Road safety beyond mine gates

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Abstract

Incidents that occur within mine sites, particularly those with serious injury or fatal outcomes, usually feature prominently in media reports, causing additional pressure on mining operations. This is one of the reasons why mine operators put a lot of effort into dealing with safety issues within the confines of active mines.

However, mining activities also have a significant influence on safety that extends 'beyond mine gates'. One of the examples is traffic safety on roads generally not considered as directly associated with mining activities. This network of 'supporting roads' includes site access roads, railway access roads, service roads, exploration roads, as well as public roads used by mining operations.

Unfortunately, serious accidents occur on these roads but do not receive the same level of scrutiny by the media or attention by mining operators. Some of the hazards associated with driving beyond mine gates include:

- inadequate road configuration
- hazardous roadsides
- interaction with fauna
- unsafe speed
- long commute
- fatigue
- lack of training.

This paper will summarise a range of practical measures aligned with Safe System principles that can be implemented to reduce the risk for road users on the supporting roads network.

Introduction

Mining operations and transportation

Mining operations are complex organisational systems established to provide end users with access to natural mineral resources. They consist of production elements (sequences) which are linked and rely on each other for a successful delivery of desired organisational outcomes. Transportation, under all modes – road, rail, sea and air – is one of these intrinsic elements that is critical for safe and efficient mining operations.

Being such an intensive, over-arching and high-risk activity it is of no surprise to see that transportation incidents continue to feature heavily in mining incident statistics.

Transportation on mines varies in scope, mode, vehicles, drivers and networks on which it takes place. Factors that affect the safety of people involved in transportation include interaction between large and small vehicles, fatigue, inexperience, sub-standard roads, railway crossings, speed and others.

Efficiency (productivity) and safety of transport chains on mining operations are linked and inter-related. As a consequence, mining organisations dedicate significant effort to ensuring safety of their transportation systems.

Because productivity gains are often best controlled and managed within active mining areas, i.e. ensuring that mining haulage equipment operates as efficiently and safely as possible on their journey between loading and dumping, mining organisations focus most of their efforts on ensuring safety on a limited network of primary haul roads associated with this essential mining task. These roads form the primary mining road networks and include haulage routes linking loading areas, waste dumps and ROMs or processing/rail loading areas.

Some of the improvements that are implemented on these networks include developing road design guidelines, road safety auditing, proximity detection technologies, fatigue management technologies, separation of incompatible road users and others.

As a consequence, there has been a noticeable improvement in the condition of roads and traffic management practices on these primary mining road networks. While the industry incident records are yet to reflect these improvements as statistical trends, a comparison between the condition of mining road networks now and just a few years ago suggests that safety gains will follow.

Mining transportation beyond the confines of mines

While significant improvements have been and are still being made by mining organisations in ensuring improved efficiencies and safety on primary mining road networks, similar efforts are not clearly evident in addressing safety issues on other roads that are directly or indirectly affected by mining activities.

As mining production chains rely on comprehensive transport systems across transport modes, it is important that a more holistic approach for ensuring safety (and, consequently, productivity) of mining transportation systems is considered.

Mining organisations should investigate opportunities of extending their efforts on improving safety on roads which are outside primary mining road networks but directly or indirectly affected by their operations. These roads include both secondary (supporting) mining roads as well as public roads.

The supporting mining road network supports activities such as site access, exploration, railway access, servicing of critical infrastructure (e.g. water, electricity or gas supply, etc.).

Most mining operations rely on public roads for transportation of materials, goods and consumables to their operations, transportation of their product to ports, processing plants or off-loading facilities, and for commuting by their workforce.

The variety of users, vehicles and road conditions associated with these 'supporting' (secondary) road networks creates a mix that may cause unsafe events. In fact, there are, unfortunately, numerous examples of crashes on secondary roads that could be related to mining operations.

However, not all of these events are readily attributable or linked to mining operations in relevant incident/crash databases managed by road authorities or mining legislators. As a consequence, the extent of the impact of mining operations on public roads crashes cannot be clearly identified and quantified.

It is therefore important that mining organisations start to recognise their impact on and exposure to traffic risks on secondary road networks and implement effective, appropriate and relevant improvement measures for managing these risks. In doing so, it is important to manage these risks under a Safe System risk management framework that is used by Australian road authorities.

The Safe System is the current national approach for improving road safety by considering all four key components of road safety: users, vehicles, speed and road environments, as well as their interaction.

The basic premise behind the Safe System is the appreciation of the limitations of the human body to absorb physical forces as well as the acknowledgement that road users make, and will continue to make, mistakes while driving and crashes will continue to occur despite prevention efforts. Therefore, the road system should be designed to expect and accommodate human error [1].

