
**THE UNIVERSITY OF
NEW SOUTH WALES**
 SCHOOL OF MINING ENGINEERING

Modelling Safe Work Behaviour

David Laurence

Background

- Regulatory change is happening
 - Queensland & NSW
 - ➔ Enabling environment, general duties, risk assessments, safety management plans & systems, due diligence, Codes, guidelines, enforcement policies
 - Increasingly onerous for management let alone mineworker
- Many incidents connected with rules and regulations

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Incidents & rules and regulations

- In particular
 - ➔ Lack of awareness of procedures or rules
 - ➔ Not complying with or ignoring rules
 - ➔ Lack of clear instructions
 - ➔ Poor communication generally
 - ➔ Production taking precedence over safety
 - ➔ Failing to wear protective equipment
 - ➔ Overriding or bridging out safety barriers
 - ➔ Inadequate training
 - ➔ Lack of familiarity with equipment
 - ➔ Fatigue

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Aim of investigation

1. To improve the effectiveness of mine safety rules and regulations
 - ➔ through a better understanding of the attitudes and behaviours of the mining workforce.
 - ➔ seeking the direct input of mineworkers rather than relying solely on the views of regulators and management.
2. Is there a link between regulatory environment, mine specific rules and safe behaviour?

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Surveying the Workforce

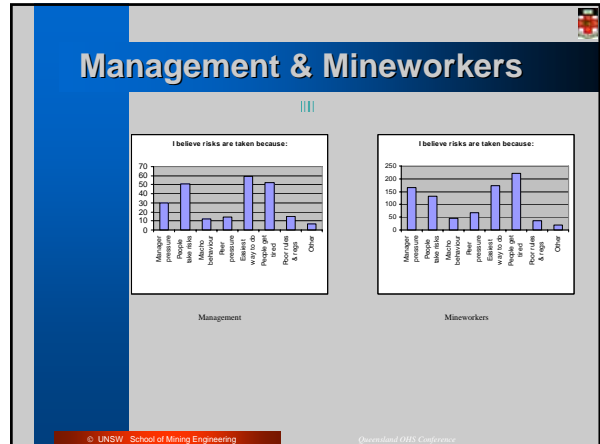
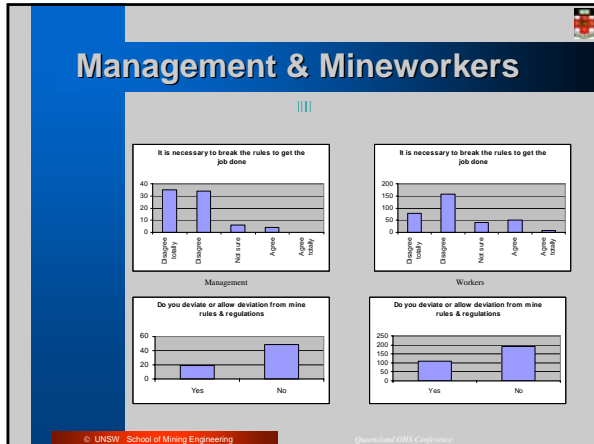
- 2001/2
- 30 mines, ~ 500 participants
- Mainly Queensland & NSW
- Sweden, Canada
- Comparisons between
 - Coal v metal
 - Open cut v underground
 - Management v operators
 - Employees v contractors
 - Australia v international

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Surveying the Workforce

- Knowledge and understanding of and compliance with rules and regulations
- Communication at the mine
- Attitudes towards risk-taking and error making and fatalism
- Attitudes towards the operation and maintenance of a particular higher risk system or process
 - continuous miners,
 - boggers (loaders) and trucks
 - heavy mobile equipment
- Opportunity for mineworkers to express opinions to independent researcher

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Knowledge & Understanding and Compliance with Rules and Regulations

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- "keep them simple and easily understood;
 - rules to do with width of driveage are outdated – need to be revised as technology has outgrown rules;
 - (we are) overrun with rules and regulations;
 - not enough training provided;
 - more practical, plain English
 - work better if everyone involved in the process;
 - the reason for a rule being in place should be explained in induction;
 - need constant reminding;
 - rules and regs here aren't well known - management relies on each recruits knowledge from previous mines;
 - common sense and person to person communication is still the most effective
 - the latest version (Qld regs) is too vague
 - rules and regulations especially the regulations are written up to be confusing and complicated - people who have a lower level of education and comprehension have a hard time understanding and absorbing the information."
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Sector	Knowledge of rules	Process of making rules	Knowledge of risk assessment, duty of care, SMS	Personal involvement	Major problems with rules
Underground coal	Limited	Limited	Limited	Limited	too many to remember
Underground metal	Limited	Limited	Limited	Limited	too many
Open cut coal	Fair	Good	Fair	Fair	lack real world understanding
Open cut metal	Fair	Good	Fair	Fair	too complex
Quarries	Limited	Limited	Limited	Limited	too many, too rigid
All coal	Limited-fair	Fair	Limited-fair	Limited	lack real world understanding
All metal	Fair	Fair	Limited-fair	Limited	too rigid & inflexible
All underground	Limited-fair	Limited	Limited	Limited	too many to remember
All open cut	Fair	Good	Fair	Fair	too complex
All management	Good	Good	Fair	Good	too complex
All operators	Limited	Limited	Limited	Limited	too many
All contractors	Fair	Limited	Limited	Limited	too many
All employees	Limited	Limited	Limited	Limited	too many
Sweden	Good	Fair	Fair	Good	too many
Canada	Good	Good	Good	Fair	too complex

