Knowledge management and transfer for mine emergency response

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Abstract: This paper discusses the fact that US coal mining organisations are losing the knowledge they need in order to be able to respond to emergencies. The authors note that knowledge management provides a useful perspective from which to view the problem, but that the debate about what constitutes knowledge should be broadened to include a debate about what constitutes management. It is argued here that knowledge is actually shared knowing distributed across group members; that such knowledge can be managed by cultivating it; and that narrative is the medium through which this may be done. The paper then examines NIOSH research that has attempted to use such an alternative knowledge management approach to help potential mine emergency responders better deal with the predicaments they are likely to encounter on-site.

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1 Introduction

An underground coal mine is one of those high-risk organisations, like a space shuttle installation or construction site, where one of the more common forms of organisational learning, trial-and-error, is not allowable (Aase and Nybo, 2002). That is because error carries such potentially disastrous consequences (a shuttle disaster or mine explosion, for instance). Thus, while errors occur, they cannot be introduced intentionally so that new personnel can experience what happens when something goes wrong under certain conditions. Rather, in high-risk organisations, neophytes will be indoctrinated with

protocols, post-hoc analyses of past incidents, and, if they are fortunate, informal interactions with individuals who have knowledge gained in other circumstances that can be transferred and applied to the current situation. It is these informal contacts that have the most value, according to Aase and Nybo (2002), because they take the individual beyond rote learning of fact-based information and on to the realm of lessons learned from active inquiry into an organisation's stock of knowledge.

It is ironic that in the Information Age, when organisations are literally awash in facts and figures, they are facing a critical loss of knowledge. That is because those who have expert insight into 'how things really work' in an organisation are on their way out – either through turnover, downsizing, or retirement. This problem is particularly acute in the US coal mining industry and in many ways makes it an exemplar for what is going on, to a lesser degree, in other enterprises.

Beginning in the early 1980s, the US coal mining industry underwent a transformation that had a tremendous impact on the labour force: Vigorous competition drove prices down; less competitive properties were closed; productive capacity was concentrated among fewer, large companies; the average mine size was increased; and improved technologies were introduced. All these forces resulted in much higher productivity – mining more coal with fewer people. Of the 221 000 coal workers the US Bureau of Labor Statistics estimated there were in 1977 (US Department of Labor, Bureau of Labor Statistics, 1978), only about 75 000 remain. These labour cutbacks have produced a cohort of workers who came into the industry 20 or more years ago, managed to stay, and, for the most part, have not been augmented or replaced by younger employees. This means that the typical employment pattern seen in general industry, people leaving and at least some new people coming in, has not happened to any great extent in coal mining.

Nowhere has this outflow of employees and expertise had a greater impact than in mining organisations' ability to respond to emergencies. By US law,[1] every operator of an underground mine must ensure a capability for emergency mine rescue and recovery. The mine operator may do this by establishing two mine rescue teams (each with five members and one alternate) that will be available when miners are underground, or the operator may enter into an arrangement for mine rescue services. While mining states are still able to muster enough teams to comply with the law, there are now no resources to spare. Mine closings, and the associated reduction in the number of miners, have reduced the number of trained mine rescue members. The same process has also reduced the pool of potential emergency managers.

In July of 1992, a committee of Federal and Pennsylvania state personnel was formed to consider the status of mine rescue in Pennsylvania (Pennsylvania Department of Environmental Protection, Bureau of Deep Mine Safety, 1992). The committee made the following assessment: "Mine rescue coverage in Pennsylvania meets the requirements spelled out in the Code of Federal Regulations, Title 30, Part 49. It does so with almost no reserve capacity, and a great reliance on federally supplied, State grants funding". The Pennsylvania committee members also noted this about the mine rescue infrastructure in their state: No one knows for sure what equipment is available or where it is located. There are unanswered questions about both liability and payment for mine rescue activities performed during emergencies in mines other than those owned by team members' employers. Pennsylvania state teams are losing team members and other privately maintained teams are in jeopardy. The workforce and the rescue teams are aging

(average age in 1992 was in the early 40s). As a result of these factors, there is the concern that there may not be enough adequately trained and equipped teams, or people capable of directing their activities, to meet the needs of an emergency.

