Information: The Achilles Heel of Emergency Response

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Introduction:

In recent years there has been considerable effort expended in developing the emergency response capability of mines. As well as the major improvements in the capacity to get people out safely from underground and even quickly deal with an incident, a lot of effort has been expended in developing the capacity of mines to manage incidents on the surface. Various organisations including the Mines Rescue Services of Queensland and New South Wales offer competency based comprehensive courses. The CSIRO has developed the NEXSYS integrated risk management system and we have 21st century technology. SIMTARS has developed sophisticated computer based mine environment monitoring systems and analysis tools. There have been a number of seminars and workshops aimed at improving emergency preparedness. In Queensland the QMRS has provides training and support of the MEMS system for response to emergencies. It is therefore surprising to see that, at each of the level one emergency response exercises conducted at Queensland underground coal mines over the past nine years, the management of information vital to the successful execution of the response has been handled very poorly. A number of real incidents that the author has attended, have also exhibited major information management problems.

Examples of these problems include:

- Five hours into the incident the mine manager having to personally go to the tag board to see who is still underground.
- Personnel being shown as being underground when they have gone home.
- Confusing the location of an underground caller with the location of the fire (an error of only 2 kilometres) because of inadequate record-keeping and information display.
- Using post it notes to record information on a mine plan that kept falling off the printed mine plan.
- Not debriefing underground personnel before letting them leave the site.
- The Incident Management Team not being aware of debrief information.
- Not keeping any systematic track of personnel locations, mine environment monitoring data or events.
- Writing gas monitoring data onto mine plans without any date and time info so that they are used four hours later as part of the interpretation when they are no longer accurate.
- Having to go to the control room to get any gas monitoring information.
- Having to wait for the software security device to arrive from another mine before ventilation and mine fire simulation could be undertaken.
- Not knowing or accessing the mines rescue guidelines for re-entry.
- Having no mine plans available for use and waiting for a mine surveyor to print them out.
- Using mine plans that are inaccurate and out of date.
- Expecting the control room operator to single-handedly manage the underground communications, monitor the mine environmental data, prepare the first aid room and keep track of where all resources are.
- Expecting the ventilation officer to actively participate in planning and decision making of emergency response whilst also running the gas chromatograph, collecting bag samples, doing the ventilation simulation and trending and interpreting the gas results.

The key to an effective early response is adequate information on what has happened, where, what is likely to happen, who was involved, where everyone is, and what resources exist to control and respond to the incident. An example of this is the level one exercise at Crinum Colliery where the men trapped underground in the refuge bay were able to work out the scenario more quickly than those in the IMT because they concentrated on the relevant information

The basis for establishing effective information systems can then be simply derived by identifying who needs what information, when and where will this information come from? From there systems can be developed appropriate to the capabilities of the personnel and resources available to the mine. These systems need to be dynamic, able to adapt as the circumstances and resources change. This paper seeks to explore and expand upon this theme.

The Mine Emergency Management System (MEMS) structure, as promoted by the Queensland Mines Rescue Service and widely used in Queensland underground coal mines, will be used to illustrate the operation of a mine site during an incident. This does not mean that MEMS is the only way to manage an incident, rather, that it is an appropriate system, if properly organised and resourced.

Control Room Operator (CRO)

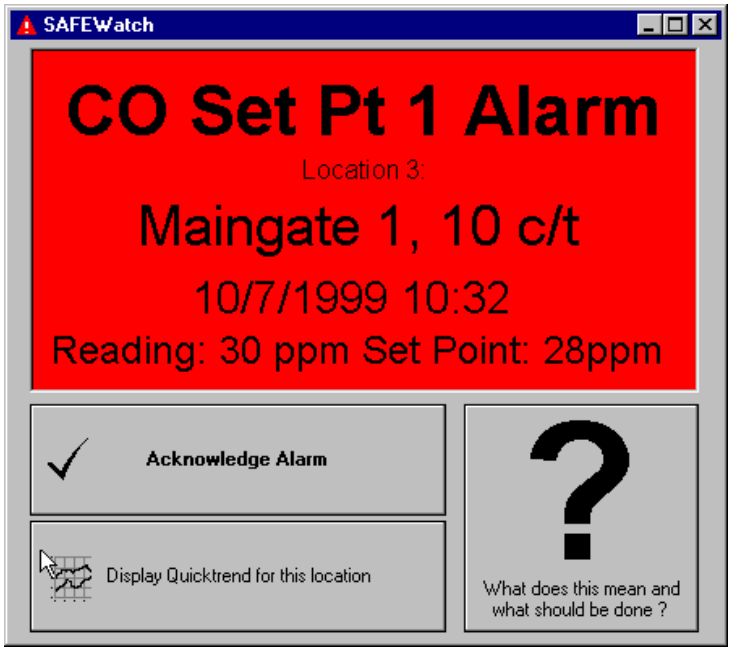
When an incident is occurs the first indication will either be an automated alarm or signs detected by underground workers. In either case the initial action officer will be the CRO either being contacted by the underground workers for more information or contacting them to obtain more information. As such this person is the lynchpin of the early part of an incident.

