that some industries specifically focus on hiring a homogeneous workforce with similar background and values, minimizing the differences in cohorts. An example of this human resources hiring practice is Texas Instruments, a company that purposely seeks similar values in their employees (Cauldon, 1997). Historically, the mining population may be viewed as fairly homogeneous with common values, partly by virtue of geographic location of mines and the adjacent communities, and partly by virtue of the families that include generations of miners—a grandfather, an uncle, a father, a son, a cousin. Career choice used to be relatively predictable for those entering the workforce (Wyld 1994), but this is no longer true. There is no longer an expectation of lifetime employment with one company or even within one industry.

Cohort differences discussed in the literature include such issues as career expectations, changing recruitment and retainment strategies, obsolescence, and communication gaps. Each of these issues affects today's training practices. Employees are focusing on their individual career development and looking for positions that will allow them to improve their knowledge and skills. Thus, to engage younger employees, training needs to focus on practical skills and knowledge that clearly relate to individual development goals. As an example, older workers—Veterans and Baby Boomers—are less comfortable with high-tech tools and need training to become more techno-literate.

TRENDS IN TRAINING APPROACHES

Organizations are using various sources to provide training for employees. To study training approaches, Lynch and Black (1998) used the Educational Quality of the Workforce National Employers Survey (EQW_NES) with the goal of understanding how employers' training investments are influenced by the decision to invest in new technology and reorganize the workplace. They found that 81 percent of the sample provided some type of formal training.

It is interesting to note who provides this formal training. (See **Chart**). Fifty percent of the sample population used equipment suppliers and buyers to train their employees. Thirty-six percent used private consultants, 34% used industry councils or associations, 33% used technical or vocational institutes, 30% used community or junior colleges, 20% used four-year colleges, 12% used government-funded training programs, and 5% used unions.



Lynch and Black concluded that the type of training program offered by businesses varies considerably by employer; however, most employers do offer some sort of formal training with smaller employers less likely to provide formal training. The mining industry also utilizes a variety of sources to provide its mandated training and informal training, although the authors suggest that this informal training is less likely to be provided and if provided less likely to be documented.

Formal and Informal Training

Most U.S. organizations use a formal/informal approach to provide training for their employees, although it must be noted that it is easier to measure the effect of formal training as opposed to informal training. Bartel (1989) reported those U.S. organizations employing fifty or more workers spent $32 billion on formal training programs. There are no qualitative figures for informal workplace training. A study by Loewenstein and Spletzxe (1998) developed a survey to compare both formal and informal training in relation to individual job wage growth. Taking into consideration the problem in survey design measurement of informal training, they concluded that when combined, formal and informal training can jointly account for a major factor for individual job wage growth. By inference, increased job growth wages reflect improved skills and performance. Thus, it is suggested that combining formal and informal training increases performance/production/ safety.

In today's workforce, researchers must examine both formal and informal training data to accurately analyze the impact of training on the individual and the organization. Models that accurately measure informal training should become increasingly more important and an area for future inquiry. With mandated training in the mining industry, standardized measures for informal training are particularly important.

Development of 'Collaborative' Materials

A current trend in training is that of companies developing "collaborative materials." That is, companies in the same industry develop training materials together for common use in the industry. Dugas, et al. (1999) identified a 1996 study that evaluated the success of delivering interactive instruction in the workplace through industry organizations and associations. Case studies were conducted looking at four human resources council modules and four industry association modules. In all cases, the councils or associations were contemplating development and distribution of courseware to associated employers. The authors pointed out that these associations not only served as developers and providers of courseware, but acted as a conduit to help small and mid-size companies gain access to materials. Six factors were identified as leading to success of such a program. These include development of partnerships, adequate needs assessments, authentication of materials, relationship of content to industry needs, sufficient market for products, and appropriate delivery media.

Transferable vs. Non-transferable Training

Transferable training versus more job-specific training generally not relevant to other jobs is a definite trend in today's on-the-job training. The tendency is to provide very specific, focused training for workers. One of the concerns expressed by companies is that providing transferable training may develop skills that can be applied to the larger, eternal market and thus to other (competitive) firms. In other words, the global market increases as the number of available workers decreases, and it is suggested that organizations will under-invest in training for fear of external poaching of "trained"employees.

It is important to recognize this trend in training as it is opposed to one of the stated needs of certain workers, which is to focus on their individual career development and look for positions that will allow them to improve their knowledge and skills. Thus, to engage younger employees, training should focus on practical skills and knowledge that clearly relate to a worker's goals. This creates a conflict for the mining industry, because mining jobs tend to be very specialized.