On 27–28 January 1995, some 280 people attended a *Mine Emergency Preparedness Conference* held at the National Mine Safety and Health Academy in Beckley, West Virginia (US Department of Labor, Mine Safety and Health Administration, 1995). The participants, who came from across the USA and several other countries, included personal protective equipment manufacturers, mining industry officials and labour representatives, state and federal mining personnel, educators, and mine rescue team members. These individuals were convened in multiple working groups to offer recommendations for improving mine emergency response. Their recommendations, contained in a report released by the US Mine Safety and Health Administration, addressed seven issues related to mine rescue: the composition of mine rescue teams; how to finance the mine rescue function; regulatory requirements; rescue equipment; communications and counselling responsibilities; maximising the effectiveness of mine rescue contests; and liability considerations.

In essence, the *Mine Emergency Preparedness Conference* echoed many of the concerns raised by the Pennsylvania committee a few years before: In the face of a shrinking and aging mine rescue and response force, there is a need for the conservation and wiser use of all remaining resources. And, given the generally recognised employment pattern in coal, there is a need to prepare for a wholesale change-out of personnel in the near future. It was recommended that the industry embark upon a strategy of teaching mineworkers how to better react to non-routine situations, the use of more realistic emergency simulations to train rescue teams, and an increased focus upon preparing people to manage rescue operations. This paper examines a programme of research that was begun in the early 1990s to address some of the problems involved in enhancing expertise within a specialised community of practitioners while at the same time preparing for a new generation of incumbents.

2 A ‘knowledge management’ approach

The admonition that “there is no new thing under the sun ” (The Holy Bible, 1999) may very well apply to Knowledge Management (KM). Wilson (2002), for instance, has dismissed KM as largely information management in a different guise, promulgated by consulting companies in order to have something to sell at the end of the last decade. Alternatively, Hlupic *et al.* (2002) might also be used to support the argument that KM is just old wine in a new bottle, but from a rather different perspective. In discussing the 18 assorted definitions of knowledge management they had discovered, the authors concluded that the wide range of formulations results from the fact that KM has attracted an array of scholars representing many different disciplines. And, like the blind men and the elephant (Saxe, 2004), each has brought his or her particular academic bent to the arena. Thus it is that for all its faddish aspects and co-optation by consultants (Ponzi and Koenig, 2002), and despite the fact that as a subdiscipline it might be no more than the sum of all its parts, the notion is hanging around and engendering increasing debate. The reason is fairly simple: KM focuses upon a very real problem and frames the issues in a way that is intuitively appealing.

The problem is made explicit when organisations are in danger of not being able to function well enough to meet their reasons for being. The solution, or part of it, anyway, is to be more systematic about finding, understanding, and using knowledge (Knowledge Management/Transfer Workgroup, 2002). The issue, given that definitions of 'data' (discrete facts) and 'information' (contextualised data) are generally agreed upon (Bouthillier and Shearer, 2002), is whether anything systematic can be done with 'knowledge'. In other words, can knowledge be managed? It is interesting that scholarly debate centres overwhelmingly on what constitutes knowledge – very few KM researchers have explored what it means to 'manage'. Yet, one conditions the other, and in a very real sense arguing the nature of knowledge without first resolving what management entails is putting the cart before the horse.

