



Mines Rescue

## **EFFECTIVE MINES RESCUE TRAINING: INTEGRATING VIRTUAL REALITY**

October 2013





## Background

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Mines Rescue Deployment is generally required post an underground incident where the environment and associated conditions are hazardous, usually involving a combination of heat and humidity, unstable ground, low visibility, flammable and irrespirable atmospheres, all of which have claimed the lives of Mines Rescuers.

Each hazard on its own is in theory, fairly easily dealt with but when in combination, as when from an underground incident, such as a major fire or explosion, then the level of risk is greatly magnified, and this is the environment that Mines Rescue teams are required to operate in.

For their safety Mines Rescue teams must be prepared to operate in such an environment.

## Traditional training

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Traditionally the preparation of mines rescuers is focused on classroom delivery of theory regarding the mining environment, mines rescue equipment and procedures. This including topics such as gases, ground support, breathing apparatus, first aid, fires and firefighting. This is usually followed by practical instruction and assessment in both individual and team procedures revolving around when and how to use the equipment in specific mines rescue situations.

Whilst this approach is appropriate, its effectiveness is limited by the nature of the environment that the training/assessment is delivered, for example:

- Donning of a self-contained self-rescuer may be taught in the classroom, but better assessed in a training gallery.

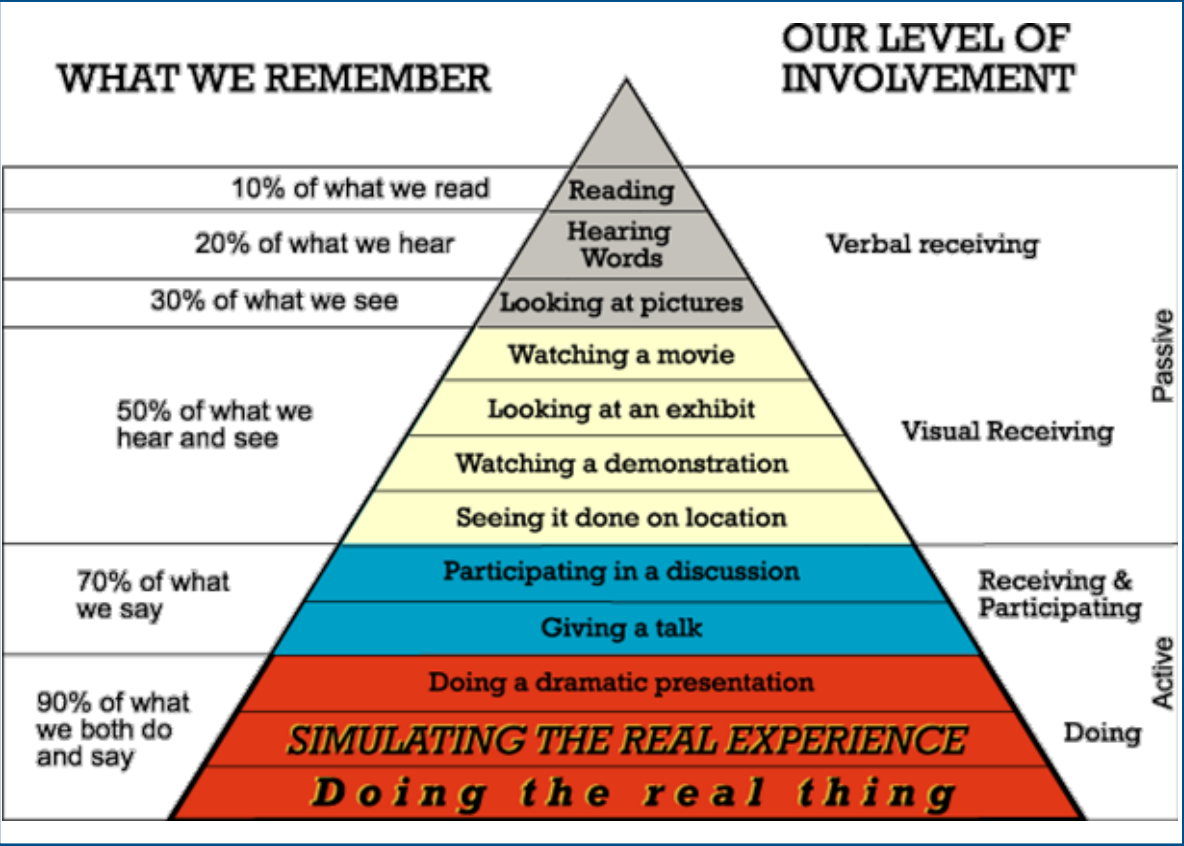
Whilst this traditional training method is successful, how effective is it in assessing the ability of a mine rescuer to follow the correct procedure whilst operational in a hazardous environment, for example; on a Long Wall Face, after their breathing apparatus fails, visibility is limited and the atmosphere is toxic?