Communication Issues

Smith (1993) reports that U.S. Department of Labor statistics show that immigrants accounted for 22 percent of the growth in the U.S. labor force between 1980 and 1987. These trends in demographic changes, especially in areas with high immigration populations, are forcing companies to take steps to properly train and educate these workers. In California S.B. 198, passed in 1991, requires employers to communicate occupational safety and health information in a manner readily understandable to all employees. Toward that end, the Contractors' Safety Association of Texas City is only one of many associations to provide health and safety training in Spanish as well as English formats. Smith (1993) identified several areas for consideration if we are to provide safety training for a "salad bowl" society.

Comprehensive training programs should include (1) evaluation of literacy among workers, either English or a native language, (2)if communicated in English, instruction in how to read and write English with special emphasis on workplace terms and language, (3) translators/interpreters familiar with technical jargon, (4) signs and training material that are visual in nature and easy to understand, and (5) acknowledgment of cultural differences and their effects on the workplace.

Recent Psychological Contributions to Training

An overall trend in the workplace is the increased contribution of psychologists in such varied areas as assessment; workplace job losses and job transitions; "road rage, air rage, and desk rage;" violence in the workplace; tenets of healthy workplaces; career decisions; and training issues. There has been a recent development in the area of training with universal implications. Bennett Schwartz at Florida International University has observed that, in many cases, "the way that we think is the best way to learn is not, in fact, the best way (Carpenter, S. 2001)."

Research in the area of cognitive psychology has challenged the "truism" that practice makes perfect. *How* such practice is structured makes an important impact on how well people retain what they have learned. However, recent research found that this is a principle that most lay people fail to recognize (Simon, 2001). The reported study confirms, as earlier research on both verbal and motor learning has indicated, that practicing several different skills in separate, concentrated blocks leads to better performance during practice than does interleaving (arrange in alternate layers). The practice trails on those separate skills.

But in the long-term, interleaved practice leads to better learning than does blocked practice. Unfortunately, the temporary boost that blocked practice provides prompts people to over estimate how well they have learned the motor skills they practice. "People are often poor assessors of what they have learned (Simon, 2001)." "If people are making judgments about whether they're prepared to do something, they might make a decision that would be wrong," explains Simon. In some circumstances this is not serious, but in others such as in a surgical procedure, or mine machinery operations, the consequences can be serious.

This finding, that blocked practice leads to better short-term performance and poorer long-term learning, can fool trainers and teachers. The research highlights that "the value of knowledge depends on its longevity."

Worker involvement and knowledge management

Worker involvement is a continued trend in safety and health training programs in both structure and content. Incentives and feedback have been shown to be successful in improving safety conditions and reducing accidents (McAfee and Winn, 1989). The "empowerment" movement of the 1990s showed that involvement of workers increases their skill knowledge (Miles 1992). Recently, a new concept, *Knowledge Management (KM),* has emerged which in part combines the concept of worker empowerment and tenets from the age of technology and communication.

Growing interconnection between rapid socio-technical change and a globalizing economy has led organizations to put increasing emphasis on knowledge enhancement and utilization in the workplace. By current wisdom, an organization that can improve its performance the most and at the fastest rate is the organization that survives. Knowledge Management is a recent development in organizations' attempts to better utilize their stocks of knowledge in order to improve workplace performance.

In essence, all organizations must react to environmental changes in much the same way—through information exchange (Shockley, 2000). The organization that has the best information, in the appropriate quantity, at the right time, is the organization that is most likely to survive. Shockley (2000) provides some thoughts on what type of organization is apt to be receptive to knowledge management:

- An organization must have a culture of trust, because individuals who possess knowledge are being asked to share it with others;
- Risk taking must be condoned, because ideas are paramount, and not all ideas end up working;
- The organization must not only share successes, but failures as well, because sharing both is critical to learning;
- There must be a commitment to time, because a KM culture requires a long-term building process;
- It is absolutely critical for management to buy into KM and encourage workers to share information.

One outcome of the growth of a KM culture is the ascendance of worker proficiency in knowledge-based decision-making, and the organization's willingness to foster employee skills in this area. It is generally recognized that just as KM allows organizations to react to their environment, it is the decision-maker's facility at knowledge management that makes organizational survival happen (Holsapple, 2001).

