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Advanced Fatigue Management Survey

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Executive Summary

This qualitative research project explored Advanced Fatigue Management (AFM) accredited operator perceptions in relation to AFM and associated safety system, processes and culture.

Purpose

Anecdotal evidence and information provided from the National Heavy Vehicle Regulator's (NHVR or the Regulator's) Operation Wake Up suggested that AFM operators are performing safer in relation to fatigue risk management compared to other operators. However, the number of AFM operators is low compared to the number of operators within the heavy vehicle industry. Therefore, the purpose of this research was to explore demographics associated with AFM operators, AFM operator perceptions in relation to AFM and increasing the uptake of AFM within the industry, the barriers and enablers of participating in AFM, fatigue risk management system elements and the level of Safety Culture Maturity (SCM) in relation to AFM accredited operators.

Methodology

Telephone interviews were conducted to explore AFM accredited operators' perceptions regarding AFM, their fatigue risk management and indication of the SCM of company operations. The telephone interview method was chosen over other qualitative methods due the number of participants and widespread geographical location of heavy vehicle operators across Australia.

Key findings

Research revealed a number of key findings, including:

- Drivers operating under AFM had better compliance with fatigue management requirements of the HVNL than drivers working under Basic Fatigue Management (BFM) and Standards Hours.
- Businesses operating under AFM reported no fatal, serious or minor/property damage incidents attributable to heavy vehicle driver fatigue in the past 12 months.
- Current AFM operators indicated that the flexibility associated with additional work hours or periods of time without a major break (e.g., 14 days on in the natural resource extraction industry) was the major benefit of AFM accreditation.
- The primary reason identified by current AFM operators for this low uptake of AFM by the heavy vehicle industry is that it is believed the application process is too difficult, time consuming and costly for most operators, especially those that do not have the expertise in developing and implementing appropriate and adequate fatigue risk management systems.
- The majority of AFM companies were classified as being in either the "Calculative" or "Proactive" stage of SCM. Although this is a good result, there is room for SCM improvement. This result suggests that safety is in the forefront of AFM companies with the majority of companies operating with a well-developed and implemented fatigue risk management system.
- Those companies that actively communicate with drivers and management are visible in the workplace discussing safety issues with staff are more likely to develop trust and receive meaningful collaboration and engagement from staff for identified safety issues, reporting incidents and participate in safety improvement strategies.
- Traditional methods utilised for safety-related communication are ineffective within heavy vehicle operations due to some drivers not returning/leaving from a home base/site on a regular basis.
- Management commitment and support are necessary to ensure continued improvement of not only AFM processes and the greater fatigue risk management system but also the continued development of SCM.

Limitations and Future Research

There were a few limitations associated with the research. Due to limited memory recall of AFM operator participants' data was not collected regarding the age range of drivers and numbers of certain incident types (e.g., property only/minor damage incidents). Future research should provide potential participants with prior knowledge of questions that require specific numbers in relation to certain demographics, including, for example, range of drivers' age and numbers of incidents. In addition, due to many AFM participants being in senior management roles, there could be some bias by participants towards reporting safer options in relation to questions asked about safety in their company and

managerial processes. Further, future research should utilise a comparison group(s) to assess the level of safety management and fatigue risk associated between AFM operators and others in the heavy vehicle industry.

Conclusion

Although no current comparison data is available, AFM operators seemingly are performing at a safe level in relation to heavy vehicle operations and SCM. AFM operators also acknowledged the flexibility offered by AFM accreditation as a major benefit. However, AFM operators perceived that the application process was the most negative component of AFM including the primary reason for the limited uptake of AFM accreditation within the heavy vehicle industry.

Recommendations

The current AFM research identified a number of recommendations aimed at improving AFM, fatigue risk management and AFM uptake by other heavy vehicle organisations, including:

- Promotional strategies are required to encourage greater uptake of AFM nationally.
- Comprehensive guidance material should be developed by the NHVR to assist organisations in the AFM application process and requirements.
- Additional ongoing advice and guidance material should be developed to assist organisations to develop and implement elements of a fatigue risk management system, especially for the general trucking industry.
- AFM operators should engage in additional leadership strategies aimed at increasing management commitment and support for fatigue risk management as a priority over and above legislative compliance and productivity.
- Operators should introduce a just culture (e.g., “no blame” approach) reporting and investigation of incidents and driver error. All staffing levels within organisations should be included within these processes.
- AFM operators should develop procedures that require all incidents and near misses to be reported, recorded and investigated. This data should be utilised as information for future safety improvement strategies.
- Strategies should be developed that ensure all drivers receive safety-related communications, including those that work remotely from operators’ home sites or do not regularly return to a home base of operations.
- Further research should be conducted to compare the results reported within this research project with those operators performing heavy vehicle operations under potentially BFM and/or Standards Hours.

Contents

1. Introduction

Within Australia, the history of heavy vehicle compliance is partly a success story, with fatalities involving heavy vehicles trending downwards since the introduction of the Heavy Vehicle National Law (HVNL) compared to periods prior to HVNL implementation. However, the fact remains that transport and logistics is the most dangerous sector in which an Australian can be employed and Australia's half a million heavy vehicles are over-represented in the total number of road deaths.

National Transport Insurance (NTI) data, which is based on insurance claims of $50,000 or more, indicates that fatigue remains a problem. The National Truck Accident Research Centre (NTARC) review of NTI Major Accident Investigations data currently provides the most valid and reliable data for examining fatigue-related heavy vehicle incidents in Australia. The NTARC data on heavy vehicle crashes caused by heavy vehicle driver fatigue between 2003 and 2017 is shown in Figure 1. This data indicates that the rate of crashes caused by heavy vehicle driver fatigue has dropped since the Heavy Vehicle Driver Fatigue reform (the precursor to the current HVNL fatigue management requirements) was introduced in 2008, with the average rate in the years prior to the reform was substantially higher than the average rate in the years since the reform (24.6% versus 11.3%). However, the NHVR notes that the rate of heavy vehicle crashes caused by driver fatigue has been relatively stable between 2009 and 2017.

