

Comparison of Experience-Based and Evidence-Based Safety Risk Management Features for Heavy Vehicle Transport Operations

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Abstract

Independent research¹ into safety management features that distinguish between lower insurance claimers and higher insurance claimers identified 14 characteristics that show clear evidence of efficacy in safety management in trucking operations. Findings of this research were compared against risk management factors included in the risk assessment process adopted by a major truck insurer. When these were compared with the Zurich Risk Engineering (ZRE) grading criteria substantial consistency was found. There were some inconsistencies as well.

Background

Insurance companies have an interest in the progressive reduction in financial losses by those that hold policies with them. Zurich Financial Services Australia employs risk engineers to provide expert advice to insurance policyholders about their specific risks and risk control practices. Zurich Risk Engineers have developed a risk assessment and grading system through their experience collectively over the past 20 years. They offer this service to their policy-holders, enabling them to make informed decisions about the level of risk they are prepared to tolerate. The risk assessment criteria for operating trucks are listed in 4 topic areas:

1. *Business and journey risk factors*, where area of operations, commodities and loads, concentration of asset values, fatigue exposures, road and weather conditions, site risks, and vicarious liability are assessed;
2. *Driver risk factors*, where driver assessment and training, driver contact practices, driver maturity and health management, driver profile, driver qualification and selection, and driver work conditions and turnover are assessed;
3. *Vehicle risk factors*, where safety features for heavy vehicles, vehicle age and specification, vehicle maintenance and inspection, and vehicle security in transit are assessed; and
4. *Management controls*, where drug and alcohol policies, fatigue risk management, fleet performance management, fleet risk management policies and procedures, incident reporting and investigation, loss history, management expertise and quality, mobile phones/distractions, and route planning are assessed.

This examination enables a rating or grade of risk for policy holders. Based on risk gradings, the Zurich Risk Engineer then provides specific risk management improvement ideas².

As there has been scant research evidence to base this advice on, risk engineers have relied on their experience and observations to define risk and risk control criteria. A study of evidence-based safety management practices (Mooren, 2016) can now inform the approach taken to risk assessment and safety management. The culmination of three-part study conducted by the University of NSW provided a set of characteristics of trucking companies that are at least associated with lower claims for safety related incidents. A strategic review of the scientific safety management literature (Mooren et al., 2014a) identified characteristics with some empirical evidence of effectiveness was

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² For more detail on ZRE risk grading and advice on improvements see:
https://www.zurich.com.au/content/risk_features_home/motor_fleet/truck.html

first carried out. Then a survey of 50 Australian companies that operate heavy vehicles (Mooren et al., 2014b), using testing the characteristics found in the literature review. Finally, an in-depth investigation of 15 companies surveyed to validate the survey findings.

This research identified 17 characteristics that distinguished companies with good safety performance from companies with poorer safety performance. This set of 17 characteristics are most likely not an exhaustive set of elements or characteristics/practices. However, unlike many other studies of effective safety management characteristics, those found in this research were validated by triangulating the results of three consecutive studies.

The characteristics were then reframed as implementable safety management practices and grouped into logical topic areas. This involved combining two characteristics relating to driver remuneration into one. That is, the characteristics “pay by time worked” and “pay to wait” were combined as “drivers are paid for all hours worked regardless of task or activity”. Also, “pre-trip inspection checks” were linked to having “fewer defect notices” for practical purposes, forming a single practice, “maintenance and pre-trip vehicle checks ensure that trucks are in safe conditions for all trips”. This resulted in a total of 14 safety management practices, as shown in Table 1.