Bock (1998, http://www.bockinfo.com) characterizes the management of knowledge in decision-making as a process with four parts that compose a loop (see **Figure 2**): "Knowledge is created." This happens in the heads of people. "Knowledge is captured." It is put on paper in a report, entered into a computer system of some kind or simply remembered. "Knowledge is classified and modified." The classification can be the addition of keywords, or it may be indexing. Modification can add context, background or other things that make it easier to reuse later. The test of this step is how easily people in the organization will be able to find and use the knowledge when they need it. Knowledge is shared. When knowledge is shared and used, the folks who use it modify it. This takes us back to knowledge creation."

Figure 2 The KM Decision-Making Process

Not only are people creators of knowledge, they are one of its main repositories. The knowledge that is contained in the human brain pool, while perhaps harder to access than the structured knowledge housed in computers, is more likely key to organizational survival. Bock (1998) suggests we look for key knowledge by asking: "What do we lose when key people leave?" or "What do we have to teach every new person?" He further notes that to strengthen these repositories we should change our thinking from "training" to "facilitating learning," and put job aids and learning tools in the hands of people on the job.

The more that learning takes place, the more tacit knowledge (involving the "right" way to do a thing, and idiosyncratic to the worker) is created in the organization. The decision-making process, which depends upon explicit and/or tacit knowledge, begins with the perception of a problem. Given the increasing existence of unstructured conditions in modern organizations, these problems are increasingly of the type that requires access to tacit knowledge. In recent years, organizations have directed a great deal of interest to tacit knowledge and to discovering ways it can be shared and used (Courtney, 2000). The decision-making process consists not of leaping to some technically determined analysis, but of developing mental models by drawing upon the store of tacit knowledge residing in the organization.

Knowledge is the most critical resource for an organization operating in a dynamic environment. Many knowledge-management issues, it is true, center upon such material aspects of control such as computers and databases. Other issues, however, deal with the human factor. For those who analyze organizations from a KM perspective, the way in which an organization's actors, both human and computer, process the knowledge resources obtained from shared learning is most essential to the making of decisions (Holsapple & Joshi, 2001). And, it is the making of decisions that leads to solutions, which, in turn, add value to the organization.

Sveiby (1997, http://www.svieby.com) has posited a framework for knowledge resources that identifies different types by their attributes (structural capital vs. human capital) and shows that there are paradigmatic differences in how we understand knowledge by what we choose to focus on within those two domains. **Table 1** divides those who see knowledge as object and those who see knowledge as process into structure-oriented and people-oriented practitioners. It is the people-oriented practitioners who most interest Sveiby because the issues on the Knowledge = Process track are about how to maximize the ability of an organization's people to innovate. "In the end innovation is the only competitive advantage that companies have and it is much harder to do than investing in an IT-application. Anyone can buy new KM software, but very few have the ability to create sustainable creative organizations. Investment along the People-Track involves investing in people."

Table 1 The Two Tracks of Knowledge Management

Track/Level	Knowledge = Object	Knowledge = Process
Organization Level		"Organization Theorists"
Individual Level	"AI-specialists"	"Psychologists"

Shockley (2000) suggests that training should run the gamut, from seminars in which senior managers explain why KM is essential to survival and how each worker fits into the process, to a review of the advantages of each individual having information available to allow for quick problem resolution, even at the lowest level. The training should also provide a general description of the overall system for capturing and disseminating information, and specific instruction should be given any time a component is added to the knowledge infrastructure, or any time a critical element changes.

Styles of Learning

From the specifics of adult learning to different styles—cognitive, auditory, visual, tactile—attention is being paid to theories and

methods of adult learning. Clearly, training will only be successful if it is designed around sound adult educational needs and learning principles. Adults have their own unique ways in which they learn. Caudron (2000) discusses the importance of designing training materials around the ways adults learn. She points out that the best learning experiences occur through personal experience, group support, and mentoring. The context of the learning is important, as most adult learners want to know how what they learn will apply in the workplace. Learning by experience is important, in that adults learn best by having experiences and reflecting on them, or by reflecting on past experiences. Group learning experiences are also important (**Figure 3**). In groups, learners can help each other understand the learning event and learn from each other.

Figure 3 Interactive Mine Emergency Command Center Training

According to Caudron, there are several important concepts adult trainers should practice. She encourages the use of collaborative interaction—atmosphere where learners and instructors support each other in the process both in and out of formal learning—and the use and encouragement of cooperative communication. She also suggests trainers remember that peoples' feelings are critical in developing relationships in any learning situation.