Hazards on roads beyond mine gates

Managing road hazards and users on roads that are not under the direct supervision and control of mining organisations is more challenging than managing safety within the confines of mining operations. Some of the issues with managing traffic risks 'beyond mine gates' include:

- Two-faceted safety attitude (safety culture) of parts of the workforce; exhibiting a positive and exemplary safety attitude while at work and surrounded by co-workers or supervisors but having a different attitude in either 'their own time' (i.e. before or after work hours), or on duties where they are not supervised (e.g. lone driving along railway access tracks).

- Some supporting mining roads are used infrequently and carry low traffic volumes thus reducing their perceived 'risk rating' with mine management and hence not warranting major spending on their improvements.

- Private organisations usually have little, if any, control over public road networks.

Consequently, some of the hazards that receive due scrutiny when located on primary mining networks tend to be overlooked and not addressed appropriately if located on secondary road networks.

Some of these hazards include inadequate road configuration, hazardous roadsides, interaction with fauna, unsafe speed, fatigue, lack of training for driving on remote and unformed roads, and others.

Strategies for improving safety on public roads

Public roads are owned and managed by the respective road authorities (local government, state government, etc.) and as such, private entities generally do not have much influence over this component of their transportation networks.

In order to improve the safety of its commuting workforce and local communities, as well as to ensure efficient transportation of materials and goods, it is important that organisations take a proactive approach aimed at establishing themselves as critical stakeholders for the management of affected road networks.

When considering addressing road safety issues on public roads it is important to note the following:

- Any improvements on public roads should be done in consultation and collaboration with the respective road authority.

- Road authorities manage their road networks on tight budgets; there are often other priorities on their networks that dictate how their budgets are spent. Consequently, private contributions are often required to achieve the desired outcomes that are not aligned with road authorities' priorities.

Recognising the importance of managing the safety of both mining and general traffic (which, in many mining regions of Australia, can usually be linked to a mining operation, i.e. family, suppliers, contractors, etc.) on public roads, there has been an emergence of regional community and industry-based road safety groups or initiatives around the country. Examples of these include:

- Mining Industry Road Safety Alliance (MIRSA), central Queensland

MIRSA is an alliance of coal mining companies and associated contractors and service providers established to improve road safety on regional highways by educating employees and contractors about road safety issues and implementing a range of safety initiatives such as fatigue management sessions, road upgrades, management of wide loads, education of young drivers and conducting various safety campaigns [www.mirsa.com.au].

- Road Accident Action Group (RAAG), Mackay/Whitsunday region, Qld

RAAG has been established to ensure a coordinated and collaborative approach to reducing the incidence and severity of road crashes on Bruce Hwy between Proserpine and St Lawrence, Peak Downs Hwy and associated western arterial roads by targeting identified crash causal factors through driver education programs and initiatives [www.raag.com.au].

- Industry Road Safety Alliance, South West and Peel region, WA.

The Industry Road Safety Alliance has been established as a partnership between local police, government agencies, industries and communities to address regional road safety issues stemming from major infrastructure projects and associated increases in traffic loads on an already busy and relatively restricted road network. The achievements of the alliance, hailed by the Western Australian Office of Road Safety as a model worthy of adoption by other industries and communities, include improvements to street lighting, car parks and roads as well as heavy haulage curfews, bus services, speed restrictions and driver education campaigns [2].

Such groups and initiatives have been proven to be effective in dealing with road safety issues on their regional road networks. It is a model that could be applied in other areas where mining organisations have been identified as a key stakeholder in a regional road safety issue.

The importance of such initiatives is further demonstrated by a recent finding by the WA police that 80% of fatalities in the South West region of WA were local residents [3].

Road safety assessments and route selection

The Australian Road Assessment Program (AusRAP) has been initiated by the Australian Automobile Association and all state automobile clubs to assess roads for their risk rating based both on historical crash data and also on the intrinsic level of safety of the road itself (i.e. alignment, single or divided carriageway, roadside hazards, provision of barriers, etc.).

The results of these assessments have been presented in the form of network maps with ‘star rating’ similar to the Australian New Car Assessment Program (ANCAP) safety rating of new vehicles.

So far, the AusRAP assessment has covered the entire National Highway Network and most national highways. The AusRAP results can be accessed on AusRAP (www.ausrap.org) or state automobile club websites or by contacting the clubs directly.

The AusRAP rating can be a valuable tool for mining organisations to determine preferred routes for their transportation or commuting requirements. It can identify road sections which have been rated as being unsafe (Figure 1) and implement appropriate procedural or engineering measures for mitigating hazards (in consultation with the road authorities). Some of these measures can be relatively affordable and yet yielding significant crash reduction improvements. For example, the installation or improvement of linemarking and guideposts can reduce crash potential between 10 and 40% [4].