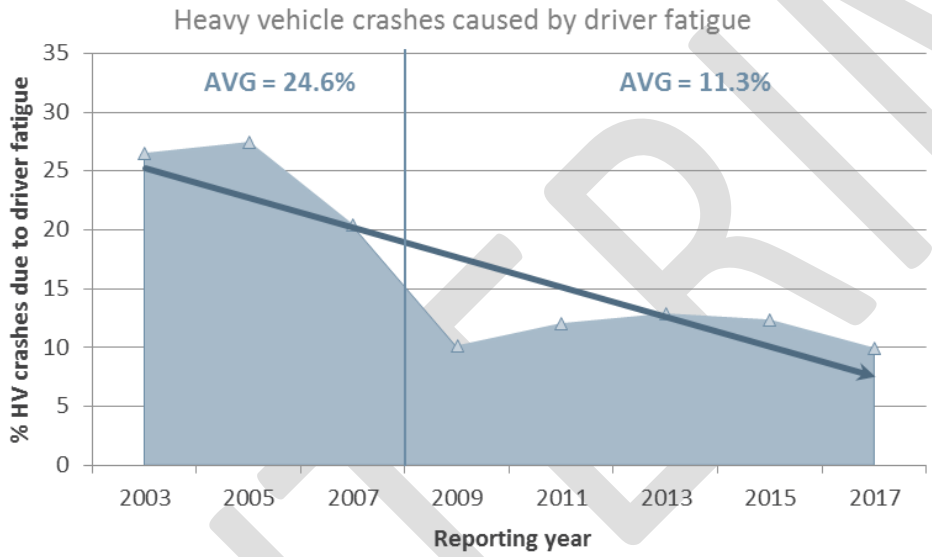

Figure 1: Trend in heavy vehicle crashes caused by driver fatigue in Australia between 2003 and 2017 (Source: NHVR, 2019)

Although it is relatively easy to implement and enforce prescriptive hours-of-service limits across the heavy vehicle industry, these prescriptive HVNL regulations cannot fully account for the dynamic nature of the physiological systems underlying fatigue-related impairment (Gander, 2015). Therefore, these results further indicate a need to implement additional or alternative strategies to further improve fatigue-related crash statistics.

1.1 AFM and Fatigue Risk Management

Recent literature review focussing specifically on heavy vehicle transport revealed little robust empirical research in the heavy vehicle transport sector and little evidence for effective safety management characteristics that can reduce crashes and injuries (Mooren et al., 2014). Although research has identified a range of risk factors for heavy vehicle incidents and injuries (Loeb & Clarke, 2007; Lueck & Murray, 2011; Parker et al., 1995; Williamson, 2005; 2007; Williamson & Friswell, 2013), organisational practices that may be used to manage the risks to drivers have received surprisingly little research attention.

Fatigue management, ideally, is self-managed and provides the type of real-time data that keeps employees and supervisors in front of risks, and gives workers the kind of immediate feedback that actually influences the culture of the environment. A robust, sustainable, fatigue risk management system should be a blend of training, education and awareness, and a flexible policy actively supported by senior management.

Prescriptive hours-of-service limits are long established and are intended to be easy to apply and enforce and should involve relatively modest costs for both enforcement agencies and transport companies. However, prescriptive limits are

increasingly being criticised for being an overly simple solution to a complex problem. Prescriptive hours-of-service limits are a one-size-fits-all approach that does not take into account key factors that affect fatigue risk at the operational level.

Although it is relatively easy to implement and enforce prescriptive hours-of-service limits across the heavy vehicle industry, these prescriptive HVNL regulations cannot fully account for the dynamic nature of the physiological systems underlying fatigue-related impairment (Gander, 2015). For instance, the fatigue-related impairment associated with a given shift (or duty period) is dependent on where the shift occurs in the sequence of shifts (the roster), whether a worker begins that shift well-rested or with an accumulated sleep debt, and the workload experienced during the shift (e.g. number of deliveries, pressure to meet timeframes).

Heavy vehicle operators can apply for fatigue management accreditation under the following National Heavy Vehicle Accreditation Scheme (NHVAS) modules:

- Fatigue Management: Basic Fatigue Management (BFM) - Operators with BFM accreditation can operate under more flexible work and rest hours, allowing for (among other things) work of up to 14 hours in a 24-hour period. BFM gives operators some flexibility in when drivers can work and rest, as long as the risks of driver fatigue are properly managed; and

- Fatigue Management: Advanced Fatigue Management (AFM) - AFM brings a genuine risk management approach to managing heavy vehicle driver fatigue. Rather than prescribing work and rest hours, AFM offers more flexibility than Standard Hours or BFM in return for the operator demonstrating greater accountability for managing their drivers' fatigue risks.

To qualify for accreditation heavy vehicle operators/organisations must be audited by an independent auditor to verify that their record-keeping and other procedures comply with the Fatigue Management Standards. This is called an On-Entry Accreditation Audit. An organisation/company must also be audited at specified intervals after qualifying so that their accreditation can be continued. These are called Scheduled Compliance Audits, and they are to check that organisations/companies are doing what they said they would do.

1.2 Safety Culture

Safety culture is referred to as the shared values, norms, beliefs and ideas of safety within an organisation (Guldenmund, 2000) and it is crucial in shaping and defining how safety is presented and integrated in the organisation's daily processes, functions, and management. Safety culture is complex as it is comprised of the underlying and enduring structure of the fundamental values, norms, and assumptions toward safety in an organisation (Mearns & Flin, 1999). Scientific understanding of the importance of safety culture in an organisation can be traced back to the Chernobyl disaster, whereby a poor safety culture was viewed as a crucial contributing factor to the occurrence of the incident (Pidgeon, 1991). Ever since this disaster, safety culture had been regarded as a fundamental factor in promoting safety values and attitudes in the organisation and its members (Pidgeon, 1991).

The role of the safety culture of the workplace has attracted a large amount of literature (Zohar, 2010), but little of this research relates directly to the trucking industry. Originally, the concept of culture was proposed by anthropologists to describe and research societies, but the term is now widely used to describe organisations. Culture represents the languages, values, attitudes, beliefs and customs of an organisation (Muchinsky, 2003). In addition, the term culture represents a complex pattern of variables that, when taken collectively, gives the organisation its unique "flavour". There are several definitions of organisational culture; however, arguably the most uncomplicated was suggested by Deal and Kennedy (1982, p. 4) who referred to safety culture as, "The way we do things around here".