This person also generally keeps track of personnel and equipment underground. He has to make the initial assessment and react appropriately. He then has to brief the senior mine official (SMO) on site and if appropriate activate the emergency management system. He would be the first person to complete a situation report – summarising the current situation.

It is therefore imperative that he have good communications with the underground, easy access to the location of underground personnel and a mine environment monitoring system that delivers accurate relevant information. Figure 1 below shows a typical control room.

Figure 1. A typical control room.

The CRO can have up to ten computer screens to monitor, whilst filling out three or four log books, answering the DAC, a range of phones and two way radio. If an alarm occurs he will then generally have to access hard copy of the appropriate Trigger Action Response Plans (TARPS) in order to see what action is required. The first problem is deciding which plan to follow. He then will have to access his duty card and the emergency response plan if he can find a copy. Why are these not in electronic format available from one or more of multitude of computer screens at his disposal via a short cut or hot key? Even better would be if an electronic alarm if triggered when he acknowledges it, the computer can tell him what to do and even assist him in doing it for example forwarding the alarm to the SMO, calling the mine manager etc. The computer system should be configured to allow quick action and clear identification of issues. Figure 2 depicts an example of how key alarms could be displayed.



Q why are there two telephones in all control rooms?
A because when he/she is busy on one we can ring him on the other.

Figure 2. Alarm display and response screen.

He should prepare a succinct summary of the status of the incident to brief the SMO in MEMS this would be a situation report. If this was an electronic document then it could be quickly shared both on site and offsite. In addition this would be available to any authorised person with the need to physically talk to the CRO – saving time and the interruption to his other tasks. As key factors change the document can be updated and time stamped.

Senior Mine Official (SMO) on site

This person will obtain a briefing from the CRO and make the first decisions on how to proceed. These could include evacuation, in seam response and/or calling for assistance. He may need to call on other senior mine personnel for assistance or to take control of the incident management. Time is of the essence; his priority is to assess what actions to undertake –evacuation – in seam response etc. He may decide that he needs additional information. Some of the information may be sufficient to decide on some actions – summoning assistance etc. He may then recruit a logistics officer to start the process of acquiring additional resources as well as personnel to collect information and make detailed analysis of the situation to determine actions (planning). The third arm of the MEMS system

comes into play when there are a range of actions to implement (operations). To make this cascade effective there should be a readily accessible roster of on call officials for all key roles.

Incident Controller (IC)

The SMO is the IC until a more senior mine official may arrive on site. In this case it is imperative that he is able to effectively brief the IC of the status. The IC will rely on effective communications of key information from each of the functional areas.

Planning is responsible for collecting all the data to characterise the mine environment and the status of the incident including location of personnel. They are also responsible for predicting what is going to happen and for developing plans to retrieve any personnel at risk, safely and control the incident. The basic information system centred on Planning is depicted below.

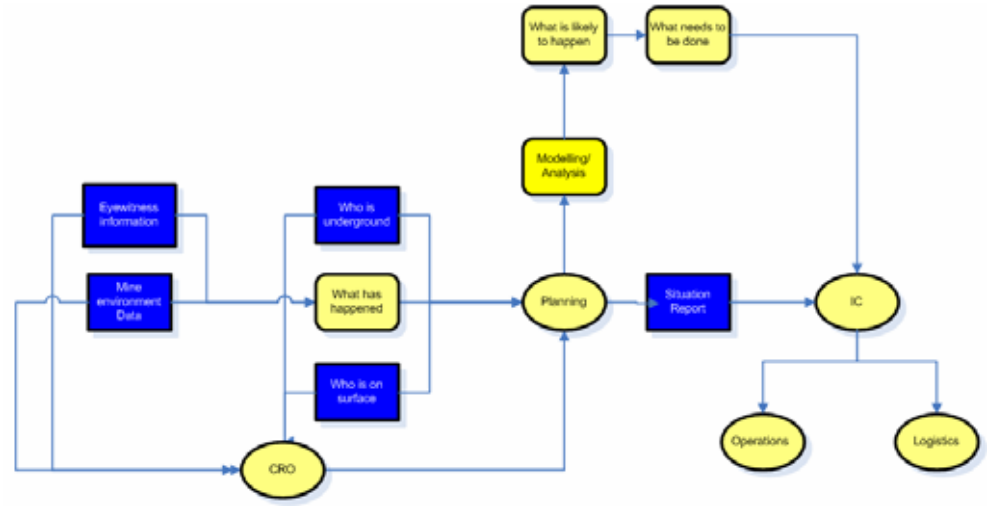


Figure 3. Information flow for Planning Group.