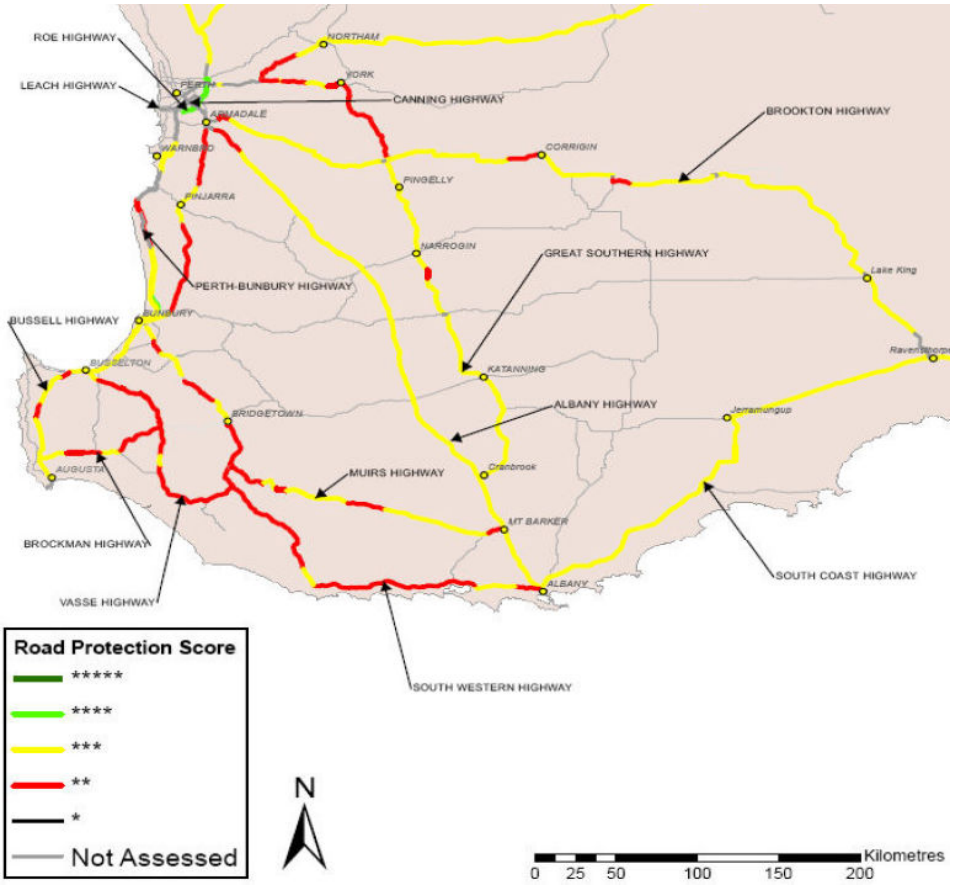

Figure 1: AusRAP star rating of WA highways [5]

Heavy haulage scheduling

In addition to route selection for transportation needs, transportation scheduling is a very important safety improvement tool on public roads.

Heavy haulage transport should be planned and scheduled to minimise the impact on the affected road network. Transport schedules should avoid seasonal or daily traffic peaks on the surrounding public road network. This requires identifying major holiday (seasonal) peaks (e.g. the well-known busy

Easter holiday weekend in South West WA) or times of major traffic flows (e.g. start and finish of school hours, finishing times of other major employment centres in the region) where certain roads or unsafe/busy intersections should be avoided.

Interaction with railway traffic

It has been recently reported that train drivers experience hundreds of near-miss incidents at level crossings. Inevitably, some of these near-misses turn into incidents with, frequently, catastrophic outcomes.

Road authorities have recognised the magnitude and complexity of this issue on their networks. However, the most effective countermeasure of installing grade-separated crossings, is cost prohibitive for implementation on a large scale.

Research suggests that unlike other fatal road crashes, those at railway crossings are less likely to involve fatigue, speeding, drugs or alcohol. Instead these crashes are more likely to be attributed to errors in driver behaviour such as risk taking, not stopping or giving way, running the flashing lights, etc. [6]

It is thus suggested that when grade-separating of crossings is cost prohibitive for the level of perceived risk, mining organisations should, in conjunction with minor improvements to visibility and conspicuity of level railway crossings, develop targeted campaigns aimed at educating the workforce and communities about hazards associated with railway operations. A similar campaign has been applied and reported as having positive results on a private railway network in the Pilbara in Western Australia.