A safety culture model (see Figure 2) developed by Cooper (2000) provides an integrative framework for the analysis of the safety culture construct (Fernandez-Muniz, Montes-Peon & Vazquez- Ordas, 2007). The model highlights the elements that determine or impact on safety culture within a specific context, including the integrative or reciprocal relationships between subjective internal psychological factors, observable safety related behaviours and objective situational factors (Cooper & Phillips, 2004; Choudhry et al., 2007; Fernandez-Muniz et al., 2007). Cooper maintains that organisational culture is the product of multiple goal-directed interactions between people (psychological), jobs (behavioural) and the organisation (situational) (Cooper, 2000; Choudhry, Fang & Mohamed, 2007), with each component able to be measured independently or in combination (Choudhry et al., 2007).

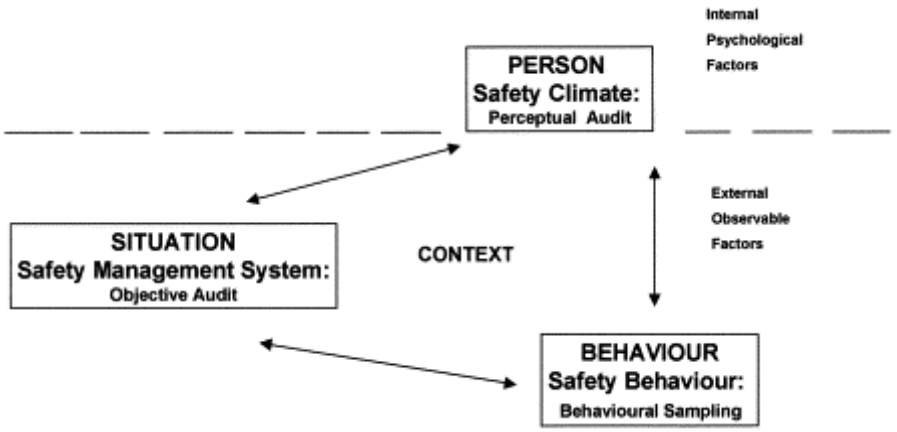

Figure 2: Reciprocal safety culture model (Source: Cooper, 2000)

Research has indicated that other crucial aspects of the organisation influencing safety processes such as safety culture should be considered when adopting a risk management approach. For instance, Gunningham and Sinclair (2014) conducted a study within an Australian mining company that was operating five mine sites, with a uniform safety management systems, risk management standards, safety policies, and key performance indicators across the sites. The study demonstrated that the mines varied in their safety outcomes although they had similar risk management systems in place. These results indicated that other factors, such as safety culture, appear to contribute to the safety performance at each mining site, beyond the organization's standard safety procedures and corporate risk management systems.

Furthermore, research also suggests that improvement of safety culture would depend upon the degree at which organisational management acknowledge and recognise the problem as well as their willingness to provide resources and management support (Mannion, Konteh & Davies, 2009). Likewise, research has suggested other organisational factors that comprise an organisation's safety culture, including organisational commitment, management involvement, reward systems, employee empowerment, reporting systems (Wiegmann, Zhamng, von Thaden & Mitchell, 2004), senior management commitment, flexible and realistic practices for handling safety hazards, continuous organisational learning and a universal care and concern for safety hazards/risks shared across the entire workforce (Cole et al., 2013; Pidgeon, 1998).

The concept of safety culture had also been applied in driving safety, both within the general driving population and work-related contexts (Bomel Ltd., 2004; Oz & Lajunen, 2008). While safety culture research within the work driving setting is limited with gaps still existing in the literature, previous research suggests that safety culture has a role in discouraging risky driving behaviour in workers. For instance, Oz and Lajunen (2008) investigated the relationship between organisational safety culture and risky driving behaviour among 73 professional drivers. They found that professional drivers who perceive their work environment as having a high traffic safety culture and work safety culture are less likely to commit and report driving violations. These results suggest that within an organisational setting, placing a high importance on safety at work may result in lower reported frequencies of risky driving behaviours by employees.

Holistically, safety culture is a useful concept for understanding and influencing safety policy, processes, and performance within an organisation (Biggs, Banks, Davey, & Freeman, 2013; Dingsdag, Biggs, & Sheahan, 2008). In contrast, research has indicated the effectiveness of safety improvement strategies/ interventions is reliant on workplace culture and interventions may fail if the workplace culture is not conducive to change (Hengel, Joling, Proper, Blatter, & Bongers, 2010; Judd & Keleher, 2013). Although all organisations have a safety culture, the degree in which a safety culture is executed differs in maturity and effectiveness across organisations (Biggs et al., 2013). In addition, research has also indicated "safety culture is amenable to manipulation and intentional change" (Wiegmann et al., 2007, p. 7).

Safety culture can be complex and safety culture improvement can be difficult to manage. In order to improve safety organisations are required to understand "safety culture" and the components that influence safety culture. Unfortunately for many, addressing safety culture is a specialised area requiring specialised attention. Following is a safety culture model that simply describes certain milestones/activities that companies must reach to progress to a higher level or stage of safety culture.

1.3 Safety Culture Maturity

The Safety Culture Maturity (SCM) Model has been utilised within the discipline of safety management and has been applied to safety culture development within a number of potentially hazardous industries (Foster & Hoult, 2013), including aviation (Gordon, Kirwan, & Perrin, 2007), rail (Keil Centre, 2004; Kyriakidis, Hirsch, & Majumdar, 2012), offshore natural resource extraction (Fleming, 2001; Hudson, 2007), the construction industry (Lingard et al., 2014) and petro-chemical industries (Filho, Andrade, & de Oliveira Marinho, 2010; Lardner, 2002). In relation to safety culture, considerable research has indicated that no clear guidance exists regarding what a good culture looks like and how to create such a culture.

Hudson (2007) suggested that merely defining and describing the components of a safety culture is insufficient to help organisations improve the safety culture within their organisation. He advocates understanding safety culture using an evolutionary model in which organisations are placed on a continuum from those with advanced safety cultures to those with safety cultures at less advanced stages of development. Hudson argues that defining intermediate stages can assist organisations to engage in culture change in manageable (and measurable) steps.