Morgan (1997) suggested that modern management has developed a sort of tunnel vision in which "the mechanical way of thinking has become so ingrained in our everyday conceptions of organisation" that it is difficult to see alternatives. So, given this mindset, it is assumed that in order to manage any part of an organisation (including a stock of knowledge), one must rationalise and control the thing to be managed. It appears from the literature that a great deal of mental energy has gone into reconciling knowledge with this prevailing management paradigm. But the concept does not fit. Scholars keep bumping into Polanyi's (1966) contention that knowledge is a process of knowing and, 'We know more than we can tell'. Since what we cannot tell is not amenable to mechanical forms of manipulation such as codification, managing it, in the traditional sense, is problematic.

In attempting to better define knowledge and move the debate forward, Hildreth and Kimble (2002) also implicitly redefined what it means to manage. For these authors, knowledge is a duality composed of 'hard' dimensions that can be articulated, and 'soft' dimensions that cannot. Further, with the balance between the two shifts from situation to situation – it is possible to tell more (or less) of what one knows about some things (at some times) than others. Therefore, by inference, the management of knowledge needs to be a dual activity. Hildreth and Kimble (2002) seem to slip from a mechanical to an organic (Morgan, 1997) way of thinking in discussing the soft aspects of knowledge as something that, rather than being controlled like hard knowledge, is 'nurtured'. Interestingly, there is a management concept from the natural world that evokes both control and nurture. It is the concept of husbandry. Webster's Third New International Dictionary (Merriam-Webster, 1993) refers to husbandry as the cultivation, conservation and judicious use of resources, which, of course, KM theorists agree knowledge is. And, though this less mechanistic take on management does not actually cast knowledge in a new light, it does suggest how soft knowledge might be managed – by cultivating it.

At this point, it is instructive to return to the main debate in order to couch knowledge as something that may, indeed, be managed. The starting point is a statement from Polanyi (1969) himself: "We can account for this capacity of ours to know more than we can tell if we believe in the presence of an external reality with which we can establish contact". In other words, there is something outside the individual mind that is more than just 'information' or contextualised data subject to individualised interpretation. Popper (1978), one of Polanyi's contemporaries, called this reality 'world 3'. Beyond the physical (world 1), beyond the psychological (world 2), there is a shared reality "of the products of the human mind, such as languages; tales and stories and religious myths…". Moreover, there is a particularly important feedback effect between worlds 2 and 3: "Our minds are the creators of world 3; but world 3 in its turn not only

informs our minds, but largely creates them… Our relationship to our work is a feedback relationship: our work grows through us, and we grow through our work". Cole (2002) elaborated this thought in arguing that knowledge resides not just in the habits and mental models inside individuals' heads, but "is the product of an ongoing interaction with the work at hand, the tools used to perform this work, and negotiations among members of the work group" and is "distributed across the individuals…". If one accepts this socio-cultural standpoint, knowledge is, indeed, 'out there' and something that can be managed as a resource.

If there is knowledge external to individual consciousness and distributed across the members of groups, it is there because it gets transferred; and it is in the transfer process that it can be, and is, managed. Socio-cultural learning theory provides insight into how this may be done. Socio-culturalists, while not rejecting the validity of behavioural and constructivist learning theories, the province of world 2, hold that education is a way to empower people to better comprehend their situation and make optimum use of the knowledge and material resources available to them. The vehicle for this process of empowerment is narrative, or storytelling. It is through the tales and stories residing in world 3 that people receive the constituents of meaning, which helps them in their continual decision making and problem solving activities.

Put simply, narrative occupies such a ubiquitous role in how we come to know what we know, that its existence, like that of oxygen before Priestly, has until recently been largely unrecognised and uninvestigated. During the past few decades, however, an increasing number of scholars have been drawn to examine what part narrative plays, not only in the arts and literature, but in medicine and science as well (Rankin, 2002; Leinhard, 1997; Nash, 1989). Bruner (1986) noted that we have two modes of thought, which, while complementary, have distinctly different operating principles. On the one hand, there is paradigmatic thinking, whose processes we know quite a bit about: It is the thought mode of logic and science. The goal of paradigmatic thinking is universal truth. On the other hand, there is narrative thinking, about which Bruner thinks we know little: It is the thought mode of everyday life. The goal of narrative thinking is to connect events so that they make sense. Therefore, in everyday life, even in the everyday life of a philosopher or a scientist, narrative "is the fundamental scheme for linking individual human actions and events into interrelated aspects of an understandable composite" (Polkinghorne, 1988). In other words, narrative is where we get meaning. Polkinghorne (1988) went on to say that the "realm of meaning … is not locked within a personal existence: it transcends us as individuals…".