Table 1 Evidence-based safety management characteristics and practices

Group	Topic	Study finding – validated characteristics	Evidence-based management practices
Risk assessment and management	Fleet	Safety features in choosing vehicles	All appropriate safety equipment, including safety features on trucks, is provided
		Fewer defect notices Pre-trip inspection checks	Maintenance and pre-trip vehicle checks ensure that trucks are in a safe condition for all trips
	Journey risk assessment	Check traffic conditions	Route risk assessments are done for all delivery journeys
		Speed limiting on poorer quality roads	
	Site risk assessment	Safety audits at own sites	Site and job risk assessments are regularly carried out
	Monitoring	Document fatigue management	Monitor fatigue management practices
Response to safety concerns	Time limits on response to drivers' safety concerns	All managers respond quickly to safety concerns raised by drivers	
Driver risk management	Recruitment/employment	Check accident history	Recruitment criteria focus on safe driving records
		Fewer drivers over 60	Driver fitness is assessed to ensure drivers' abilities to safely carry out all job duties
	Pay/conditions	Pay by time worked (not by trip or load)	Drivers are paid for all hours worked regardless of the task or activity
		Pay to wait	
	Training	Experienced drivers check/coach other drivers	Training for drivers is based on individual tuition by experienced safe drivers
Discipline	Formal investigation of unsafe behaviour	Identified unsafe behaviours are formally investigated	
Incentives	Offer incentives for safety innovations	Drivers are given incentives, including monetary incentives, clearly linked to work safety efforts	
Safety culture	Communication	Encourage driver input into WHS	Managers encourage driver input to WHS decision-making
		Show management commitment to safety management	Managers take responsibility and show leadership in making safety a clear priority

The 14 practices were then grouped into topic areas and the topic areas further grouped under headings:

- Risk assessment and management (6 practices) – covering topics relating to fleet, environment and job risk safety management;
- Driver risk management (6 practices) – covering driver employment, remuneration, training, monitoring, discipline and incentives; and
- Safety culture management (2 practices) – covering communication management.

Based on the weight of the safety literature it is very likely that moderating influences among some or all of the practices exist, particularly the moderating effect of the safety culture management practices on some or all of the other practices.

Method

The 14 characteristics Table 1 were compared with factors of the Zurich Risk Engineering (ZRE) system for truck fleet risk management. The aim was to see how closely ZRE system compares to the 14 evidence-based characteristics, and to explore possible refinements to improve risk assessment and safety management improvement processes. The key findings of the UNSW study (Mooren, 2016) were compared with the ZRE system as described³ and confirmed by the two Zurich Risk Engineers who co-authored this paper.

Results

While the 14 characteristics found in a recent study do not represent a comprehensive set of safety management characteristics, the ZRE system closely parallels many of these characteristics. A summary of the comparisons is presented in Table 2.

While there are parallels between the 14 evidence-based characteristics and the ZRE grading system, there are some differences as well. An analysis of the similarities and differences are presented under each topic below, highlighting where the ZRE system has fully or partially included the 14 evidence-based characteristics as well as anomalies where the UNSW study did not find support for safety practices being advocated.

Fleet risk The UNSW study identified that important fleet management characteristics that distinguished between higher- and lower-claiming companies were, *all appropriate safety equipment, including safety features on trucks, is provided, and maintenance and pre-trip vehicle checks ensure that trucks are in a safe condition for all trips.*

With respect to vehicle risk management the ZRE grading system includes safety features for heavy vehicles, vehicle age and specifications, and vehicle maintenance and inspections. They also suggest that vehicles are comfortable and adequate for the tasks. In addition, they advise that maintenance programs should be proactive, recommending that a policy exists that requires all drivers to carry out a regular (daily) vehicle inspection/check. There is good agreement about the provision of all appropriate safety equipment and the need for maintenance and pre-trip inspections.

However, the ZRE system advice about truck replacement considering vehicle age is not consistent with the finding from the UNSW study indicating that vehicle age is not an important safety factor. Indeed, the study found that higher-insurance claimers had younger truck fleets than lower-claimers.

³ https://www.zurich.com.au/content/risk_features_home/motor_fleet/truck.html

Table 2 Comparison of ZRE grading factors⁴ and 14 evidence-based safety management practices