We do our best in training galleries and in mines rescue competitions, but how closely does this get to the “real” environment, and how effective are these traditional training methodologies?

More importantly, how does this assist in the team’s decision making process and then demonstrate the resultant effects of any decisions made?

### Adult learning principles

Edgar Dale was a US professor and educationist at Ohio State University. In 1946 he developed his most famous model, the “Cone of Learning”. Since then it has been frequently quoted, as the definitive model for how we retain information when delivered in various styles and mediums. It also and gives us some useful indicators as to the best way to generate retention.



Can we use better methodologies to deliver a safer Mines Rescue brigade better able to operate more effectively?



## Virtual Reality

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Coal Services' Mines Rescue has undertaken the use of Virtual Reality in order to create a "realistic" environment best able to fully expose and test mine rescue brigades in an environment that is as close as possible to that which they will be expected to operate, whilst still guaranteeing their safety.

In the Academic world, there is a Reality-Virtuality Continuum, which basically maps any combination of Real Environment (Reality) and Virtual Environment (Virtuality) with interaction by Real/Virtual objects. In the non-academic world, Augmented Virtuality has been better known as "Mixed Reality":



The various types of simulations may be summarised as:

***Simulation:***

Generally have little or no interactivity, the aim being to deliver outputs relative to inputs; examples include spread sheets, and data analysis applications.

***Pros:***

Good for trialing large quantities of scenarios quickly, e.g. cause and effect.

***Cons:***

There is a low chance of the trainee remembering outcomes, thus it is not suitable for training of physical tasks.



### ***Real Simulation:***

This is otherwise known as practical training, and is thus completely practical and interactive; examples include firefighting training, first aid scenarios, and equipment testing.

#### ***Pros:***

Allows high memory retention, establishes muscle memory and reflexes.

#### ***Cons:***

Can be expensive to set up and run, and as training must remain safe, allowing trainees to experience severe incidents or hazardous environments is both difficult and limiting.

### ***Virtual Reality:***

This involves creating a completely computer generated world, interaction being limited to being an observer rather than a participant, examples are computer games and low interactivity simulators

#### ***Pros:***

Simulation of any scenario is possible, including major disasters. Allows a much higher degree of observer access.

#### ***Cons:***

Limited training outcomes due to no direct participation from trainee, for example: if an action is to be performed it's done via proxy, such as moving a joystick or pressing a button.

### ***Augmented Reality:***

This allows a "real environment" to be overlaid with virtual objects, examples being Google Maps, and Mobile Phone applications that overlay camera view.

#### ***Pros:***

Provides high fidelity imagery that people can best recognise and associate with.

#### ***Cons:***

Limited as the simulation is still restricted to boundaries of reality, for example the location of a camera or an event must be witnessed to record it in the first place.



### ***Mixed Reality:***

This allows a “Virtual Environment” to be manipulated by real interaction; examples include Flight Simulators, high-end Military training, and now Coal Services Mines Rescue.