Lankard (1995) suggests that numerous changes in the workplace, including increased age of employees, diversity of experience, and other factors, require a different way of thinking with respect to training. As opposed to following the traditional model of an instructor imparting knowledge to passive learners, training must allow employees to draw on experience, link concepts to real world situations, and transfer knowledge from one situation to another.

Lankard discusses continuous on-the-job growth and development and three new ways for employees to learn at work. These methods include action learning, situated learning, and incidental learning. Action learning takes place in the process of finding solutions to problems, learning takes place in the context of problem solving. In situated learning, knowledge is taught in contexts in which the information will be used in real-life situations. The notion is that by presenting content in an authentic social context and culture, learning occurs that offers the benefit of increased knowledge and potential for applying the knowledge and skills in new ways in the real situation. Last, the author describes incidental learning—learning that is embedded in the trainee's actions. Examples provided include learning from mistakes, learning by doing, and learning from personal experimentation. Lankard concludes that these types of learning need to be considered for future workplace training.

Multimedia Learning

Dugas, et al. (1999) report that multimedia learning materials are receiving the greatest attention in training. The authors point out a number of advantages to the use of multimedia. The chief advantage cited is that multimedia instruction can deliver training just-in-time, is self-paced, and above all is interactive. Multimedia can also be cost saving for employers whose employees need constant upgrading of skills but cannot be released from work easily. The content of a training module

can be easily upgraded, especially if delivered through this medium on Intranet systems and networks. Another advantage the authors cite is that multimedia learning materials are advantageous for smaller and/or remotely located workplaces. Courseware offers flexibility and cost effectiveness to industries that cannot afford downtime for training.

Lin Greinsing-Pophal (1998) discusses the growing use of multimedia by organizations in employee education. The author points out that traditional training methods can be time-consuming and expensive. They also present logistics problems in terms of accommodating the schedules of multiple employees and generally require employees to be away from the regular work environment in order to participate in the training. These issues have sparked many organizations to rethink how they conduct employee education. Greinsing-Pophal quotes technology-based training expert Dr. Brandon Hall: "This is a major trend that's occurring and it's going to dramatically change the face of training over the next several years." Greinsing-Pophal, too, cites various advantages to using multimedia training. These include reduced training time, consistency in content delivery, embedded testing, presentation of materials at the employee's own pace, and the fact that employees might not need to leave their regular duties to participate in training.

Evolving Training Content

Training within the mining industry has previously been focused on safety issues related to the production, extraction of the commodity, and the physical hazards of the mining environment itself. More recently, training efforts have been placed on health issues that supplement traditional safety topics. Two of the primary health issues being targeted today are employee exposures to dust and noise.

Another area of training that should be expanded when considering an evolving, changing, and especially aging workforce, are those ergonomic considerations that enhance safety through incorporating sound principles for redesign of the workplace. Several experts, for example, Hallett (1997), agree that older workers are often neglected in the training process only to be blamed later for non-comprehension. Czaja (1995) reported a study finding that training can mitigate age declines in performance. The study found that age only accounted for a small portion of the variance in performance, and that older workers who had received recent task training performed better than those who had not received recent training.

There are several types of training that should be considered for the aging workforce. They include task-specific training, general ergonomics and postural awareness, age awareness, and employee wellness. Task-specific training should occur upon hiring, when a new process/tool is introduced, or when design changes have been made to a process/tool. General ergonomics and postural awareness training for workers and management will help aging workers and those who work with them understand the physical and physiological capabilities and limitations of workers. The ergonomics training will also help individuals to recognize risk factors that may lead to injury or illness. Hence, these risk factors can be thought of as indicators and preventive measures can be taken early. Specific age awareness training for managers, people who work with older workers, and the older workers themselves is needed to educate individuals about the process of aging and how it relates to job design. Finally, physical and physiological declines should be discussed and the worker should be given an opportunity to derive solutions for his or her work environment.

Exercise and wellness programs, often promoted by companies because they increase productivity, are critical for substantial gains in muscle strength, aerobic capacity, thermo-regulation, mood-state, and healthy lifestyle. Strength and flexibility training can slow down the aging process and increase worker ability. Physical function is strengthened through conditioning and thereby reduces risk of injury and related cost while enhancing productivity and worker capacity (Shephard, 2000).

Employers need to stress the importance of wellness programs and strength and flexibility training not only to improve the overall health, endurance, and strength of their employees, but also to improve mood and decrease stress.