Cole (1997) showed how research in reading comprehension and artificial intelligence supports the notion of narrative as the way we derive meaning. He reported that researchers attempting to write computer programs that can summarise written text found that approximately 15% of the information in any particular passage is explicit. The rest is implicit or tacit, and understandable only when the computer has been programmed with narrative scripts that constitute a stock of knowledge upon which it can draw to make sense of what is going on in specific settings. In sum, then, both humans and computers seem to need to be rooted in narrative for the sake of coherence.

To this point, it has been argued that US mining organisations are losing knowledge; that knowledge is shared knowing distributed across group members; that such knowledge can be managed by cultivating it; and that narrative is the medium through which this may be done. The remainder of our manuscript examines the research,

mentioned above, which has attempted to use such a knowledge management approach to help potential mine emergency responders better deal with the predicaments they are likely to encounter on-site.

3 Cultivating stories of past emergencies

The study and use of narrative, or storytelling, is occurring at a critical time. As social scientists have begun pointing out, many of the details that go into planning and executing key organisational processes are now conveyed electronically rather than being written down. Thus, the only place where there may be a lasting record is in someone's head. Bock (1998) held that we can target what is important from an organisational perspective by asking what an organisation loses when a worker leaves, or what we have to teach a new person coming in. In the case of mine emergency response, the present researchers sat down with a total of 30 mine rescue veterans and asked them to tell stories to capture what was happening at specific moments in particular incidents with which they had been involved. These individuals invariably gave their accounts with an eye to the future: "… a lot of people have come and gone since 1969, and we are having fewer problems. So, in the next 10 to 15 years, there is just going to be a handful of people who have had any experience".

The narrators were guided through four major topic areas by the interviewers, who audiotaped their comments. Each topic area consisted of several questions designed to elicit general thoughts about the following:

1 When and how the veteran became involved in emergency response work.

2 The types of decisions that are made during emergency responses.

3 Details about specific aspects of emergency responses, such as how long the individual stayed on-site.

4 What the veteran would tell future responders to help them be better prepared.

Every session lasted from 60 to 90 minutes, and was concluded only when the narrator had nothing new to add. The audiotapes were transcribed, and stored as computer text files. The analysed accounts yielded a myriad of useful insights. Four brief cases are offered here for purposes of illustration:

Case 1 Why I volunteered for mine emergency work

I feel like I have excelled in mine safety, and I hope I have left some type of mark. The superintendent who hired me told me that the more I knew the better opportunity I had to keep in work, because in the coal industry you had ups and downs, and lay-offs and so forth, and from the first day, I made an effort to get involved in as much as I could. I was immediately asked to go on a first aid team and in those days, if you were on it, you had to do it on your own time. And I put my own time in, and I was on a competition first aid team, and then later on, I think it was two to three years later, I got on the mine rescue team, and I got pretty deeply involved in mine rescue after that.

Case 2 Sometimes the correct decision is to take no action

What had happened, there was a methane outburst at the neighbouring colliery. The assignment we were given was to go into the tailgate, or return airway, and travel that return airway, taking samples and looking for any survivors. The first samples we took gave us 56% methane and the rest was associated gases. So we knew we were in a real inert atmosphere that would not support life. And here, in the distance up the roadway, we could see this light moving. There were two individuals, one was a gentleman in his early 60s, I would imagine, and the other was a young man 16 or 17 years of age. Now, what this elderly miner had done, when he heard the bump and he heard people up the long-wall screaming, he took clear plastic and threw it over the top of both him and his coworker, and took his knife and cut the compressed air hose that was going to the cutting machine. So, now, they were more or less sitting in this little bubble and surviving off the compressed air that was down in the area. Management's decision not to turn off the compressed air was made unaware to me at the time. The mine manager made the decision that the compressed air that runs down that long-wall, we have to maintain, because somebody may be using it to survive on. They knew that the compressors were not dumping enough loading. So, they knew this compressed air was leaking or going someplace.