Topic	ZRE grading factors	Evidence-based management practices
Fleet	Safety features in vehicles have been determined through a risk assessment process.	All appropriate safety equipment, including safety features on trucks, is provided
	Maintenance program is proactive. A policy exists that requires all drivers to carry out regular (daily) vehicle inspection/check.	Maintenance and pre-trip vehicle checks ensure that trucks are in a safe condition for all trips
Journey risk assessment	Ensure that medium, long and infrequent trips are suitably planned. Regular route assessment.	Route risk assessments are done for all delivery journeys
Site risk assessment	Ensure that assigned parking areas are not in proximity to storage or manufacture of dangerous and/or combustible materials.	Site and job risk assessments are regularly carried out
Fatigue Monitoring	Fatigue monitoring systems are applied consistently across the organisation.	Monitor fatigue management practices
Response to safety concerns	The Fleet Risk Manager is 'actively' responsible for improving the loss performance of the fleet.	All managers respond quickly to safety concerns raised by drivers
Recruitment/employment	No more than one (1) on-road crash in the past three years. Pre-employment aptitude/behavioural driver assessment	Recruitment criteria focus on safe driving records
	Frequent proactive measures such as medical checks, eye exams and training is essential to control losses from a maturing workforce.	Driver fitness is assessed to ensure drivers' abilities to safely carry out all job duties
Pay/conditions	Pay and benefits package are above national averages to attract top performers.	Drivers are paid for all hours worked regardless of the task or activity
Training	Ensure all new drivers undergo mentoring / buddy system training, if not formal on-road training, for the first weeks of employment.	Training for drivers is based on individual tuition by experienced safe drivers
Discipline	Ensure that an incident investigation form is established to facilitate investigations.	Identified unsafe behaviours are formally investigated
Incentives	Pay and benefits package are above regional/national averages. (No additional safety incentives are included.)	Drivers are given incentives, including monetary incentives, clearly linked to work safety efforts
Communication	Procedures to incorporate driver in the management process including daily planning.	Managers encourage driver input to WHS decision-making
	Create measureable key performance indicators	Managers take responsibility and show leadership in making safety a clear priority

Journey and site risk assessment The UNSW study found that lower claimers were more likely than higher claimers to check traffic conditions and limit speeds on poorer quality roads. However, with regard to GPS monitoring, the UNSW study found that GPS monitoring was more often used by high insurance-claiming companies than by low-claiming companies. However, the provision of satellite phones for drivers working in remote locations is supported by the research. Regarding journey and site risk assessments, ZRE includes route planning for safe operations. They suggest that route plans are developed for all trips by experienced dispatchers or drivers, and that good communications between dispatcher and driver are important. Sat-Nav or GPS are recommended to assist drivers on route. In addition, they urge managers to ensure that one-off routes are evaluated for hazardous road features, speed limits, weather conditions, etc. Hazards may include: built up areas, schools, hospitals that are passed on route. This is consistent with the evidence-based characteristic, *route risk assessments are done for all delivery journeys*. However, GPS monitoring systems were found, in the UNSW study, to be more prevalent in higher-claiming versus lower-claiming companies.

⁴ It is noted that some of the ZRE risk management factors are presented as what they are looking for as positive indicators of good practice and some are listed as risk improvement ideas.

The UNSW study found that systematic site risk assessments or job safety analysis procedures were more prevalent in companies with lower insurance claims and they provide ideas for encouraging and managing regular risk assessments. One lower claimer provided a monetary incentive for completing risk assessments each week. Another lower claimer showed documents outlining specific risk assessment procedures for every customer site. Some of the managers in lower-claiming companies provided copies of job and site risk assessment forms but they often admitted that the assessments were not regularly carried out.

The ZRE system and UNSW study findings are in agreement with regard to site risk assessment, that *site and job risk assessments are regularly carried out* is an important safety management characteristic. However, the focus of site risk in the ZRE system is concentrated mostly on the identification of fire and security risks. They suggest that if required to deliver to hazardous sites, companies should ensure there are at least well-developed access and egress plans.

Fatigue monitoring The ZRE system advises that good risk management involves proactive fatigue controls that are established in advance of legislative compliance or major loss; and insist that fatigue monitoring systems are established and applied consistently across all operations of the organisation. The UNSW study found evidence to support inclusion of *monitor fatigue management practices* in good safety management. While lower claimers were vigilant in checking driver fitness prior to delivery journeys, higher claimers were not vigilant. Fatigue and fitness for duty are documented and are always checked by managers in lower-claiming companies, but not always by those in higher-claiming companies. The pre-trip checks include ensuring that both driver and vehicle are fit for the tasks assigned each day. Higher claimers left the responsibility for risk assessment largely to the drivers. For example, a manager in a higher-claiming company said that working out breaks during the journey is up to the driver, whereas a manager in a lower-claiming company advised that he sits down with each driver and together they plan the tasks.