For each of the information categories in the blue boxes the process for collecting the data must then be identified. Eyewitness informant needs to be collected by a debrief process, who does this, how is it done and how is the information passed on to the planning group? The location of persons underground will be via a combination of resources, work locations may be defined initially via the tag board. Underground communications between the workgroups and the CRO typically would then refine this and identify any injuries etc. This information will change as persons move throughout the mine and as any evacuation occurs. In addition if teams of persons are sent underground to deal the incident they need to be included in this information. A lot of time would be saved initially if the CRO had the tag board information to him electronically and he could update it as it becomes refined. Electronic information can be transmitted quickly around and offsite. A speedy response would be enhanced if it was known what personnel were on the surface and where they were or at least how to contact them. Many mines operate local mobile phone systems on site; none seem to have installed speed dial systems in the control room. Typically the CRO has to find the phone numbers and manually dial each person. At some mines this function has been hived off to an assistant.

Some mines doe not have mobile phone coverage on site. On two occasions the landlines failed causing major communications issues. There was no backup system for offsite communications.

As the incident develops the links become more complex, the sources of information and those requiring information grow. Figure 4 depicts this where an in seam response has been activated. In addition more stakeholders make demands for information, corporate office, mines inspectors; mines rescue superintendents, the media, workers' families, district safety and health representatives, outside consultants etc. Their demands have to be managed. Ignorance is not a management technique. Some groups will manufacture information if they do not get it from whatever source is available to them.

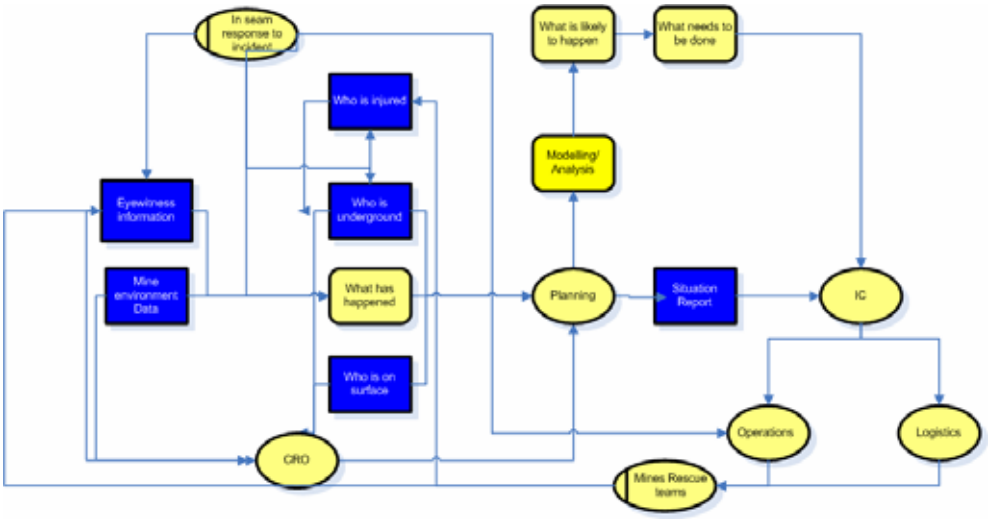


Figure 4. Information flow as a response to an incident develops.

Logistics will organise to provide all the resources necessary to accomplish this, monitoring what resources are required and when they will arrive.

Operations will carry out the plans once agreed by the IC.

Simple really, except that the track record in Queensland from the level one exercises is less than perfect.

The issues

The problems start immediately. The CRO is usually deluged with communications from all areas of the mine trying to find out what is happening. The alarm system is probably blowing it's head On top of the SMO wants to know what is going on. Current personnel locations systems usually consist of tag boards, which are poorly managed. Often in an incident the CRO has other functions – preparing the First aid room, monitoring the mine environment, running the Gas Chromatograph, operating the evacuation siren. Needless to say he is overloaded and cannot function effectively. Misinformation is common.