Case 3 Know when it is time to rest

Well, I watched J.W. go into 72 hours at one time, and that is too long. He would tell you that that is too long, too. It is almost emergency dependent. If it were someone trapped, if it were a mine fire, if it were something else. We, from burnout, from doing things like that, have tried to establish that you will not stay longer than 12 hours. And if I had to recommend it, I would recommend it to 12-hour shifts. If you do eight-hour shifts you got three sets of individuals that have to be briefed, and so 12-hour shifts leaves two groups of individuals running something. I think 12 hours, if it were going to be many, many days can really get old, too. But 12 hours we have handled, and very well, on several occasions now.

Case 4 Train future responders with simulations based on actual mine emergencies

First, it was just hypothetical situations. And they did not seem to prove too much, because they were too hypothetical, "Maybe this, maybe that". So, then we just decided to take incidents – actual incidents that occurred and re-live them. And it really brings things out, you know. "Are you prepared for this? Are you prepared for that?" When you speak of an actual situation in front of these guys, and they start to solve problems, then you can see – you see the panic starting to climb. You have got these men missing, and whatever you are doing is going wrong. You want to do this to ventilation, and the answer is "No, that won't work, because the ventilation door is burnt up. You can't shut that door". "Oh, what are we going to do now? I can't shut the door". So, it really proved it was working.

Of course, the cases are abstracted from literally dozens of pages of transcribed material provided by each respondent. That raises an interesting issue from a knowledge management perspective: Just as those being interviewed were engaged in deriving meaning, so too were the researchers who had to get meaning from this "stew of culture tales" (Cole, 2000).

Weick (1995) described how researchers go about getting meaning in the following way:

> "The answer is, something that preserves plausibility and coherence, something that is reasonable and memorable, something that embodies past experience and expectations, something that resonates with other people, something that can be constructed retrospectively but also can be used prospectively, something that captures both feeling and thought."

In other words, Weick considered the effort to involve plausibility, coherence, and reasonableness, even if the story must be filtered to make it acceptable and credible. The goal of the present research is to present soft knowledge that would lead to insight, but not to relate everything each person said about a particular topic. In this sense, the soft knowledge is filtered and will be less comprehensive "but, if the filtering is effective, more understandable" (Starbuck and Milliken, 1988). One product of this research is a NIOSH Information Circular entitled, "An Oral History Analysis of Mine Emergency Response" (Vaught *et al*., 2004), which purports to use stories in text to transfer some of the collective wisdom of the 30 veteran responders to a new generation of mineworkers.