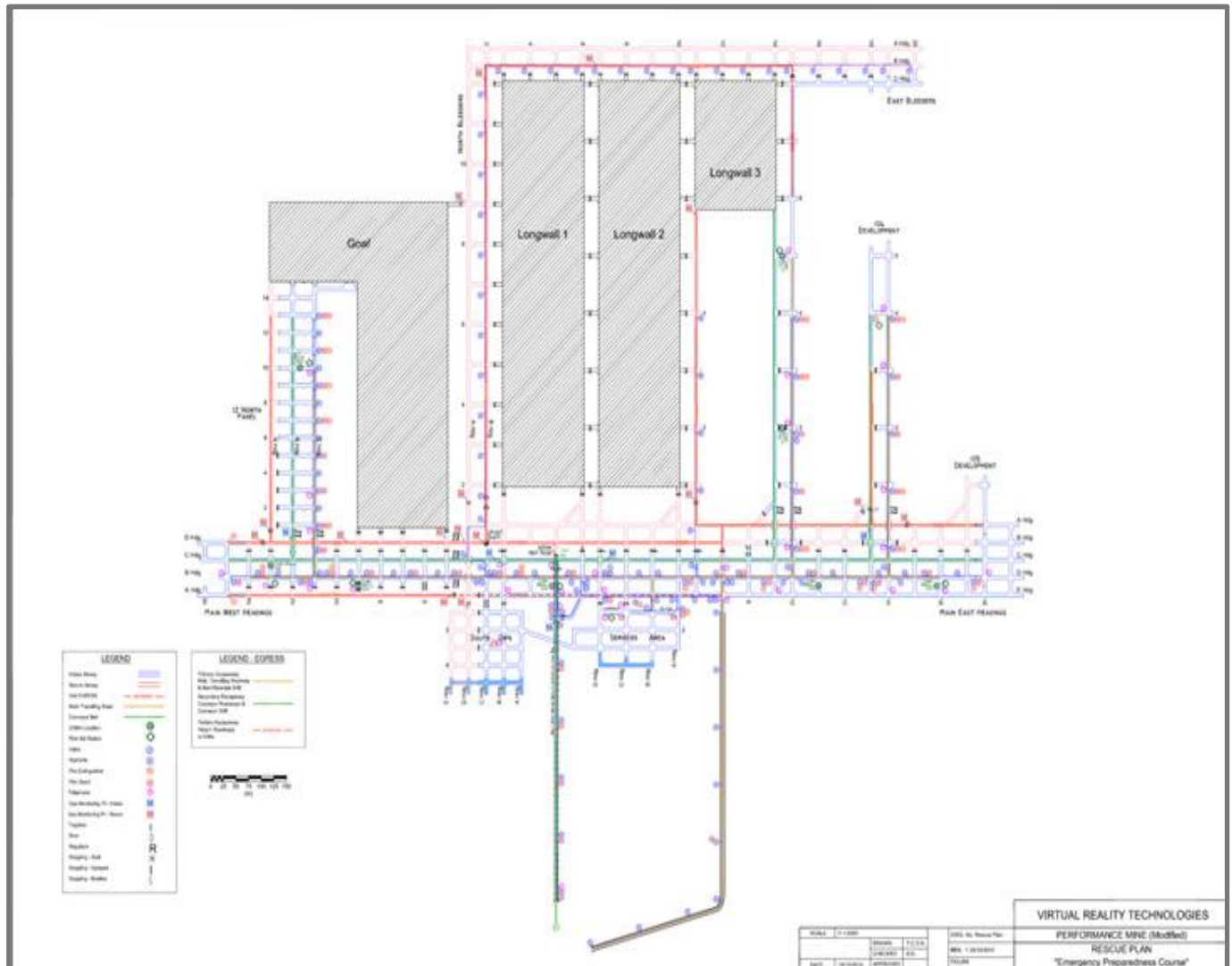
### ***Pros:***

This has the benefits of all types of simulation. It can expose trainees to all scenarios and can access impossible locations, allowing for a replay of scenarios both for review or alternative analysis. It engages both the physical and mental senses of the trainees allowing for greater retention (up to 90% as per Edgar Dale’s model).

### ***Cons:***

Usually expensive to set up and run due to both building the Virtual Environment and physical props.

## Mines Rescue Virtual Reality



There are some key elements that dramatically increase the effectiveness of the training delivered by Mines Rescue:

- The **Scope**
  - ✓ Fully operating surface and underground mine
  - ✓ 50 km's of underground roadways
  - ✓ Mine hardware (transport, extraction, ventilation)
  - ✓ Longwall Extraction
  - ✓ Cut and Flit roadway Development
  - ✓ Pillar Extraction
  - ✓ Traditional Continuous Miner Development



- The level of **Control**
  - ✓ Airflow
  - ✓ Gas levels
  - ✓ Water levels
  - ✓ Visibility
  - ✓ Ground
  - ✓ Communication
  - ✓ Events
    - Fire
    - Explosion
    - Inundation
    - Smoke
    - Vehicle accident
    - Roof fall
    - Rib fall
    - Gas level
- The level of **Interactivity**
  - ✓ Travel (use)
  - ✓ Communication (use)
  - ✓ Airflow (measure)
  - ✓ Gas levels (measure)
  - ✓ Fire Extinguisher (use)
  - ✓ Ventilation appliances (use doors, erect walls)
- The level of **Exposure**
  - ✓ 3 dimensional or 2 dimensional
  - ✓ Team or Individual based
  - ✓ Full mine or creation of customizable scenarios





### **Conclusion**

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Virtual Reality training has been used successfully in a number of industries, from Aeronautical to Mining. Pivotal to its success is its ability to replicate the “real” environment and its ability to create “flow on” effects from any decisions made or actions taken.

The Coal Services Mines Rescue Virtual Reality training system incorporates all of the successful elements of Virtual Reality training, and combined with the traditional classroom and practical training systems delivers unparalleled Effective Mines Rescue Training.



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