Response to safety concerns The UNSW study found that managers in lower-claiming companies are more likely than managers in higher-claiming companies to put time limits on their responses to drivers' safety concerns. Regardless of whether there were formal policies about time limits, drivers in lower-claiming companies consistently said that managers respond quickly to any safety concerns they raise. The practice, *all managers respond quickly to safety concerns raised by drivers* is an effective safety management practice. The ZRE recommended management controls do not specifically call for prompt responses to safety concerns raised by drivers. A risk improvement suggestion is to "ensure that responsibility for facilitation of the incident investigation system is clearly appointed", but it stops short of suggesting timeliness of responses to drivers' concerns.

Recruitment and employment The UNSW study formed a convergence of research evidence to confirm the importance of using *driver recruitment criteria that focus on safe driving records*. From a safety perspective, testing the safety risk background and risk propensity of drivers, including accident histories, has been found to be an important safety management practice (Darby et al., 2009). The recruitment of drivers by lower claimers involved more comprehensive safety focused assessment than did higher claimers' recruitment processes, including checks on driving accident histories. Higher claimers consistently checked references, but were less likely to check accident histories or safety records of drivers when recruiting. With regard to recruitment, Zurich Risk Engineering suggest that written qualification standards for the recruitment of drivers should be consistently applied in the recruitment process. These qualifications include, among others, "no more than three minor road rule violations in the past five years, no serious (drink driving, reckless driving, etc.) road rule violations in the past five years, no more than one on-road crash in the past three years, and satisfactory completion of a pre-employment aptitude/behavioural driver assessment." They say that companies should establish procedures that require at least one upper level manager to review, agree and sign-off on the field supervisor's decision to hire, and that specific characteristics required of drivers are consistently used in all driver recruitment processes.

This is consistent with the evidence-based characteristic, *recruitment criteria focus on safe driving records*.

The UNSW also found that while higher claimers were more likely to employ drivers over the age of 55 than were lower claimers, the important physical aspect of drivers relating to safety was their *fitness and abilities to safely carry out all job duties*. Assessments were carried out at the recruitment stage and throughout the employment tenure for each driver to ensure that drivers are not at risk of injury through lack of fitness or capacity to carry out work. The ZRE system included advice on good practices in driver selection and qualifications, driver maturity and health management, and driver work conditions and turnover. It also suggests frequent proactive measures such as medical checks, eye exams and training to designed to help drivers recognize and overcome limitations is essential to control losses from a maturing workforce.

Pay/conditions The UNSW study confirms the importance of ensuring that *drivers are paid for all hours worked, regardless of the task or activity*. Drivers not paid for all hours can tend to make up for their loss by working extra hours or extra jobs. Also, importantly, if they are paid on the basis of productivity, they may be more likely to take risks such as speeding and driving long hours (Hensher and Battellino, 1990; Mayhew and Quinlan, 2006). It is argued, in the literature cited, that paying drivers for all hours worked gives them stability and certainty of income and they are less likely to work in an unsafe manner. A number of studies into pay methods have demonstrated that the method of driver pay influences safety outcomes (Hensher and Battellino, 1990; Hensher et al., 1991; Williamson, 2007). The UNSW study also confirmed, empirically, that lower claimers were more likely to pay drivers for the time they spent waiting to be loaded or unloaded, and that lower claimers were more likely than higher claimers to pay drivers for the time worked instead of by the trip or truckload. While the ZRE system does not address the matter of paying drivers for all hours worked regardless of work activity, it advises that good practice is where pay and benefits packages are above regional/national averages to attract top performers.