4 Using narrative to inform a computer simulation

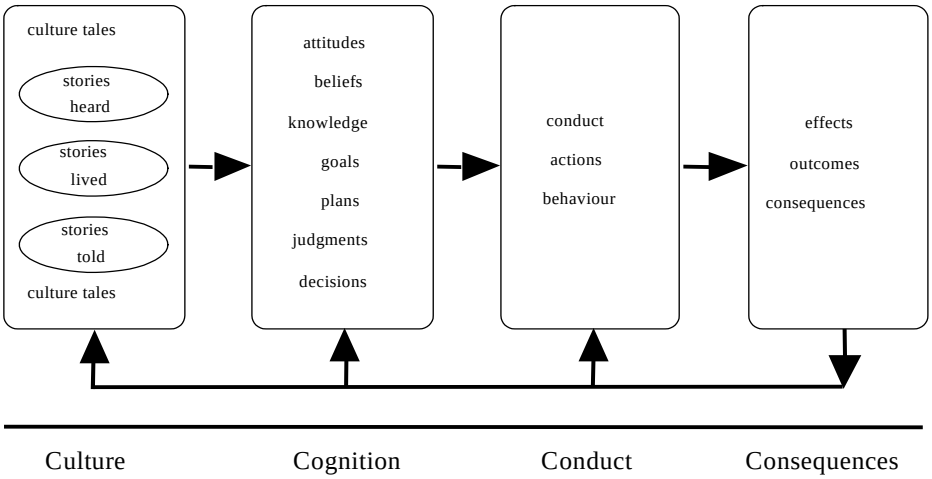
A point stressed repeatedly by the veteran responders is that mine rescue personnel and those who must manage emergencies should be given ample opportunity to practice decision making in realistic scenarios. There are two ways this has traditionally been done in the industry: The US Mine Safety and Health Administration offers Mine Emergency Response Development (MERD) training, which allows participants to play various response roles in a classroom setting; and a few companies conduct mock disasters at their mine sites. Both of these approaches are fairly labour-time-and-cost intensive. Also, it is problematic (especially in mock disasters) to provide appropriate and timely feedback to each person involved in one or another aspect of decision making. For these reasons, it was decided to develop a web-based mine emergency simulation that could be used in a mine office or other on-site location with computer and internet access. The result was what might be thought of as an electronic MERD with enhanced feedback capabilities, dubbed the Mine Emergency Interactive Training Simulation (MERITS) (Brnich *et al*., 2004).

MERITS is rooted in narrative. The basic scenario is developed from the collected stories discussed above. The setting is a small underground coal mine in the Appalachian mountains of the eastern USA. As the simulation opens, the protagonist (trainee or trainees) is kept busy performing the mundane tasks of a mine superintendent: reviewing production and status reports, signing the latest payroll sheets, and approving vacation requests, among other activities. This has the function of familiarising everyone with the interface and the many tools and sources of information that can be accessed when needed. Sometime around mid-morning, a fire occurs in an area of the mine. The first

indication that something is wrong comes when a motorman calls to report that he smells smoke near the mouth of 2 West Mains. From that point on, what happens or does not happen depends largely on the actions of the protagonist, although certain fact based events will always occur, providing a general timing and order to the story.

The story develops over time, with a continual unfolding of points at which the person(s) playing the superintendent's role must either initiate decision alternatives or do nothing. The decisions will, of necessity, be like those that individuals or groups have used (or failed to use) in actual emergency situations. Some will be good alternatives, and some, although possible, may not be effective (or may even be harmful). While individuals are working the simulation problem, they also receive feedback about what impact the chosen alternative has had upon the situation. Thus, the exercise teaches by reinforcing good decisions, concepts, and strategy, while providing a basis for remediating incorrect thinking. Shared knowledge grows from this process, because as the story unfolds, those who are working the simulation add their own stories of correct actions taken and opportunities missed. This fits the socio-cultural theory of learning, which is depicted in Figure 1 (Cole, 2000).

Figure 1 How narrative guides what people do.



To the extent that the MERITS simulation is perceived as being authentic and relevant to workers' circumstances, the simulated outcomes for various decision alternatives presented in the scenario can serve as powerful models to help workers learn in the safety of a training situation. An overview of one field test session, itself a story, will illustrate this point:

> "The session started with an introduction to MERITS and the simulated mine. The instructors presented the trainees with logistical and technical information regarding the layout of the mine, production methods, and emergency management procedures. Trainees were given time to review the information, look at the mine maps, and ask the instructors for clarification on issues related to the mine. The introduction lasted for 45 minutes and was followed by a brief overview of the software interface and its tools and the capacities of the computer to perform actions and commands during the simulation. After this, the trainees were given a short break.

