The Evolving Mining Workforce: Training Issues

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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 retire. This paper defines the problem, offers a model to structure the inquiry, and presents the key issues a multi-disciplinary team of NIOSH researchers identified, based on an extensive review of the current literature in relevant areas. Issues include differences between cohorts, such as the newer workers (Generation M), and present workers (Boomers) with respect to their physical, social, psychological, and cultural characteristics, their learning styles and work expectations. Specific issues for an aging workforce are discussed. Some preliminary recommendations are offered on the type of training needed.

Introduction

The American workforce is aging. In the federal government, 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 there have been a number of articles in the Wall Street Journal 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 not only reflects this international and national trend of the aging, soon-to-retire-worker, it is exaggerated, because there was a boom in the mining industry in the seventies and a large number of mine workers, mainly in their twenties, were hired. The 1980's and 90's brought a downturn in the market with downsizing and layoffs resulting in a lack of "new, younger hires" over the past years. 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 indicates that the percentage of injured or ill or older workers have 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 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 (Kentucky Post, April 17, 2001). An article in the New York Times, reprinted in the Pittsburgh Post Gazette on June 24, 2001, discussed the proposal to import Ukrainians to work in the mines in West Virginia. The focus of this paper is on issues in defining and training an evolving mining workforce and not recruiting, but clearly the one is dependent on the other.

Almost no research has been conducted on the effect of continually changing, dynamic, physically demanding workplaces such as mines, have on the way aging workers interact with their jobs, nor on the kinds of educational interventions that could help them deal with their changing circumstances. By the same token, 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 in such situations. Data also suggest that older workers, while injured less often, sustain more serious injuries with more lost time from the job.

There is a significant safety issue involved with the older and younger worker. 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, 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 life. 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 constitute 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 workforce with a multi-disciplinary team made up of sociologists, psychologists, industrial, safety, and mining engineers, ergonomists, plus education and training experts. Teiger (1994) stressed the importance of a multi-disciplinary approach to deal with the problems of age and work conditions. This paper discusses the beginning phases of that inquiry - selected results from a review of the literature and suggested preliminary recommendations for training.

The Research Model

Researchers developed a model to guide the exploration of the problem of the evolving mining workforce (**Figure 1**). Initially 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 may lead to better communication, understanding of learning styles, and the development of targeted training.

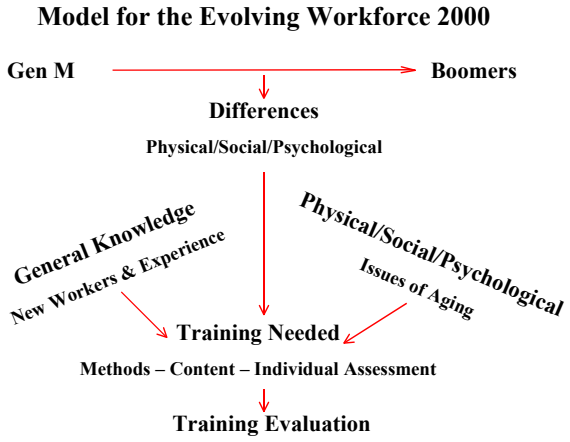

Figure 1 Model for an Evolving Workforce

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. Present and past training methods need to be observed. 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.

Characteristics of the Mining Workforce

Cohorts, as defined in the introduction, provide a means of organizing and defining the present and future mining workforce. Authors suggest that cohorts are quantitatively and qualitatively distinct; the social, economic, and cultural circumstances for each cohort differs and among other influences, accounts for differing characteristics and needs. Willis (1985) suggests that cohort differences seem to have some distinctly different educational implications for the various

age groups. For 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 generations must be considered. The population numbers 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:

1. **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: patriotic, loyal, fiscally conservative, and faith in institutions.

1. **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: idealistic, competitive, question authority, and "me" generation.

1. **Generation Xers** 1960-1980 (70.1 million people). Those born after the blush of the Baby Boom and came of age deep in the shadow of the Boomers and the rise of the Asian tiger. The traits associated with this group are: techno savvy, diverse, independent, skeptical, and entrepreneurial.

1. **Generation Nexters** 1980-2000 (69.7 million people to date). Those born of the Baby Boomers and early Xers and into our current high-tech, neo-optimistic time. The traits associated with this group are: independent spenders, globally concerned, health conscious, and cyber literate.

Clearly, there is overlap in these group designations. Zemke et al (2000) indicate that they would have overlapped the groups if they hadn't been concerned about confusing the reader. To add further confusion, other authors use different terms to refer to the same cohorts. The NIOSH researches have chosen to use the Zemke et al definitions. The majority of miners in the current workforce are either Baby Boomers or Generation Xers.