Training The UNSW study found that *training provided for drivers is based on individual tuition by experienced drivers*, distinguishes between lower and higher claimers. In general, the research results on safety benefits from driver training are mixed (American Transport Research Institute, 2008) and this research found there was little difference between lower and higher claimers in respect of the amount of safety related training provided. In fact higher claimers were found to be more likely to use standardised driver training courses. However, lower claimers were more likely to provide safety training tailored to address the specific risks of the job tasks performed and to be based on perceived drivers' skill deficits, through using experienced drivers to train or coach less experienced drivers or drivers found to have skill deficits. This approach is consistent with other research (Robotham, 2001), that identified that specific safety learning needs related to job tasks is an important training success factor. Regarding training, ZRE include driver assessment and training in their grading system. They suggest that on-going/periodic reviews of driving awareness and skills for all drivers be carried out – based either on collision history or time period. They suggest that companies ensure all new drivers undergo mentoring / buddy system training (i.e. direct driving supervision by an experienced senior driver), if not formal on-road training, for the first few days / weeks of employment. Further, they advise that good practice is to provide driver training (i.e. at least driver awareness training if not formal on-road training) for those drivers that have been identified as 'Increased Risk' and provide ongoing 'refresher' training in driver awareness and / or on-road skills for all drivers (i.e. either periodically or based on collision performance).

Discipline The evidence from the UNSW study supports the inclusion of the practice of formal investigation of unsafe behaviours. Probst and Estrada (2010) found that employees' perceptions of safety policy enforcement is a predictor of accidents and accident reporting. If discipline is not consistently applied to all drivers the actions may be seen as excuses to punish drivers for simply

being unpopular with management. In the UNSW study, lower-claiming companies had in place more consistent approaches to safety related disciplinary investigations than higher claiming companies. Interestingly, the UNSW study found that higher claimers actually had more safety policies than did lower claimers. So it was concluded that, regardless of the formal policies in place the important safety management element is to identify unsafe behaviours and formally investigate them. The ZRE risk management system does not specifically address the management or investigation of unsafe behaviours. It advocates for having formal safety policies and incident investigation, but falls short of advising on formal and consistent disciplinary procedures.

Incentives Prior research evidence that incentives for safe behaviour and safety innovations are effective safety management practices, was supported in the UNSW study. The finding was that lower claimers, and no higher claimers, give drivers *monetary incentives clearly linked to work safety efforts*. Where lower claimers provided additional incentives for safety, the financial incentives were clearly linked to safety criteria, for example for completing job risk analyses, or end of year bonuses for safe driving. By contrast, higher claimers reported providing meals or other non-monetary extras for drivers but the link to safety criteria was unclear. Beyond advising that drivers should be paid generously to attract high calibre drivers, there is no mention of additional incentives for safety in the ZRE system.

Communication The UNSW study found that managers in lower-claiming companies were more likely to *encourage drivers to have input into WHS decision-making*. Managers in higher-claiming companies reported that they were more likely to set criteria and rules for vehicles and drivers without consultation with drivers, than did managers in the lower-claiming companies. It was also observed that lower claimers seemed to focus more strongly on proactive risk assessment, ensuring that rules are agreed, and consulting drivers on safety issues. Two previous longitudinal studies have shown that implementing interventions involving driver discussion groups focusing on safety risks and safety ideas can reduce crashes (Gregersen et al., 1996; Salminen, 2008), suggesting that encouragement of driver input into WHS decision-making can improve safety outcomes. Moreover, having studied safety for remote workers, Huang et al (2013b) argue that it is especially important to have effective channels of communication when truck drivers, and other employees who work largely in isolation from managers and other workers. Given that drivers often spend long periods of time alone, they may feel that they cannot communicate about safety issues that concern them, i.e. that they must assume sole responsibility for their own and others' safety. Indeed, the UNSW study found that the drivers in both higher- and lower-claiming companies expressed a need for this communication. While the ZRE grading system does not explicitly call for the encouragement of driver input into WHS decision-making, it views as positive the development of procedures to "incorporate driver in the management process including daily planning."

It can be concluded, from the UNSW study results, that better safety outcomes could be seen in companies where *managers take responsibility and show leadership in making safety a clear priority*. The managers in companies with lower insurance claim rates tended to take a more active and substantive approach to managing safety in their organisations, whereas the higher-claiming companies were found to take a more passive business-as-usual style of managing safety. Managers in lower-claiming companies were found to more fully accept responsibility for safety management, whereas many managers in higher-claiming companies complained that they had to face unfair challenges imposed by government or otherwise placed responsibility on drivers or others (e.g. customers, depot managers). Drivers and managers alike in higher-claiming companies demonstrated a much lesser interest in safety, with one manager saying he hardly ever thinks about safety, and managers in a two other higher-claiming company saying it would be difficult to get drivers interested in safety.