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Attitudes towards risk taking, errors, accidents

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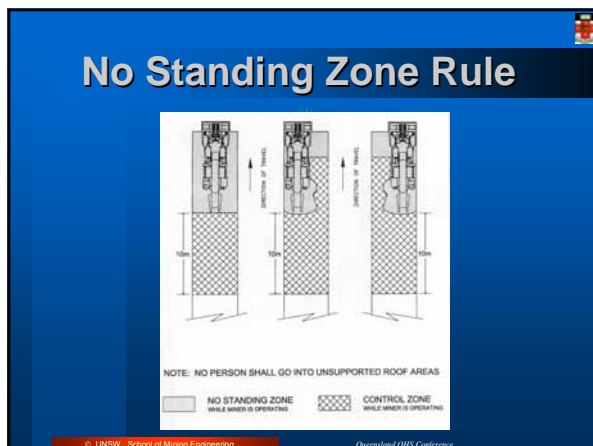
- “Risks may be taken when some one gets tired and tries to take short cuts to get a job done
 - Because of the long shifts now worked at this site fatigue is becoming more of an issue
 - Humans will make errors from time to time - procedures and planning should consider the outcomes from these errors and make provision accordingly
 - As long as the job is done all the rules are thrown out the window;
 - Common sense should always prevail, but there is always the element of the other unknown, don't rush in head first;
 - People should stop and think about their task before starting the job;
 - If we take more time to educate people to think about what they are doing there may be less errors on the job;
 - While ever there is a human element involved there is a greater risk of accidents. Rules and regulations help to control these risks.”
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Sector	Becoming accustomed to risks Agree = disagree	Risks are taken because:	Errors are made because:	Accidents occur because:	Fatality
Underground coal	Agree	Fatigue	Work pressures = haste	Poor equipment design	Very high
Underground metal	Agree	Fatigue	Haste	Taking unnecessary risks	High
Open cut coal	Agree	Fatigue	Haste = forgetful = carelessness	Taking unnecessary risks	High
Open cut metal	Agree	Fatigue	Haste	Taking unnecessary risks	High
Quarries	Agree	Easiest way to do it	Haste	Poor procedures	Very high
All coal	Agree	Fatigue	Haste	Taking unnecessary risks	High
All metal	Agree	Fatigue	Haste	Taking unnecessary risks	High
All underground	Agree	Fatigue	Haste	Taking unnecessary risks	Very high
All open cut	Agree	Fatigue	Haste	Taking unnecessary risks	High
All management	Disagree	Easiest way to do it	Haste	Taking unnecessary risks	Low
All operators	Agree	Fatigue	Work pressures	Taking unnecessary risks	Very high
All contractors	Agree	Fatigue	Haste = carelessness	Taking unnecessary risks	High
All employees	Agree	Fatigue	Work pressures	Taking unnecessary risks	Very high
Sweden	Agree	Easiest way to do it	Carelessness = haste	Taking unnecessary risks	Very low
Canada	Strongly agree	Various	Carelessness	Taking unnecessary risks	Very low

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- ## What makes an Effective Rule?
- simple
 - concise
 - understandable
 - practical
 - relevant
 - easy to remember
 - clear and avoids confusion
 - well communicated
 - flexible
 - well documented
 - up to date
 - proactive
 - involves the workforce
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- ## What makes an Effective Rule?
- has the reasons for it explained
 - good communication and consultation
 - involves risk assessment
 - makes people think
 - makes people aware and alert
 - makes people foresee possibilities of incidents
 - makes people responsible
 - makes people react automatically
 - makes people look after each other
 - reduces fatigue
 - site specific rather than general
 - aligned with common sense
 - provides minimum standards
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- ## No Standing Zone Rule
- Remote controlled continuous miners
 - “an area where people can not pass or work unless appropriate isolation procedures for the continuous miner have been carried out.”
 - 112 responses
 - 50% had a fair idea
 - zero % correctly defined
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Adult Learning Model

STAGE OF LEARNING (traditional nomenclature)	STAGE OF LEARNING (revised nomenclature)	DESCRIPTIONS OF WORKFORCE BEHAVIOUR (from various researchers)
Unconscious Incompetence	DIRECTED	Lack of knowledge (what rules?); Still learning what can go wrong; Directly finding or breaking rules; Person directed and does task without thinking; Don't know you don't know.
Conscious Incompetence	SYSTEMS	Flooded with and learning the rules; Putting hazards into a risk management system; Safety management systems; Planned risk management; Know you don't know.
Conscious Competence	COMMUNICATION	Following the rules; Communication is interactive, effective and two way; Know you know.
Unconscious Competence	AUTOMATIC	Safe work habits; advanced emergency preparedness; Automatically act to avert danger; Risks managed through to constant awareness; Responsive and disciplined workforce taking responsibility for their own safety and the safety of others; Mental control; autopilot; do it without thinking.