> The simulation was started about one hour and 15 minutes after the training day began. Trainees started in their mine superintendent role by reading status reports about the mine and its daily activities. They reviewed shift reports and familiarised themselves with the mine's personnel. An exercise built into the early stages of the simulation provided an opportunity to complete a typical personnel task with MERITS.
>
> As the simulation progressed, trainees were introduced to a problem at the simulated mine and immediately became engaged in finding a resolution. Trainees increased their physical activity – standing up, moving around, and reviewing maps on the walls. Discussion increased, with disagreements ensuing over the course of action needed to resolve the problem. The balance between mine rescue and overall emergency management was a focal point of debate. Each group decision carried the weight of the trainees' real mine emergency experience and their roles in those events. Decisions needed to be made quickly and, as consensus was reached, the computer operator would perform requests and build commands to effect the trainees' decisions. As the simulation progressed, the trainees' concerns shifted more toward large-scale emergency management issues rather than underground response tasks. Trainees referred to the mine's emergency response plan to coordinate actions and delegated duties to various mine personnel using commands built by the computer operator. Prompt action by trainees early in the problem enabled them to see successful results of their decisions. The trainees worked on the simulation problem for over two hours.
>
> After the simulation ended, the debriefing session began. The computer, which had recorded all events and trainee actions that occurred during the simulation, had created a time-stamped trainer's log. This log served as the foundation of the instructors' debriefing session. The instructors discussed response times to events with the trainees, who were able to see how their actions impacted the resolution of the simulation problem. Instructors guided a discussion of key decisions that led to a successful resolution of the problem, while also pointing out things that could have been done differently."

This session was held on 5 July 2000, and was conducted by an experienced mine emergency and mine rescue instructor. The participants were managers from small underground coal mines. All trainees reported that they enjoyed and learned from the simulation.

5 Conclusion

This paper has argued that a knowledge management approach can be used to prepare future mine emergency responders. The knowledge management approach suggested here synthesises environmental, technical, organisational and personal perspectives. It also posits human judgment as a critical component of the decision-making process, recognising that while computers may be useful in structured situations, it is ingenuity that prevails in unstructured conditions (Gorry and Scott Morton, 1971). Bock (1998) characterised the management of knowledge in decision making as a process that comprises a loop: "Knowledge is created. This happens in the heads of people… Knowledge is shared. When knowledge is shared and used, the folks who use it modify it. This takes us back to knowledge creation". Not only are people creators of knowledge,

they are collectively one of its main repositories. Bock further noted 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 soft knowledge (involving the 'right' way to do a thing) is created in the organisation, or, more precisely, in the mine emergency response community. In recent years, organisations have directed a great deal of interest to soft knowledge and to discovering ways it can be shared and used in the decision process. In Courtney's (2000) paradigm, 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 organisation. Mitroff and Linstone (1993) suggested how a multiple-perspective approach might best be used in organisational decision making:

- Achieve a balance among technical, organisational, and individual perspectives.
- Use good judgment in drawing out the plausible elements in each perspective.
- Recognise that information is gotten differently from the technical perspective than from the organisational perspective – the latter two (organisational and individual perspectives) require good listening.
- Understand that the perspectives have mutual interdependencies and impact.
- Avoid thinking statically, because the environment is dynamic.

The key to managing soft knowledge is an ability to stop thinking of organisations as machines and start viewing them organically, as having shared learning (Addleson, n.d.).

It was mentioned above that KM is predicated on the notion that knowledge is one of the most critical resources for an organisation or community of practice. Many knowledge management issues, it is true, centre upon such material aspects of control as computers and databases. Other issues, however, deal with the human factor. For those who analyse organisations from a KM perspective, it is the way in which an organisation's players, both human and computer, process the knowledge resources obtained from shared learning that is most essential to the making of decisions (Holsapple and Joshi, 2001). And, it is the making of decisions that lead to problem solutions, which, in turn, spell survival for the organisation.

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Note

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