Along with other researchers who have developed similar versions of the maturity model framework (Reason, 1993; Westrum, 1996, 2004), Hudson's (2001) five-stage Safety Culture Maturity Model (see Figure 3) has been utilized to determine the level of safety culture maturity within high-hazard or high-risk organisations. The Safety Culture Maturity Model developed by Hudson (2003) incorporates a five-step progression from a "pathological" stage indicating limited care for safety and no safety systems, through to a "generative" stage where managing safety risks is a way of life and fully integrated safety systems are effectively in place (Foster & Hoult, 2013). The descriptions for the stages of safety culture are provided below (Filho et al., 2010; Foster & Hoult, 2013; Hudson, 2003):

- **Pathological** - safety problems are caused by workers. The primary drivers of the organisation are the business, not safety, and a desire not to get caught by regulators.
- **Reactive** - organisations start to treat safety seriously. However, safety action is generally undertaken in reaction to safety incidents or events.
- **Calculative** - safety is steered by management systems which are primarily driven by management. Involvement by other entities within the workforce is limited.
- **Proactive** - safety problems are proactively identified and addressed before safety incidents transpire. The organisation starts to move from purely a top-down approach and employees experience increased safety participation.
- **Generative** - there is active participation at all levels. Safety is perceived to be an inherent part of organisations' operations.

Basically, an organisation moving from a pathological safety culture towards a generative safety culture:

- Is increasingly informed about health and safety and
- Shows increasing levels of internal trust and accountability about health and safety.

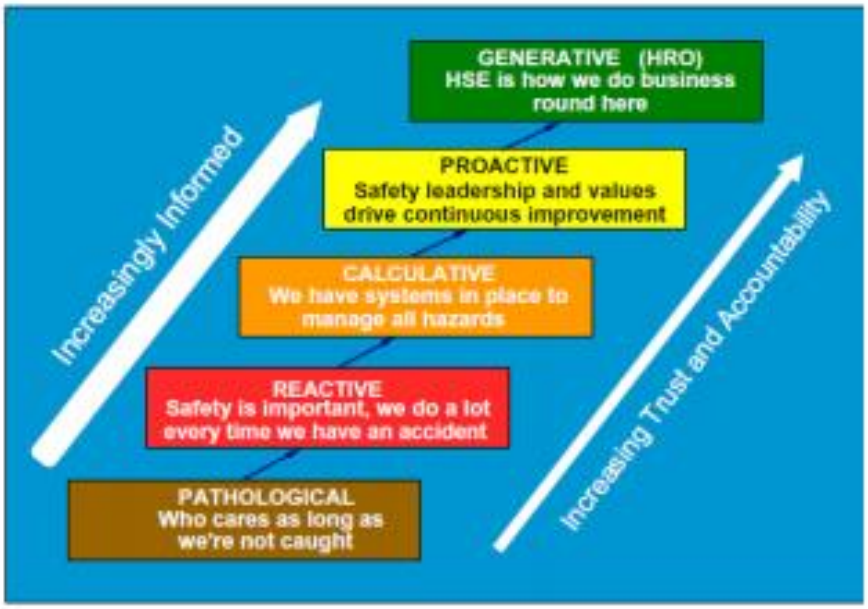

Figure 3: Safety Culture Maturity Model (Source: Hudson, 2003)

The Safety Culture Maturity Model has yet to be applied to the heavy vehicle industry setting. However, results from recent work-related road safety research suggest that organisations and heavy vehicle drivers operating within the work-related road safety area are operating at differing levels in relation to safety culture, the identification of and management of core work-related driving issues (Davey, Wishart, Rowland, Freeman, & Banks, 2008; Rowland & Wishart, 2014; Wishart & Rowland, 2012, 2013). Therefore, those organisations operating in the early stages of safety culture maturity (e.g., Pathological, Reactive and Calculative) may hinder the application of any potential future initiatives to improve safety. For example, organisations operating in the early stages are reactive in nature and may not be open to any initiative to proactively improve safety, whereas organisations operating in the later stages are considerably more proactive and congruent to initiatives to improve their safety culture.

Subsequently, primary barriers to organisations incrementally reaching a level of safety culture would include bureaucratic cultures, safety legislation, and a basic requirement of compliance, management failure, and the perceived difficulty of cultural change.

The SCM model is a good example of a model that can inform companies of their current level of safety culture and assist companies regarding changing their safety culture in manageable and measurable steps. Although the model has not been utilised within the transport sector it may prove to be easily applied due to its simplistic nature compared to other safety culture models.

1.4 Research Rationale

Driver fatigue and drowsiness pose a major threat to highway safety, and the problem is particularly severe for commercial motor vehicle operators. Twenty-four hour operations, high annual mileage, exposure to challenging environmental conditions, financial pressures and demanding work schedules all contribute to this serious safety issue (Barr et al., 2009). Although current fatigue work/rest limit regulations have significantly reduced fatigue-related crashes in Australia since their inception, strategies are required to further reduce the burden of driver fatigue within the industry.

Within the heavy vehicle industry, driver fatigue remains an issue of concern. Within the National Truck Accident Research Centre (NTARC) 2015 Major Accident Investigation Report (Driscoll, 2015) it was stated that since the September 2008 introduction of new legislation for heavy vehicle driving hours, and consequent fatigue reform, there has been considerable improvement in losses related to driver fatigue. However, recent fatigue incident figures (9.8%) reported by the National Truck Accident Research Centre (NTARC, 2019) suggest there has been limited improvement or deterioration in the fatigue result since the last reporting period (2017 – 12.2%). The link of fatigue to crashes is further exemplified by the finding that a truck driver falling asleep or being fatigued accounted for 46% of all driver impairment-related factors implicated in truck-involved fatality crashes (FMCSA, 2016). Although fatigue is acknowledged as a major

safety risk within the heavy vehicle industry, limited research has investigated relevant safety systems and practice within the industry, including those operators under one of the NHVR accreditation schemes.

Limited research has been performed addressing the effectiveness of AFM accredited companies/drivers and associated systems and practice. Recently, the NHVR's Operation Wake Up revealed that from national field-based and camera operated intercepts no AFM accredited companies intercepted received any fatigue-related offences. Anecdotal evidence also suggested that AFM operators are performing more safely than the rest of the heavy vehicle industry. However, the uptake of AFM by heavy vehicle operators remains low. The research addresses AFM operator perceptions regarding why AFM uptake has been limited which should inform potential areas for the promotion of AFM and encouragement for operators to apply for AFM accreditation. Further, due to limited information regarding AFM operations the research examines operators' fatigue safety systems, processes and practice (e.g., Fatigue Risk Management System) in relation to heavy vehicle operations and safety under AFM accreditation.