Consistent with UNSW study findings, ZRE advises that, irrespective of the title, companies must ensure that the person responsible for the motor fleet activities is experienced in various motor fleet

controls and tools (and if necessary given the business size, supported by staff with good knowledge of day to day operations). This person should be made ‘actively’ responsible for improving the loss performance of the fleet and not just liaising between the company and the insurer. It does suggest that companies establish a rigorous Quality Assurance system across all operations of the business (including fleet management) with regular internal / external audits and external certification. However, the ZRE grading system does not explicitly advocate that *managers show leadership in making safety a clear priority*.

Discussion

This study found some good parallels between the ZRE system and the results of the study comparing safety management characteristics of safer-performing companies and less safe-performing companies. Some of the risk management factors recommended by ZRE were slightly different to the safety management factors identified in the UNSW study. For example, the ZRE site risk assessment advice is largely focused on fire and security risk controls. Also, the remuneration advice does not specify payment for all hours of work, nor is there any mention of additional safety incentives. With respect to speedy responses to drivers’ safety concerns this is not specifically mentioned in the ZRE grading system, but it is implied by the suggestion to “Ensure that long-haul drivers are spoken to by management when they return to depots. This promotes well-being and value. At the same time it ensures that drivers and vehicles are periodically ‘examined’ by management.”

Importantly, a slight point of departure is reflected in the emphasis by ZRE on policies and procedures. The UNSW study found that those companies with higher insurance claims tended to have more safety policies than the lower-claiming companies. This is not to say that safety policies increase risk, just that having policies is insufficient to ensure safety outcomes. Moreover, the communication practice of “managers take responsibility and show leadership in making safety a clear priority” is suggested by inclusion of safety objectives and KPIs but is not quite the same as leadership and management commitment characteristics implied by the UNSW study finding.

The practice of *managers take responsibility and show leadership in making safety a clear priority*, is difficult to measure through safety management audits. Measurement of responsibility and leadership is more complex than the other practices covered by this research. Asking employees and drivers provides some insights but their responses may be biased. There are examples in the safety management literature from which to base tools to measure aspects of safety climate (Cox and Cheyne, 2000; Flin et al., 2000; Huang et al., 2013a; Huang et al., 2013b; Williamson et al., 1997; Zohar, 1980). A safety climate survey of seafarers found relationships between safety policy and supervisory behaviour, and in turn the perception of supervisory safety behaviour, positively related to seafarers’ safer behaviour (Lu and Tsai, 2010). This suggests that efficacy of safety management leadership can be measured by the extent to which all potential safety influencers in an organisation adopt the same level of safety commitment in their practices, and are seen to do so. A robust approach to measuring management responsibility-taking and leadership might be to select some relevant, objective indicators of these practices.

Overall, while, in some cases, the focus of the management factors were not completely aligned, the intended risk/safety management proscriptives were consistent.

Conclusions and Recommendations

The 14 safety management characteristics are unlikely to reflect a comprehensive set of ideal safety management practices. Further research should be undertaken to identify additional effective practices as well as to test the synergies afforded by combining individual safety management practices. Ideally, the evidence-based management practices will be trialled in a longitudinal study to further valid the efficacy of these practices. Until this happens, these practices could be promoted

for implementation across the transport sector, with some confidence that safety can be improved by doing this.

The similarities between the important risk management elements determined by the experience of an insurance company's risk engineering experts and those found by independent scientific research provides a cross-validation of important safety management characteristics. However, there is some scope for Zurich Risk Engineering to refine its risk management features based on the results of the UNSW studies. This will be done when the system is due for a periodic review.

Essentially, it is in the interest of companies that finance risk to assist insurance policy holders to decrease asset losses through improvement to risk control. Motivated by injury prevention, safety advocates seek to improve the safety of workers, or drivers in this case. This slight difference may explain some of the small differences in areas of focus. The economic benefits of managing asset and worker safety can be substantial, particularly through implementing evidence-based practices. Therefore is recommended that risk assessments and safety management improvements consider those characteristics that have been shown, through empirical testing, to be important.

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