Cohort differences are important to observe 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 with generations of miners - grandfather, uncle, father, son, cousin. What an individual career would be like used to be relatively predictable for those entering the work force (Wyld 1994). 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 commination gaps. Each of these issues effects today's training. 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. The older workers, Veterans and Baby Boomers are less comfortable with high tech tools and need training to become more techno-literate.

Trends in Training

Organizations are using various sources to provide training for employees. 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 affected by the decision to invest in new technology and reorganize their workplace. They found that 81 percent of their sample provided some type of formal training.

It is interesting to note "who" provided this formal training. Fifty percent of the sample population used equipment suppliers and buyers for training 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. They concluded that the type of training program offered by businesses varied considerably by employer; however, most employers do offer some sort of formal training, and smaller employers were less likely to provide formal training. The mining industry also utilizes a variety of sources to provide its mandated training and informal training, although these authors suggest that in the mining industry it is the informal training that is less likely to be provided and 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 such 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 measure can jointly account for much concerning the 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 the individual and the organization. Models that accurately measure informal training should be an area of future research. With mandated training in the mining industry, 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 use in the industry. Dugas

et al (1999) identified a 1996 study that looked at 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 these associations not only served as developers and providers of courseware, but served as a conduit to help small and mid-size companies gain access to materials. Six factors were identified leading to success of such a program. These include: development of partnerships, adequate needs assessments, authentication of materials, content meets industry needs, sufficient market for products, and appropriate delivery media.

Transferable training vs. non-transferable training

Discussion of transferable training (of use in other jobs and/or industries) versus more job specific training that generally is 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 more transferable training may develop skills that can apply 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 note this trend in training as it is opposed to some of the stated need 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 specific as with the roof bolter, or even in hanging curtain or running track haulage - important skills in mining - but, how transferable are they?

Communication Issues

Smith (1993) reports that U. S. Department of Labor statistics show that immigrants accounted for 22 percent of the growth in 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. 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 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 visual in nature and easy to understand, and (5) Cultural differences and their effects on the workplace.

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 1990's 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 upon knowledge enhancement and utilization in the workplace. By current wisdom, an organization that can improve its performance the most and the fastest, 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 are 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 in and encourage workers to share information.

One outcome of the growth of a KM culture is the ascendance of worker proficiency at 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 the organizational survival happen (Holsapple, 2001).

Bock (1998) characterizes the management of knowledge in decision-making as a process with four parts that comprise 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 re-use 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."

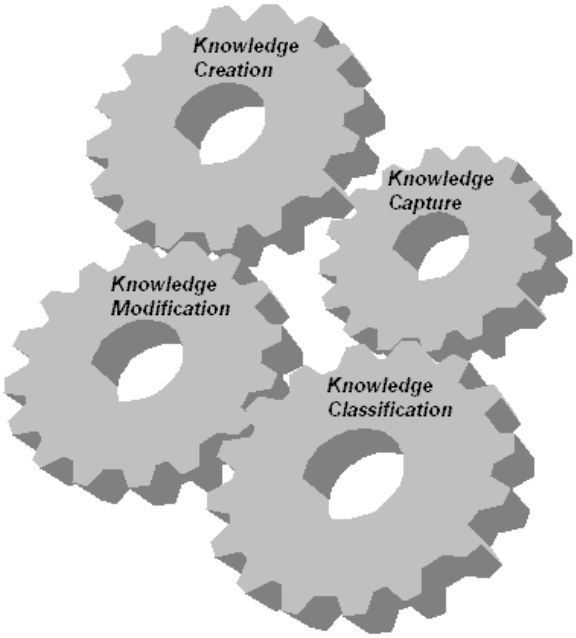

Figure 2 – The KM Decision-Making Process

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 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 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, 2001). The decision 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 as computers and databases. Other issues, however, deal with the human factor. For those who analyze organizations from a KM perspective, it is the way in which an organization's actors,

both human and computer, process the knowledge resources obtained from shared learning that is most essential to the making of decisions (Holsapple & Joshi, 2001). And, it is the making of decisions that lead to problem solutions, which, in turn, add value to the organization.

Sveiby (1997) 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. **Figure 3** 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."

Figure 3 The Two Tracks of Knowledge Management

Knowledge Management

Track/Level	Knowledge = Object	Knowledge = Process
Organization Level	"Re-engineers"	"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 him or her to resolve problems quickly, and 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. KM offers a set of tools and the opportunity to support the reworking of organizational processes, but the greatest benefit is likely to be innovation and creativity. Perhaps what is needed now is to apply the lessons KM has to impart in order to create new organizational capabilities for the enrichment of all (Hackett, 2000).