The following section describes the research framework and methodology for this research project.

2. Research Framework and Methodology

The following sections provide an overview of the research framework and methodology for the AFM Survey research project.

2.1 Objectives

The objectives of this research project incorporated conducting qualitative semi-structured telephone interviews with those operators/companies operating under AFM accreditation. The objectives of this research project are:

- Identify any demographic factors that impact on the effectiveness of AFM operations;
- Analyse self-reported heavy vehicle incident data for any reportable trends associated with AFM operations;
- Ascertain AFM operators' primary perceptions and opinions of AFM, including likes, dislikes and why AFM has not been more widely accepted across the heavy vehicle industry;
- Determine what elements of a Safety Management System, particularly Fatigue Risk Management System are implemented by AFM operators; and
- Utilising the nine themes associated with Safety Culture Maturity determine the maturity level of AFM operators' safety culture in relation to fatigue management.

2.2 Research Hypotheses & Questions

In line with the objectives of the project, the following research hypotheses and questions are proposed:

Research Hypotheses:

- Heavy vehicle companies operating under AFM accreditation maintain a high level of safety in relation to addressing and management of fatigue risk.
- Heavy vehicle companies operating under AFM accreditation have a high level of Safety Culture Maturity.

Research Questions:

- How do AFM safety systems reduce/not reduce the risk of fatigue-related incidents/crashes?
- What level of Safety Culture Maturity represents heavy vehicle operations under AFM accreditation?
- What is required to increase the uptake of AFM accreditation within the heavy vehicle industry?

2.3 Scope

The NHVR conducted the research for this project. The NHVR contacted all current AFM accredited operators in relation to participating within this research project. All information provided to the researcher was stated as confidential. The qualitative research involved operator perceptions of AFM, fatigue management practices and determination of the Safety Culture Maturity of those operators who have received AFM accreditation.

2.4 Method

An exploratory approach was utilised for the AFM survey. The following sections describe the research methodology utilised within this research project conducted by the NHVR.

2.4.1 Research Design

Telephone interviews were conducted to explore AFM accredited operators' perceptions regarding AFM, their fatigue risk management system and indications of the Safety Culture Maturity of company operations. The telephone interview method was chosen over other qualitative methods due the number of participants and widespread geographical location of heavy vehicle operators across Australia. Unstructured telephone interviews are a practical method that provides an opportunity to ascertain valuable insights into the perceptions and experiences of participants, and deliver in-depth qualitative information.

The qualitative research aimed to explore participants' perceptions and experiences in relation to heavy vehicle companies operating under AFM accreditation. An informal conversational approach was utilised with additional probing questions employed to clarify and/or expand on important experiences highlighted by participants during the focus groups. The study encompasses an open-ended enquiry method that identifies patterns and key variables regarding the topics being investigated. This technique is derived from grounded theory which facilitates the examination of major themes arising from the experiential data such as participants' responses (Corbin & Strauss, 1990; Yin, 1993).

The purpose of this qualitative method, specifically semi-structured telephone interview discussions, was to obtain a 'real world' and authentic understanding of the perceptions of AFM accredited companies regarding AFM, the AFM application process and organisational systems and processes that address fatigue risk management.

2.4.2 Participants

Fifty organisations that were currently operating under heavy vehicle AFM accreditation were invited to participate. The list of AFM accredited operators was drawn from NHVR records. Further details regarding project participants and included in section 3.2 of this report.

2.4.3 Content and Materials

To increase the reliability of the participant responses, a standardised protocol in relation to the telephone interview questions and prompting questions was adopted (Silverman, 1993). See Appendix A for the list of interview and prompting questions.

The interview questions can be divided into 5 key areas, including:

1. **Participant demographics** – pertains to the operator's/company's area of operations, type of freight transported, number of drivers and heavy vehicles, scheduling arrangements, use of contract drivers and AFM arrangements.
2. **AFM operator heavy vehicle incidents** – questions were asked in relation to the frequency of heavy vehicle incidents/crashes including fatalities, serious incidents, minor/property damage incidents and near misses. In addition, participants were asked what proportions of incidents were fatigue-related.
3. **Participant perceptions related to AFM** – participants' perceptions were recorded regarding what they liked and disliked about AFM, and also their opinions why AFM accreditation hasn't been more widely accepted by the heavy vehicle industry.
4. **AFM operators' fatigue risk management system** – a number of questions were posed to operators under AFM accreditation associated with their fatigue risk management system. In addition, did they have a form of fatigue risk management system prior to AFM accreditation (e.g., under BFM accreditation).
5. **Safety Culture Maturity** of AFM operators – A series of open-ended and prompting questions that can inform the level of Safety Culture Maturity within AFM accredited operations were redesigned for this research project. Questions were developed to ensure relevance to the heavy vehicle industry and were based on questions previously designed in health and safety ownership research by Banks (2008) and Safety Culture Maturity research by Parker, Lawrie and Hudson (2006) and Lingard, Zhang, Harley, Blismas and Wakefield (2014). The descriptors for assessing the maturity of a safety culture are provided in Appendix C.

2.4.4 Procedure

Firstly, an email was sent to the contact person in each of the AFM accredited companies prior to conducting telephone interviews (see Appendix B for a copy of email content). The email to AFM accredited operators provided an overview of the project and rationale for the NHVR conducting the AFM operator survey.

Following the email, each AFM accredited operator was phoned regarding participation in the AFM Survey semi-structured telephone interviews. Each participant was asked if they were free to talk. If yes, each participant was

requested to provide answers to interview questions (see Appendix A). If no, participants were asked to provide a more suitable date/time to participate in a telephone interview. If an AFM operator could not be contacted (e.g., did not answer contact phone number) the researcher left a message to return his phone call and followed this up by sending an email. If no response the researcher phoned again the following week. If no response was subsequently forthcoming a no response was recorded for that operator. Telephone interviews were conducted during the period from 23 July, 2019 to the 12 August, 2019. Timing was stated as approximately 20 minutes with each operator. However, interview times varied form only 10 minutes to approximately 50 minutes.