Czaja and Sharit (2000, p. 16) report that when "considering skill acquisition, training and older adults there are three important conclusions: One, older people are quite capable of learning new skills, tasks, and procedures. Two, training strategies may need to be modified for older people and these modifications may significantly improve the learning efficiency of older adults. Finally, it is important to recognize that costs associated with additional training or extended practice may be offset by lower turnover and absenteeism among older people." **Table 2** outlines some general guidelines that are important when developing training programs for older people.

In looking ahead to the future generations of older workers, we need to ensure that these training needs and workplace design changes are in place to alter the potential negative course of aging in work. The aging process becomes relevant as soon as we enter the workforce. We should plan worker activities at the beginning as opposed to the end of working life (Hallett, 1997). We should provide interesting and appropriate training throughout the life of our aging workforce. We will then have, as Lyons (1991) quoted Stephen Golant, Ph.D, a gerontologist and geographer at the University of Florida, "YEEPIEs – Youthful, Energetic Elderly Population Involved in Everything (Lyons, 1991)."

Difficulties in Assessing the Impact of Training on Bottom Line Measures

Donald Kirkpatrick (1976, 1977, 1998) is referenced widely for his four-step process for evaluating training programs. The linear process of training evaluation was first published in 1959. In 1976, Kirkpatrick defined evaluation as: "the determination of the effectiveness of a training program." His steps include:

- "Reaction - how well did the conferees like the program?
- Learning - what principle, facts, and techniques were learned?
- Behavior - what changes in job behavior resulted from the program?
- Results - what were the tangible results from the program in terms of reduced cost, improved quality, improved quantity, etc."

Supervisory and management training was a common example used for training and the four-step evaluation process. Training was synonymous with formal sessions. Standard training sessions were "off-the-job" and in a classroom.

Table 2 Summary of Training Recommendations for Older Adults

1. Allow extra time for training; self-paced learning schedules appear to be optimal
2. Ensure that help is available and easy to access; create a supportive learning environment
3. Ensure that the training environment is free from distractions
4. Training material should be well-organized and important information should be highlighted
5. Address any concerns the learner has about use of the equipment (e.g., the question, "Will I break the computer if I do this?")
6. Minimize demands on spatial abilities and working memory
7. Provide sufficient practice on task components
8. Provide an active learning situation; allow the learner to discover ways of accomplishing tasks

Source: Rogers (2000)

Kirkpatrick's model of training evaluation is still widely referenced (Mangum, Mangum and Hansen, 1990, page 75; Allen and Nawrocki, 2000, page 259; Fletcher and Chatelier, 2000, page 273). It has served the test of time as his model makes intuitive sense allowing for the blending of motivation, learning, training transfer, and economic benefit. There have been many issues raised, however, that speak to the ongoing difficulty in assessing bottom line results of training. For example:

> "Investments to enhance human effectiveness in complex systems are rife with several types of uncertainties, intangible benefits, multiple stake-holders, and inherent unpredictability. These characteristics make cost/benefit analysis for such systems a considerable challenge (Rouse and Boft 1999)."

> "Psychologists and economists have both claimed the evaluation turf and the measurement tools are so radically different that it seems to confuse the decision maker (Mangum et al., 1990)."

One reason why there has been a "push" to determine "results" is mentioned by (Oxenburgh, 1994). The idea Oxenburgh refers to is one of competition between divisions for scarce resources:

> "Remember that no matter what, or how good, your personal motivation is to reduce injuries, you have to compete against other demands for financial and personal resources within your company."

The authors hypothesize that competition between divisions within an organization puts everyone in a position to come up with some meaningful numbers on the benefit-cost question. Without common agreement as to what is considered on the cost end how to quantify (intangible) benefits, it becomes a very difficult task to compare alternatives.

Perspective for Training

Training is commonly recognized today as a growth industry with new tools and delivery systems (Bassi and Van Buren, 1999). Many see education and training as a means for obtaining competitive advantage (Allen and Nawrocki, 2000, page 237). Further, training has changed as the business that it serves has changed:

> "Education is a bigger factor in productivity growth than increased capital, economies of scale or better allocation of resources . . . " David Kearns - Xerox corp.

ASTD (in Bassi, 1999) reports that the leading edge companies invested significantly greater amounts into training than industry averages, both in terms of a percentage of payroll and training dollar expenditure per employee.