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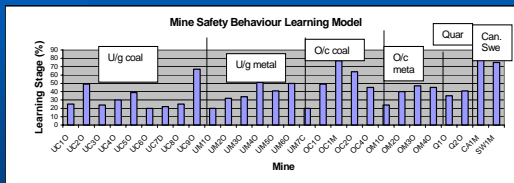
Safe Behaviour & Safety Performance

STAGE OF LEARNING	ALLOCATED POINTS (SAFE BEHAVIOUR SCORE)	SAFETY PERFORMANCE
DIRECTED	0-25	Very high LTIs; High potential for fatalities and disasters;
SYSTEMS	26-50	Moderate LTIs; High potential for fatalities and disasters;
COMMUNICATION	51-75	Low LTIs; high potential for fatalities and disasters;
AUTOMATIC	76-100	Nil or very low LTIs; low potential for fatalities and disasters;

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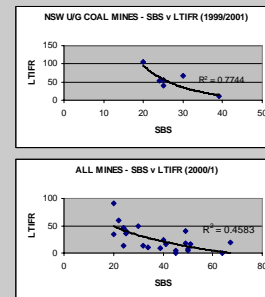
Analysis of Mineworker Behaviour



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Correlation SBS with Safety Performance



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Significance of Safe Behaviour Score

- Through a relatively straightforward process, it is possible to analyse the attitudes and perceptions of an employee group at a mine.
- From this analysis, it is possible to classify and measure their behaviours according to relatively objective criteria.

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Regulatory Environment, Rules & Safe Behaviour

- Is there a link between:
 - the regulatory environment, imposed by government,
 - mine-specific rules and procedures, and
 - safe behaviours exhibited by mineworkers?

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Regulatory Environment

- Enabling
- Based on risk assessment
- Safety management systems
- Guidelines
- Codes
- Australian Standards

Coal Mine Safety & Health Act 1999
 Coal Mine Safety & Health Regulation 2001
 Mining & Quarrying Safety & Health Act 1999
 Mining & Quarrying Safety & Health Regulation 2001

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Effective Rules

- simple
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- involve workforce
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 - look after each other
- reduce fatigue
- site specific rather than general
- set minimum standards

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Characteristics of Safe Behaviour

- knowledge and understanding of rules
- applying the rules at the right time
- understanding the rule and regulation making process and the obligations for the mineworker
- foresight and vigilance in detecting hazards
- compliance with and not deviating from the rules
- avoiding risks
- minimising errors
- willingness to be involved in safety matters
- taking time before and during a task to assess hazards
- positive reasons for working at the mine
- caring for others
- taking responsibility for own safety rather than being fatalistic

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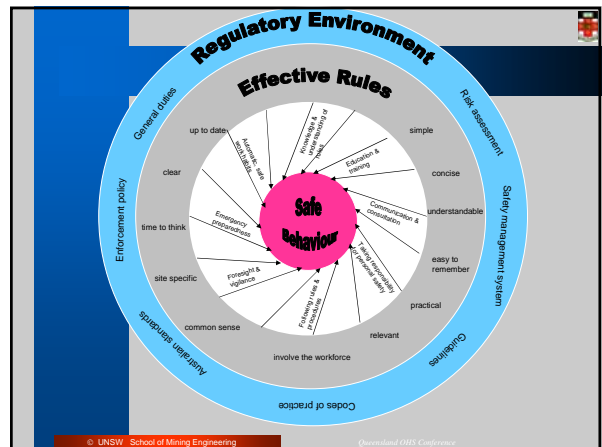
Characteristics of Safe Behaviour

- worker's goals aligned with management's
- worker involvement in risk assessments, safety management systems
- targeted education and training to suit the individual and his/her cognitive abilities
- refresher training including the use of computer simulation or virtual reality
- barriers to prevent errors becoming losses
- effective, interactive and genuine two way communication
- establishing a "what if" capability, constant vigilance
- adopting automatic, safe work habits
- emergency preparedness

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The Road to Safe Behaviour

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Where to from here?

- Work has just begun
 - More mines = larger database = refined model
 - Rules
 - ➔ Writing better rules, SWPs etc
 - ➔ Best way to learn a rule
 - words, diagrams, models, VR, at the face?
 - Quarries
 - Sweden & Canada – can we learn from them?

A Safe Behaviour Model for the Mining Industry