In relation to the telephone interviews, the researcher asked the same questions and in the same order for all AFM operator telephone interviews. However, in relation to questions aimed at prompting further responses by participants, the prompting questions were supplied based on the current conversation and not in any particular order.

2.4.5 Analysis

Notes were taken on verbatim statements, as participants' responses to close and open ended questions were recorded by the interviewer during the semi-structured telephone interviews. The major points were read back to participants to ensure clarification of the issue and accuracy of statements provided by participants. Subsequently, major points were rewritten as required incorporating any amendments. This "open" coding technique (Strauss, 1987) encompassed repeatedly reading and categorising participants' responses, focussing on similar experiences and events, which facilitated the development of themes outlined in the Results section of this report.

In relation to information collected regarding the nine components of Safety Culture Maturity, the level of maturity was determined in conjunction with information provided in Appendix C. Participants safety culture maturity was informed by their answers to the relevant open-ended questions and then their answers were compared to the descriptors from each component in Appendix C.

The following section (Section 3) provides information related to the results of the qualitative telephone interviews held with AFM operator contacts.

3. Results

Section 3.1 provides a summary of results from the NHVR's Operation Wake Up conducted earlier in 2019. These results provide additional evidence in relation to the fatigue-related safety of AFM operators compared to other operations (e.g., BFM and Standard hours).

Results were also provided through semi-structured telephone interviews with company representatives of organisations operating under AFM accreditation (see sections 3.2 – 3.5). These sections report the results in relation to AFM operator participation demographics, heavy vehicle crash/incident history, perception of AFM accreditation, details regarding their fatigue risk management system, and level of operators' safety culture maturity.

Although it is acknowledged that drivers are accredited within the AFM scheme, the results are discussed using participants companies to describe systems and processes associated with AFM.

3.1 NHVR's "Operation Wake Up"

From time to time, the NHVR conducts additional strategies aimed at heavy vehicle operational compliance. These operations, which are generally inter-agency operations, are an integral part of the regulatory environment which assists the NHVR in monitoring and regulating safety and compliance behaviours of the heavy vehicle industry. These operations are crucial in identifying and monitoring patterns and trends of unsafe behaviours and non-compliance, both across Australia and internationally.

In relation to fatigue, the NHVR conducts field based operations including "Operation Wake Up". In its second year, the primary focus of Operation Wake Up was to monitor fatigue regulated heavy vehicles, including buses, coaches and their drivers for fatigue, and where appropriate, for compliance with their work and rest hours, including compliance with the Heavy Vehicle National Law (HVNL) and other relevant transport legislation.

Operation Wake Up aims to contribute to the NHVR's Safety and Assurance agenda, whereby not only will compliant parties be identified, but non-compliant parties and trends are revealed. This assists and informs where the NHVR needs to adjust and refocus its compliance and enforcement priorities. The NHVR also monitors those drivers and companies operating fatigue-related accreditation schemes, including BFM and AFM throughout Operation Wake Up. Drivers on Standard Hours are also targeted during the operation.

Fostering ongoing cooperative relationships with partner agencies is vital for the NHVR to deliver effective on-road safety and compliance activities. Partner agencies include Road Transport Authorities and Police Forces in all States and Territories, both in participating and non-participating jurisdictions. During Operation Wake Up each team of Authorised Officers carry out the necessary inspections on heavy vehicles and their drivers for compliance with the HVNL and associated local laws, including conducting inspections of heavy vehicles for compliance with vehicle standards.

Table 1 shows the results from national heavy vehicle intercepts during Operation Wake Up. Results from the field-based intercepts revealed that 24.4% (201 of the 266) of the fatigue related offences were incurred by drivers in the standard fatigue management scheme in 2019, which is a 9.4% increase on the 15.0% (324 of 381) in 2018. Although the number of AFM accredited drivers intercepted was low, this is representative of the low number of companies currently operating under AFM accreditation (*n* = 50). However, no AFM accredited driver incurred any fatigue-related offences which is dissimilar to those drivers under BFM (33 fatigue-related offences) or Standard (201 fatigue-related offences).

Driver Scheme	Fatigue Check Intercept Count	Fatigue Offence Intercept Count	Fatigue Offence Rate
Advanced Fatigue Management	32	0	0.0%
Basic Fatigue Management	1073	33	3.1%
Standard	2401	201	8.4%
Total	3506	234	6.7%

Table 1: Operation Wake Up - National Intercepts Operating in Fatigue Accreditation Schemes (Source: NHVR, 2019)

There was a significant reduction in the utilisation of camera data and the camera data offence rate, dropping from 2041 intercepts using camera data in 2018, where there were 141 intercepts with a fatigue offence using camera data, equating to a 7.0% camera offence rate. In comparison, 1526 intercepts using camera data recorded 75 intercepts with a fatigue offence using camera data, equating to a 4.9% camera offence rate in 2019. Table 2 (below) further indicates that AFM accredited drivers are operating in a safer manner in relation to fatigue risk management with no AFM drivers receiving any camera based fatigue offence.

Driver Scheme	Camera Data Intercept Count	Camera Data Offence Count	Camera Data Offence Rate
Advanced Fatigue Management	14	0	0.0%
Basic Fatigue Management	514	18	3.5%
Standard	998	57	5.7%
Total	1526	75	4.9%

Table 2: Operation Wake Up – Camera Data Intercepts and Offences (Source: NHVR, 2019)

Results highlighted in Tables 1 and 2 suggest that drivers operating under AFM accreditation are performing safer in relation to fatigue risk management. With no fatigue-related offences incurred in 2019 during Operation Wake Up, it could be surmised that AFM accredited heavy vehicle drivers are operating more safely compared to those drivers operating under either Standard hours of BFM.

This information is further utilised within the Discussion of Research Findings section.

3.2 Demographics

This section reports on the various demographics associated with those AFM accredited operators who participated in this research project. From the 50 operators who currently operate under AFM accreditation, 39 operators agreed to participate in the research resulting in a response rate of 78%.