Commuting

Traffic risks for the commuting workforce on public roads are closely related to the accommodation arrangements with residential operations having different issues to those experienced by fly in-fly out (FIFO) or drive in-drive out (DIDO) operations.

Amongst the industry and stakeholders, there are opposite views on the benefits of FIFO/DIDO or residential arrangements. On the one hand, FIFO and DIDO are being considered as negatively impacting on regional mining communities. On the other hand, FIFO and DIDO are seen as the only opportunity to bring the workforce to the operations.

While the social impact of FIFO is currently being fully researched and understood, from a traffic safety perspective, FIFO can be considered as a safer alternative to both residential and DIDO alternatives because of the following reasons:

- companies usually organise transport to work sites with safe drivers and safe vehicles
- shorter commute

- reduced risks of fatigue caused by workforce engaging in secondary employment.

Some companies with residential operations try to deal with commuting risks by providing dedicated bus services as a safer alternative. However, it is not uncommon for bus services to never get accepted by the workforce unless companies are actively involved in their promotion, instead of commuting by private vehicles. The promotion of buses as a safer alternative to private vehicles [7] is important in establishing people's habits.

Similarly to other crashes in regional parts of Australia, fatigue and speeding are often identified as causative factors behind commuting crashes, while not wearing seatbelts still remains a factor in the severity of the crash outcomes. This situation is not dissimilar to occurrences on secondary mining networks.

A report recently released by RAC and WA Police [8] provides some disappointing statistics on road safety on rural roads in WA:

- disproportionately high total number of fatal crashes on regional roads compared with metropolitan roads (30% higher)
- over-representation of 20-29 age group
- alcohol and speeding, alone or in combination, have been found to have caused 45% of fatal crashes
- 65% of fatal crashes involved a single vehicle
- 31% of fatalities have been caused by not wearing seatbelts while an observational study [9] identified a 10% rate of non-wearing of seatbelts amongst all drivers in regional WA.

These statistics show that a significant proportion of fatal crashes on regional roads are caused by human factors.

Fatigue

Driver fatigue is a well-documented causative factor behind numerous crashes on mining and public roads.

Mining organisations are encouraged to establish appropriate and comprehensive fatigue management policies and systems that would ensure not only that the effects of fatigue experienced while at work are managed, but also that the workforce arrives at work and home after work without being fatigued. A major challenge is a potential, albeit required, intrusion on people's private lives – i.e. outside their work hours. In order to achieve this it is important that the fatigue management efforts are not directed only to the workforce but should also involve families and communities. This is particularly important for those operations whose workforce may be having long commutes directly from their workplaces to residential areas scattered a long distance throughout a region.

The impact of fatigue on commuting traffic has been highlighted in recent findings handed down by coroner Annette Hennessy [10] in relation to two fatal crashes on central Queensland roads. In these two crashes, fatigue was found to be a possible causative factor exacerbated by bad weather. The findings included 24 recommendations aimed at addressing the issue of driver fatigue especially linked to the mining industry. One of these clearly states:

> That mine operators fully explore control measures to reduce or eliminate the risks associated with workers commuting whilst fatigued.

The issue of long commutes and fatigue is not restricted to Queensland with examples recorded on roads in other states. It is another example where the mining organisations will be required to manage road risks 'beyond mine gates'.

Safe System improvements

In following the Safe System approach for improving road safety, mining organisations should develop a plan to appropriately and comprehensively manage road safety by considering vehicles, drivers, speed and roads.

Some of the suggested improvements that could be considered for implementation on roads beyond mine gates are listed below.

- Vehicles
  - reduce the number of private vehicles used for commuting purposes
  - introduce and promote bus services for commuting
  - company vehicles and hire vehicles used for company purposes should be fit for purpose and with a minimum of a five stars NCAP rating.
- Drivers
  - ensure drivers receive appropriate training for specific driving conditions (e.g. advanced 4WD training for driving on exploration tracks)
  - implement fatigue management systems and technologies
  - provide education about road hazards (e.g. railway crossings, speeding, fauna, etc.)
  - engage the community
  - consider the implementation of in-vehicle monitoring system (IVMS) technologies to influence positive behavioural changes amongst drivers.
- Speed
  - review appropriateness of speed limits (not too high and not too low)
  - implement speed enforcement on public and private roads.

- Roads and roadsides
    - conduct regular inspections and audits
    - install rumble strips and enhanced delineation to improve night-time driving
    - clear roadsides of hazardous features such as large trees, power poles, rocks or steep embankments
    - provide road barriers only if hazards cannot be removed
    - ensure that road surfaces are suitable and safe for the intended vehicles and use.

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