Too often it is impossible to locate all personnel underground – damaged communications or worse they are okay but cannot communicate because they are wearing SCSR which precludes verbal communications. In a number of exercises, groups of workers have remained out of contact for up to five hours before contacting CRO when they eventually reach fresh air. This means that surface personnel have no idea of the status of this group until it calls in. Sometimes this has become worse when part of the group splits off and disappears in a different direction.

Comment: What is the pint you are making here it is not clear.

Within the planning group the situation often gets no better. The ventilation officer is not only charged with carrying out simulations of the ventilation circuit but also interpreting the mine environment to see what has happened, often having the run the GC, take bag samples,

usually he is a member of the mines rescue team and provide gas information to the IMT. It is not surprising that quality and quantity of information suffer.

Why is it that mines require the VO to report the mine environmental data on a regular basis rather than have direct access to a computer terminal connected to the mine environment monitoring system? Why is it that often every PC on site can tell me how the longwall is operating yet only one has access to the gas monitoring data? Why is it that only the ventilation officer knows how to trend and interpret the gas data?

The current legislation puts a lot of the responsibility of ventilation control under the jurisdiction of the VO. The safety management plan process allows this responsibility to be shared with others such as the shift undermanagers (every mine has different titles for this role) who have control of manpower and ensure that tasks are completed

Another issue is paper; every group within the MEMS process seems to operate at least one log book to keep track of events, decisions, phone calls etc. Yet very few ever seem to use them to assist in the decision making process, preferring to rely on their memories which of course are perfect. Sometimes scribes are appointed to take care of the note taking – an excellent idea but they must have a working knowledge of the material being recorded otherwise some interesting notes can be taken, Why use paper ? What is wrong with using MS EXCEL – you can then combine all the logs when you need to and quickly sort the information by categories, time, actions not yet complete etc.

The IC is charged with making the decisions. Experienced people use Naturalistic Decision Making processes where they match the available data to their experience to determine what is happening and how to control it. This implies that they have enough data and that they have the experience to make the correct match. This breadth of experience can be significantly enhanced by including other experienced personnel in the IMT process. The other way is to acquire the knowledge through training and exposure to real incidents. Three of the mines who have had level 1 exercises implemented the MEMS system without bothering to train their personnel in it first. Often the decision making process has been disrupted by the movement of personnel into or out of the Incident Management room, or by phone calls coming into the room. Structured decision making is rarely undertaken and only on one occasion was a formal decision making process undertaken that was documented. Decision making is often hampered by the lack of information or ready access to that information. In some cases because of the lack of this access conflict arises due to different information for example the location of a fire or the number of injured persons and their locations. Simple systems to display key information are readily available whether they are electronic or just white boards. Someone needs to be charged with the responsibility of keeping them up to date of course otherwise they will lead to misinformation and poor decision making.

Incident control rooms seldom contain the resources to assist in the decision making process. For example very few had copies of their principal hazard management plans, relevant legislation and guidance material, mines rescue guidelines, contact details for key personnel(internal and external), or access to the mine environment monitoring system. You would never know we were in the 21st century – the information age. All these documents are readily available electronically and can be accessed from any PC connected to a network or web. Portable access can be obtained via laptops and pocket PC's. Advice from experts is only a phone call away and all information could be quickly emailed to them for assessment – assuming of course that the information is in electronic form.

One mine in Queensland had to resort to faxing graphs and information due to inadequate email during an incident

Another classis mistake is not to manage debriefing of underground personnel. This vital set of information is often completely overlooked during the exercises or only partially accessed. In some cases the opportunity to obtain eye witness accounts of the incident are lost because underground personnel are instructed to evacuate and that is all, when they may drive right past the fire and be able to determine its size and severity, not to mention put it out. At the

very least a formal debrief process needs to be implemented and all important information must be passed onto the IMT via the planning group quickly – again why not electronically?

This brings in the question of collecting information responsibly. It is vital the any emergency response plan identify the key sources of information required to manage an incident and then appoint personnel responsible for collecting, analysing and disseminating the information to the appropriate persons in a timely manner. It is not sufficient to appoint the person, the person must also be technically competent to carry out the task as well as have the time and resources to carry the task out. The VO cannot trend the gas data if his computer is being used for other purposes all the time and his is the only one with a licence to operate the trending program. Similarly he cannot carry out sophisticate mine fire simulations if the security device for the simulation software is at another site two hours away. The VO cannot carry out simulations to understand what has happened to the mine ventilation if every five minutes he has to manually recorded the gas information and deliver it to the planning manager who then manually transcribes it onto a mine plan. He in turn then hand delivered it to the IC. A computer in the IC connected to the mine environment monitoring system would have removed this manual double handing of data, made it more up to date and removed the possibility of mangling the information. Other distractions that the VO commonly suffers is the need to collect gas samples as he is the only on site trained to do this, or run the GC as only he and the CRO are trained to do it.