One major bus company had two different fleets under AFM accreditation. This company utilised AFM for both its general or usual business travel (e.g., coach/bus travel) and also a bus fleet transporting workers to and from work sites (i.e., gas (LNG) field contract). In addition, AFM company contacts were asked to provide their employment position within their company. This was requested to ascertain what level of staff is primarily responsible for AFM accreditation

and compliance. Results determined that the majority of AFM company contacts were senior health and safety personnel (e.g., managers and coordinators, n = 17). This is not surprising considering the number of companies that utilise AFM as a requirement for various natural resource extraction industry contracts (e.g., LNG gas fields). This result is closely followed by company owners and directors (n = 16) and to a lesser extent compliance administration staff (n = 4) and operations managers/schedulers (n = 2). The large proportion of company owners/directors indicates the potential importance of AFM within the companies' operations.

3.2.1 AFM Operators' Base of Operations

Figure 4 represents AFM accredited operators' home state or head office for heavy vehicle operations. The results show that a majority of AFM participants operate from Queensland (approximately 59%), followed by New South Wales (23%), South Australia (approximately 8%), Victoria (approximately 8%) and the Northern Territory (2%). Interestingly, the proportion of AFM accredited operators who did not participate in the telephone interviews were primarily from Queensland (n = 7), followed by New South Wales (n = 2) and South Australia (n = 2). The results highlight that the majority of AFM accredited operators are currently based in Queensland (n = 30, 60%).

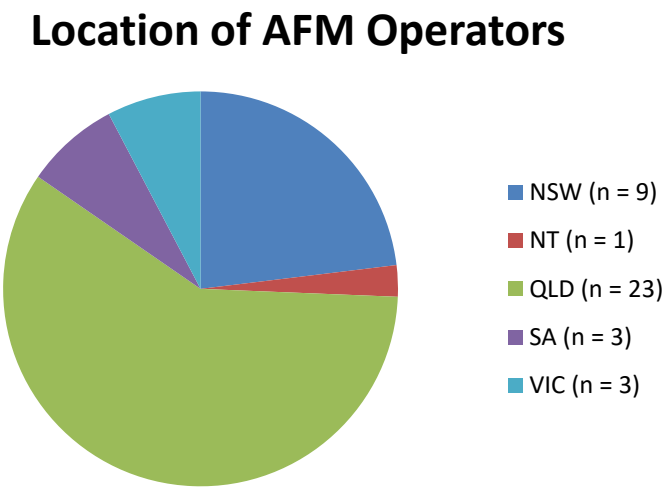

Figure 4: AFM Operator Response Rate

3.2.2 AFM Operators' Number of Heavy Vehicles and Drivers

Table 3 indicates the number of vehicles owned and/or operated and vehicle drivers by companies under AFM accreditation. The table shows that the majority of AFM accredited companies are smaller – medium size operators in relation to the number of heavy vehicles, having 50 or less vehicles. In addition, more than a quarter (n = 10) of the AFM operators own/operate less than 10 heavy vehicles. Of the 39 companies that participated in this research project, nine companies reported operating buses with five of these bus companies operating more than 200 vehicles. Although many AFM accredited companies operate with multiple heavy vehicles and drivers, two companies were owner/operator businesses (e.g., one vehicle and one driver).

Number of Heavy Vehicles	No. of AFM Operators	Number of Drivers	No. of AFM Operators
1 – 10	10	1 – 10	7
11 - 50	11	11 - 50	12
51 – 100	5	51 – 100	5
101 - 200	2	101 - 200	4
Over 200	7	Over 200	5
Did Not State	4	Did Not State	6
Total	**39**	**Total**	**39**

Table 3: Number of AFM Accredited Operator Heavy Vehicles and Drivers

3.2.3 Type of Freight Transported

Table 4 shows the type of freight/transport operations conducted by participating AFM accredited heavy vehicle operators. A majority of participants indicated that the type of freight they transported was mostly general-type freight. Most of these companies are typical "trucking companies" (e.g., line haul and general freight deliveries) with one company owner stating "*we freight anything anytime*". In addition, nine companies performed bus services or "people transport". This group contained companies that provided typical bus services commuting people in CBD and regional areas (also includes some tour bus transport) and transport for workers to and from work sites. Further, in addition to bus transport to and from work sites (e.g., natural resource extraction/Gas LNG projects), heavy vehicle operators who provide water cartage and excavation equipment also operated on these work sites.

Type of Freight	No. of AFM Companies
General freight	14
Bus services / people transport	9
Livestock	4
Water cartage	3
Refrigerated freight	2
Drilling equipment – movement of heavy vehicles	2
Other – Petroleum products (n = 1), Excavation equipment movement (n = 1), Road Works movement of equipment (n = 1), Mail services (n = 1).	4
Did Not State	1
Total	**39**

Table 4: Type of Freight Transported by AFM Accredited Operators

3.2.4 Technologies Installed by AFM Operators

Five of the AFM accredited companies indicated that they utilised various technologies within their heavy vehicle fleet. For instance, three companies (e.g., size of companies ranged from 60 – 170 heavy vehicles) stated that they utilised Seeing Machines technology as a fatigue management strategy. Further, two other companies stated that they utilised additional technologies to assist drivers and ensure compliance, including Log Checker (n = 1) and electronic recording systems (ERS, n = 1).

Although not an original question within the telephone interviews, an early interview suggested that fatigue monitoring technologies may be an additional strategy used by AFM operators to actively assist in driver fatigue detection. Therefore, this question was added to all telephone interviews with AFM company contacts. For instance, a company director stated "*we wanted to have the safest fleet possible and also assist in our AFM compliance so we decided to install seeing machines … they have proven to be invaluable*". In addition, a company that installed a version of ERS suggested "*we installed EWDs [sic] in all our vehicles to aid drivers in their counting of hours … and you can check at any time to see if they are compliant*".

3.2.5 Contract Drivers Engaged by AFM Operators

AFM companies were also asked whether they utilised contract drivers (at all) within their heavy vehicle operations. Results suggest that not many AFM operators engage contractors to drive within their fleet operations, with 28 companies stating they did not utilise contractors. One AFM company contact stated "*we only utilise company employees to drive our trucks. You just don't know with respect to contract drivers – what you're going to get. It's not worth the hassle. At least we know all our drivers are trained and mostly reliable*". This quote was typical of a number of participant responses suggesting AFM operators preferred to use their own driving staff. In total, four companies stated that they did utilise contract drivers with two of those companies stating that they only engaged contractors on an as required basis (seven companies did not state whether they engaged contractors).