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. Training will only be successful in 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 since adults learn best by having experiences and reflecting on them, or by reflecting on past experiences. Group experiences are also important (**Figure 4**). Learners can help each other understand the learning event and learn from each other. According to Caudron, there are several important concepts adult trainers should practice. She encourages the use of collaborative interaction; an 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.

Figure 4 Interactive Mine Emergency Command Center Training

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 is defined as learning that 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.

Multi-media

Dugas et. al (1999) reported multimedia learning materials are receiving the greatest attention. 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 cited is that multimedia learning materials would be advantageous for smaller and/or remotely located workplaces. Courseware could offer flexibility and cost effectiveness to industries who 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 spawned 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 may 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. Training which expands worker safety performance and incorporates current teaching philosophies should be a component of future research. More recently, training efforts have been placed on health issues which supplement traditional safety topics. Two of the primary health issues, being targeted today, are employee exposures to dust and noise. 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.

Another area of training which should be expanded , when considering an evolving, changing, and especially aging workforce, are those ergonomic considerations which enhance safety through incorporating sound principles for redesign of the workplace. Several experts (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 which may lead to injury

or illness. Then, these risk factors can be thought of as indicators and preventative 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. 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 for increased productivity reasons, 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 (Sheppard, 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 to also improve mood and decrease stress.

Czaja & 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 1** outlines some general guidelines that are important when developing training programs for older people.

Table 1: 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., 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)

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 start 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, PhD, 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 is referenced widely for his 4-step process for evaluating training programs. The linear process of training evaluation was first published in 1959. In 1976, Kirkpatrick [1976] 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 4-step evaluation process. Training was synonymous with formal sessions. Standard training sessions were "off-the-job" and in a classroom.

Kirkpatrick's model of training evaluation is still widely referenced (Mangum, Mangum and Hanson, 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. It allows 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 stakeholders, 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]:

> "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 idea Oxenburgh refers to is one of competition between divisions for scarce resources. Perhaps that competition between divisions within an organization puts everyone in a position to come up

with some good numbers on the benefit-cost question? Without common agreement as to what is considered on the cost end, and how to quantify (intangible) benefits, it becomes a very difficult task to compare alternatives.

Perspective for mine training

Training is commonly recognized today as a growth industry with new tools and delivery systems [Bassi and Van Buren, 1999 - note ASTD] . Many see education and training as a means for obtaining competitive advantage [Allen and Nawrocki, 2000, page 237]. And, 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 (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 - facilitate the instruction, provide up-to-date content, and offer strategies for teaching and evaluating skills. One notion supporting this is offered by Semb et al [2000]:

> "..while advances in technology may result in more sophisticated tools for conducting OJT, 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". Semb (1995) notes that "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 the OJT training. Although the number of OJT studies (they note 3 references) is small, he suggests that there is rich literature on tutoring, tutor training and supervisory training [Semb et al 2000 Page 291].

Cost-effectiveness will continue to be a key issue whether the training is conducted in the military, industry, or vocational education. Few seemed 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, page 73] "Like most private training decisions, it is again an act

of faith".

Faith or not, competent employees demand training. Some suggest it is a key benefit, especially for younger workers. A survey by management search firm Bridgegate LLC of Irvine, California, 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 as money. These young people have concluded that employment does mean job security. Their only sense of security is what they know and how to do. That is why they value training so highly.

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
- ❑ Demonstrate training outcomes
- ❑ Measuring performance outcomes
- ❑ Delivering training to meet specific needs
- ❑ Emphasis on knowledge management
- ❑ Rapid development and deployment of training
- ❑ Teamwork training

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

Training should focus on:

1. different cohorts - Training should target the different values, age-related work beliefs, and career expectations of four different generations.

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

3. content - The content of the training must match the need. Training of younger workers on specific skills while offering them opportunities for broader (transferable) skills training are important. For example, the specific skills for underground mining might provide some skills related to an electrician, mason, machine operator etc.

4. learning styles - Teaching methods must address the different learning styles and be based upon

the principles of adult learning.

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

6. delivery methods - A determination of what is 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.

The Bottom Line

INVESTMENT IN HUMAN INFRASTRUCTURE SEEMS NOT TO BE UNDERSTOOD BY THE ACCOUNTING SYSTEMS STILL FIRMLY ROOTED IN THE 1900S. ACCOUNTANTS TREAT THE CAPITAL OUTLAY FOR TRAINING TO BUILD EXPERTISE WITHIN THE WORK FORCE AS COST. THESE SAME ACCOUNTANTS 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 would 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 Chinese language is rich and has two symbols for the word "crisis." One symbol means *danger,* the other *opportunity.* Thus, crisis is both a danger and an opportunity; a dangerous opportunity. By treating training as an investment, the mining industry is in a position to grasp that opportunity in the develop of its human capital.

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