Communications does not just occur through the official approved channels. Figure 5 illustrates the complexity of the real communications paths at an underground mine during an incident. On several occasions during past level one exercises, communications has occurred between groups bypassing the formal recognised channels leading to problems when formal communications give different information to that already obtained through other channels. This breeds distrust and can lead to panic. What about Crinum as another example

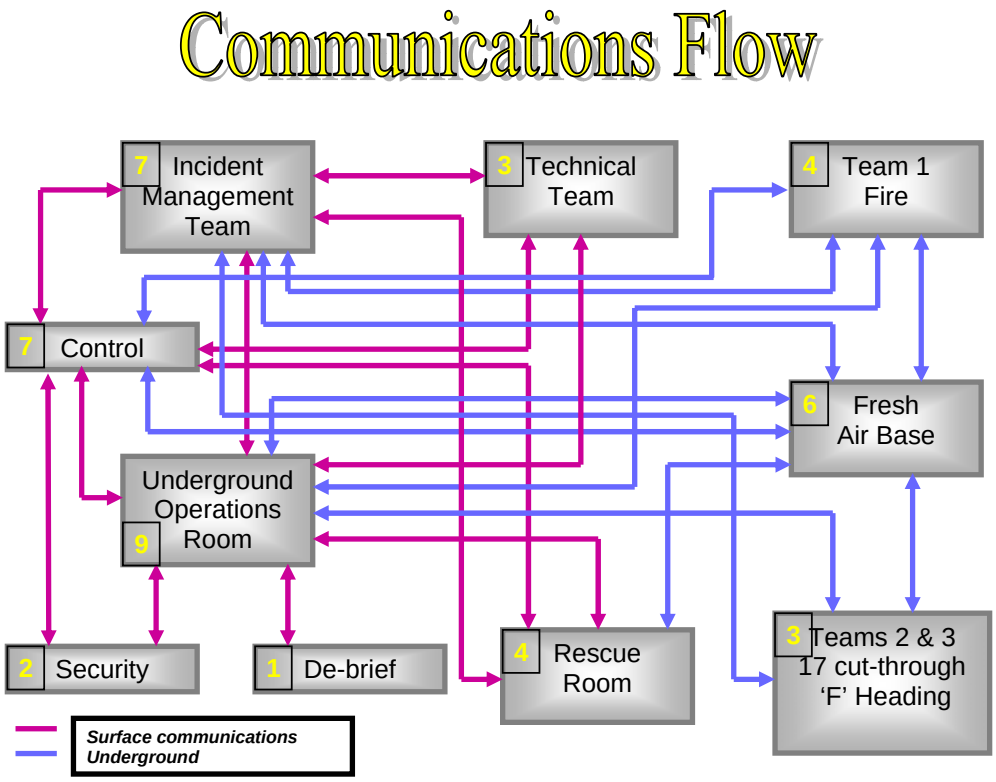


Figure 5. The actual communications paths during a recent level one exercise.

A generic problem found at most mines is that the emergency response plans and duty card systems seem to assume that the incident will occur on day shift during the week. They have seldom been tested under minimum manning conditions or other conditions of duress eg the absence of the mine manager or VO on leave. The MEMS system is specifically designed to adapt to the number of people available. On a number of occasions during level one exercises that have been triggered at night, individuals have been seen running around carrying multiple duty cards (up to 15) trying to enact them all. On other occasions they appear to be given out at random – in one case a coal preparation plant operator scored the Incident Controller role. This really indicates how little these systems are really tested and put under any strain. Mutual assistance exists for mines rescue personnel why not for other functions in the emergency response? How about a backup VO, or backup Incident Controller, Planning, Operations and Logistics coordinators from other mines? The number of times, by coincidence, key technical consultants happened to be onsite during an incident is extraordinary.

On one occasion the stores attendant was given the IC duty card and asked to check the tag board and had great difficulty in understanding the conflict between the duty card and the request.

Are duty cards becoming too long? At some mines they are more like duty books. Should they be written as outcomes rather than a process which we must follow at all costs?

Conclusions

Probably the most distressing thing about all this is that every year in each level one exercise these issues are raised, the reports are distributed, presentations, offering suggestions for improvement are done and yet there is no improvement. The industry has made major improvement in getting people out of the mines safely, and in reacting quickly in seam to incidents. No real progress appears to have been made on the managing the incidents in underground coal mines.