There seems to be a movement back to "training via apprenticeship and on-the-job training experience . . . targeted skills and knowledge will be tied to specific business objectives or needs and will place the burden of responsibility on the learner. Nevertheless, technologies will assist the learner (Allen and Nawrocki, 2000, page 261)." Technologies to assist the learner might also be very useful to assist the trainer, i.e., facilitate the instruction, provide up-to-date content, and offer strategies for teaching and evaluating skills. One support for this idea is offered by Semb, et al. (2000):

> ". . . while advances in technology may result in more sophisticated tools for conducting OJT [On the Job Training], the knowledge and skills of the individual trainer will always be the most critical component of OJT. These include both knowledge of the job and the ability to communicate that job effectively to the on-the-job trainees." "...even in a job environment as structured as the Navy, very few supervisors had received any instruction on how to conduct OJT."

Semb and his colleagues suggest that the body of literature relating to tutoring might be extended to the OJT environment with the ultimate goal of enhancing the efficiency and effectiveness of OJT training. Although the number of OJT studies (they note three references) is small, they suggest that there is rich literature on tutoring, tutor training, and supervisory training (Semb, et al. 2000 p. 291).

Cost-effectiveness will continue to be a key issue in training, whether the training is conducted in the military, industry, or vocational education. Few seem optimistic about conducting long-term, high-cost studies to prove "effect." There is continuing difficulty (and expense) in conducting high-quality, methodologically-sound studies of training "impact." Perhaps Kirkpatrick's suggestions on examining the "evidence" of effective training as opposed to determining "proof" is similar to the conclusions of Mangum, et al. (1990, p 73): "Like most private training decisions, it is again an act of faith."

Faith or not, competent employees demand training. Some authors view it is a key benefit, especially for younger workers. Kleiman (2000) reports on a survey by management search firm (Bridgegate LLC). They found that when it comes to staying on the job, workers under the age of 24 are twice as likely to be influenced by the amount of training provided in comparison to money. These young people have concluded that employment does not mean job security, but training to develop new skills does help to safeguard the future.

In the next decade, organizations' viability may be assessed by their willingness to train workers in more transferable skills. To do this, they are likely to follow the trends identified by Bassi, et al. (1999):

- ❑ Shift from training to performance
- ❑ Computer skills training
- ❑ Shift from training to learning
- ❑ Virtual organizations
- ❑ Demonstration of training outcomes
- ❑ Measuring performance outcomes
- ❑ Delivering training to meet specific needs
- ❑ Emphasis on knowledge management
- ❑ Rapid development and deployment of training
- ❑ Teamwork training

PRELIMINARY TRAINING RECOMMENDATIONS BASED ON THE LITERATURE

Based on this initial review of the psychological, sociological, ergonomic, training, education, and mining literature relevant to the focus of who, what, where, how, and why we train the future mining workforce, the authors offer *preliminary recommendations* for discussion. Training should focus on:

1. Different Cohorts. Training should target the different values, age-related work beliefs, and career expectations of the four generational groups defined earlier.

2. Formal and Informal Training. Both types of training, formal and informal, benefit the workforce and together they indicate the best results in enhancing skill performance and, by inference, greater safety on the job. In mining, where formal training is mandated, attention should turn toward the informal, mentoring, specific on-the-job training.

3. Content. The content of the training must match the need of the worker being trained. Training of younger workers on specific skills while offering them opportunities for broader (transferable) skills training is important. For example, the specific skills for underground mining might provide some skills related to

those used by an electrician, mason, machine operator, etc.

4. Learning Styles. Teaching methods must address the different learning styles and be based upon principles of adult learning.

5. Worker Involvement. Support and training are needed for workers to learn *how* to be involved in the organization, including training on management philosophy and practices, communication, and policies. Management belief in worker input is crucial to worker involvement.

6. Delivery Methods. A determination of the best method for training is important. Multimedia should not be used just because it is the latest method of instruction. Although computer training may offer many advantages to mining, the delivery method needs to be carefully evaluated. For example, teaching methods that draw on the knowledge of older workers in class and create a dialogue with younger workers may be the most successful method to transfer knowledge.

7. Innovative Ergonomic Training Solutions. Ergonomic solutions for worker safety and health should be viewed as a preventive measure to build into training and into the workplace. Integrating strength and flexibility training, wellness programs, and healthy lifestyle training can become an accepted part of future mine training.

8. Evaluation. All worthy programs used or developed for the evolving mining workforce should contain an evaluation component such as field testing, focus group input, judgment of performance and/or knowledge. In the rush to "train," evaluation is the final and key necessity.

9. Training for Safety Performance. Training which expands worker safety performance and incorporates current teaching philosophies can become an accepted part of future mine training.

10. Health training. Other health training interventions addressing environmental health hazards such as chemical exposures and carcinogens (diesel particulates) must be developed and introduced to enhance miner safety.

THE BOTTOM LINE

Investment in a human infrastructure seems not to be understood by the accounting systems still firmly rooted in the 1900s. Some companies view the capital outlay for training to build expertise within the work force as cost. These same companies might treat the capital outlay to install a new state-of-the-art mine monitoring system as an investment. If two companies have similar resources to purchase similar equipment, what can distinguish them in the competitive marketplace? The authors argue that treating training as an investment can provide an edge in safety, in performance, and in the "bottom line."

Some suggest that the mining industry is approaching a crisis as attention to the evolving workforce accelerates and concern about the future of the industry increases. The rich Chinese language has two symbols for the word "crisis:" one symbol means *danger,* the other *opportunity.* Thus, crisis is both a danger and an opportunity. By treating training as an investment, the mining industry is in a position to grasp that opportunity in the development of its human capital.

REFERENCES

Allen J, and Nawrocki L. (2000) Training in industry. Chapter in Sigmund Tobias and J.D. Fletcher (editors). Training and Retraining: A Handbook for Business, Industry, Government and the Military. 2000 American Psychological Assn.

Associated Press (2001). Young People Shun Coal Mine Careers; Industry Needs More Workers. Kentucky Post, Tuesday, April 17, 2001. Edition Kentucky Section: News Page 5K

Bartel, A. P. (1989). Formal employee training programs and their impact on labor productivity: Evidence from a human resource survey. National Bureau of Economic Research Working Paper, 3026, pp. 37.

Bassi, Laurie J and Van Buren, Mark E. The (1999) ASTD state of the industry report. Training and Development.

Bock, W. (1998). Knowledge management basics. http://www.bockinfo.com/ docs/ kmbasics.html

Carpenter, S.I. (2001) A blind spot in motor learning. American Psychological Association Monitor on Psychology, July/August Vol. 32, NO. 7. pp. 62-63.

Caudron, S. (2000). Learners Speak Out, Training and Development v 54, No 4, pp 52-57.

Caudron, S. (1997). "Can Generation Xers Be Trained?", Training and Development, vol.51: 3, March, pp. 20-24.

Cines, F.X., (2001). "W.Va. firm may import Ukrainian miners." *Pittsburgh Post Gazette*, June 24, 2001 from *The New York Times.*

Courtney, J. (2000). Decision making and knowledge management in inquiring organizations: Toward a new decision making paradigm for DSS. Decision Support Systems, 31, 17-38.

Czaja, S. J. (1995). Aging and Work Performance. Review of Public Personnel Administration , vol. 15:2, pp. 46-61.

Czaja, S. J. and J. Sharit (2000). Technology-Based Jobs, Stress and Older Workers. Review of Public Personnel Administration, vol. 15:2, pp. 46-61.

Dugas, T., Green, L., and Leckie, N. (1999). The Impact of Technologies on Learning in the Workplace - Final Report. The Office of Learning Technologies, Hull, Quebec, Canada, 58 pp.

Federal Employees News Digest Vol. 50. No 40, May 14, 2001 p. 2

Fletcher and Chatelier, Training in the Military, Chapter in: Sigmund Tobias and J.D. Fletcher (editors). Training and Retraining: A Handbook for Business, Industry, Government and the Military. 2000 American Psychological Association, p 273

Fotta, B., Bockosh G. (2000). The Aging Workforce: An Emerging Issue in the Mining Industry. In the proceedings of the 31st Annual Mining Safety, Health and Research Conference. Virginia Tech, August 2000.

Blacksburg, Greinsing-Pophal, L. (1998). Multimedia Training Technology Proves Its Worth. HR Magazine Focus on HR Technology, May 1998, pp. 16-21.

Hackett, B. (2000). Beyond knowledge management: New ways to work and learn. http:// www.sveiby.com.au.confboard.pdf

Hallett, Mark (1997). Tap Into the Power of Older Workers. Safety and Health, February, pp. 28-32.

Holsapple, C. (2001). Knowledge management support of decision making. Decision Support Systems, 31, 1-3.

Holsapple, C. & Joshi, K. (2001). Organizational knowledge resources. Decision Support Systems, 31, 39-54.

Kirkpatrick, D. L. (1977). Evaluating Training Programs: Evidence vs. Proof. Train. Dev. J., v. 31, No. 11, pp. 9-12.

Kirkpatrick, D.L. (1998). Evaluating training programs: the 4 levels. Berrett-Koehler Publishers, Inc.

Kirkpatrick D.L. (1976). Evaluation of training. Chapter in Training and development handbook. American Society of Training and Development.

Kleiman, M. (2000) Occupational Health & Safety v69n1 pp: 18, 70 Jan.

Lankard, B. A. (1995). New Ways of Learning in the Workplace. ERIC Digest No. 161. Columbus: ERIC Clearinghouse on Adult, Career, and Vocational Education.

Loewenstein, M. A. & Spletzer, J. R. (1998). Formal and informal training: Evidence from the NLSY. Bureau of Labor Statistics. Forthcoming in Research in Labor Economics, pp. 55.

Lynch, L. M.& Black, S. E.(1998). Beyond the incidence of employer-provided training. *Industrial Labor Relations Review*. (Vol. 52, n.1), pp. 64-92.

Lyons, Christine (1991). Aging Baby-Boomers: Will America Be Ready?. Arthritis Today, vol. 5:6, pp. 40-44.

Mangum, S., G. Mangum, and G. Hansen. Assessing the Returns to Training. In A.P. Carnevale, et al, New Developments in Worker Training: A Legacy for the 1990s. Madison, WI: Industrial Relations Research Association, 1990, pp. 55-89.

McAfee, R. B. & Winn, A. R. (1989). The use of incentives/feedback to enhance workplace safety: A critique of the literature. *Journal of Safety Research*, (Vol.20), pp. 7-19.

Miles, K. K. (1992). Use of participatory training techniques in a right-to-know train the trainer course for New Jersey public employees. *American Journal of Industrial Medicine*, (Vol. 22). Pp. 721-727.

MSHA. Quarterly employment and coal production, accidents/injuries/illnesses reported to MSHA under 30 CFR Part 50. Denver, CO: U.S. Department of Labor, Mine Safety and Health Administration, Office of Injury and Employment Information, 1988-1998. Oxenburgh, M. (1994). Increasing productivity and profit through health and safety. Published by CCH International.

Rogers (2000) in Czaja, S. J. (1995). Aging and Work Performance. Review of Public Personnel Administration , vol. 15:2, pp. 46-61.

Rouse, WB and Boff KR. Making the case for investments in human effectiveness. Information Knowledge Systems Management, IOS Press, 1999, pages 225-247

Ruch, Will (2000). How to Keep Gen X Employees from Becoming X Employees", Training and Development, vol. 54:4, April, pp. 40-43.

Salopek, Jennifer (2000). "The Young and the Rest of Us", Training and Development, vol. 54:2, February, pp.26-30.

Semb, G. Fitch, M. Ellis, J. and Kuti, M.. (2000). On-the job training: theory, research and practice. In: S. Tobias and J.D. Fletcher (editors). Training and Retraining: A Handbook for Business, Industry, Government and the Military. American Psychological Association.

Shephard, R.J. (2000). Worksite Health Promotion and the Older Worker. International Journal of Industrial Ergonomics, vol. 25:5, pp. 465-476.

Shockley, W. (2000). Planning for knowledge management. Quality Progress, 33, 57-62.

Simon, D.A. (2001) APA Journal of Experimental Psychology: Learning, Memory and Cognition Vol 27, No. 4.

Smith, S. L. (1993). Safety training for a salad bowl society. *Occupational Hazards*, (Vol. 55, n.3), pp. 36-40.

Sveiby, K. (1997). What is knowledge management? http://www.svieby.com. au/KnowledgeManagement.html

Tieger, C. (1994). We are All Aging Workers: For an Interdisciplinary Approach to Aging at Work. In Snel, Jan & Roel Cremer (Eds.), Work and Aging, pp. 65-84.

Wall Street Journal (2001). "Germany moves to widen welcome for immigrants." Page A 8.

Willis, Sherry L. (1985). "Towards an Educational Psychology of the Older Adult Learner: Intellectual and Cognitive Bases", Chapter 30 in Handbook of The Psychology of Aging, second edition, James Birren and K. Warren Schaie, editors, Van Nostrand Reinhold Company, NY, pp. 816-847.

Wyld, David C. (1994). "The 13th Generation and Its Revolutionary Definition of 'Career'", Journal of Career Planning & Employment, vol. 55:1. pp. 26-28.

Zemke, Ron, Claire Raines, and bob Filipczak (2000). Generations at Work: Managing the Clash of Veterns, Boomers, Xers, and Nexters in Your Workplace, American Management Association