3.2.6 Mixed Fleet

AFM operators were also questioned whether they operated with a mixed fleet or just utilised AFM. Figure 5 illustrates the response from AFM accredited companies indicating that eight companies did operate a mixed fleet, 19 did not, and 12 did not state. In addition, five of the companies that stated they did operate a mixed fleet also stipulated that they operated with both AFM and BFM accreditation.

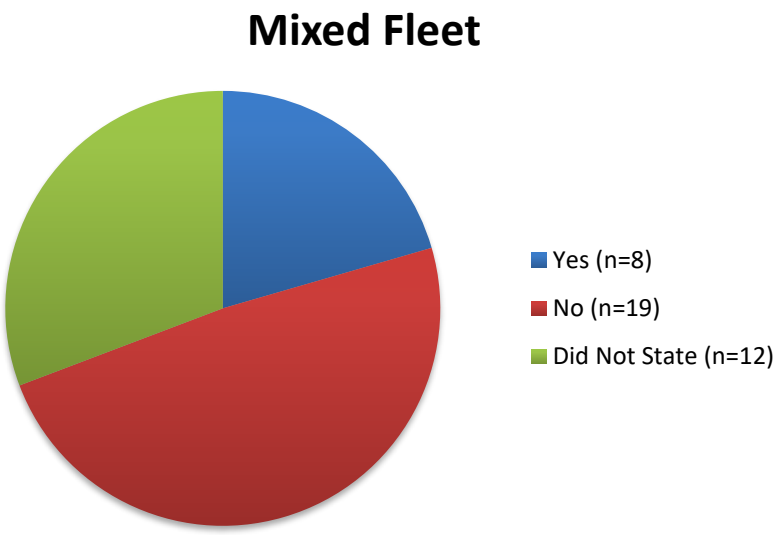

Figure 5: Proportion of AFM Companies Operating a Mixed Fleet

3.2.7 Primary Freight Scheduling by AFM Operators

AFM companies also provided information regarding how scheduling is performed in relation to work/rest hours under their AFM accreditation. Figure 6 reveals that a large proportion of AFM accredited companies (59%) participating in this research project stated "flexibility" as the main purpose of their heavy vehicle scheduling. For example, a company director stated "*we generally operate utilising BFM hours and use the additional hours enabled by AFM accreditation to get drivers home safely … better them sleeping in their own beds*". In addition, a health and safety coordinator indicated "*AFM is great, it provides additional time in case a driver is held up somewhere during loading or unloading … it just gives you piece of mind that you won't be risking non-compliance in relation to driving hours*".

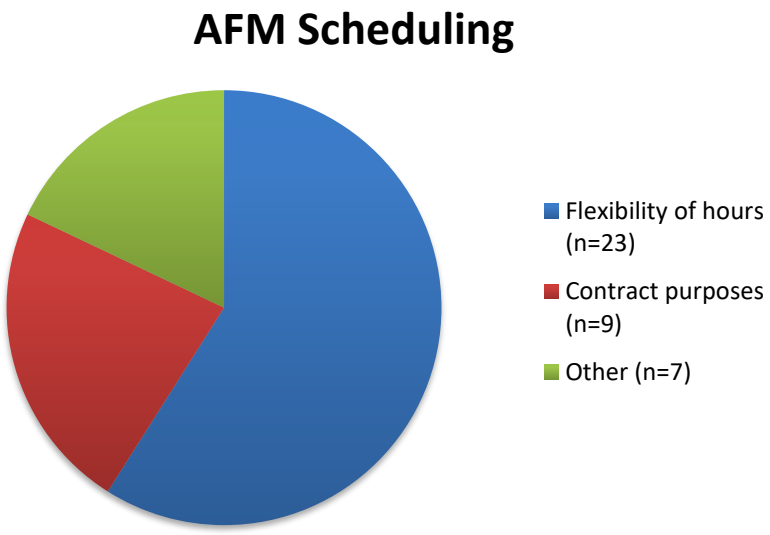

Figure 6: Company Scheduling Under AFM

3.3 Participant Heavy Vehicle Incident/Crash History

In order to gain an overview of the effectiveness of AFM accreditation and the capability of an operator's fatigue risk management system to safely manage fleet operations and subsequently mitigate fatigue risk, the type, severity and frequency of incidents that have occurred over the last twelve months were reported. It should be noted that details related to heavy vehicle incidents are self-reported by participants during the telephone interviews. Therefore, the numbers of each type of incident is based on information recall by each participant and not based on actual incident statistics. Table 3 shows the type and total numbers of self-reported incidents by each participant.

Frequency of Heavy Vehicle Incidents				
Type of Incident	**Fatality**	**Serious**	**Minor/Property Damage**	**Near Miss**
Total No. of Incidents	3 (all third party fault)	4 (all rollovers – no injuries)	19	20 (one operator)
Fatigue-Related Incidents	0	0	0	1

Table 3: Frequency of Heavy Vehicle Incidents under AFM Accreditation

Most participants stated that their heavy vehicles were not involved in any fatality or serious incidents/crashes during the previous 12 months. One male HSE Manager informed "*we haven't had a heavy vehicle incident for years now and I can't remember when one of our drivers was involved in a fatigue incident*". The three fatality incidents reported were deemed the fault of the third party (one included suicide by truck) and not the heavy vehicle driver. In addition, the four serious vehicle incidents were reported by three companies and all involved single vehicle rollovers (one company reported two heavy vehicle rollovers). For example, a male company director stated "*we recorded two heavy vehicle rollovers during the last year with both being due to tyre blow-outs and the driver losing control of the truck. It was a single vehicle incident and no one was injured*". The other two heavy vehicle rollovers were due to high winds and on one occasion the heavy vehicle rolled over during turning on a roundabout (e.g., load shift). No fatigue-related fatality or serious heavy vehicle incidents were reported.

For many of the AFM accredited participants they could not recall the number of minor or property damage only incidents that had occurred during the last twelve months. As only six companies reported/recalled minor/property damage incidents during the past twelve months, the numbers reported in Table 3 should be viewed with this limitation in mind. However, the majority of participants were adamant that their company did not incur any fatigue-related incidents (e.g., heavy vehicle crashes). For instance, one owner/director of an AFM accredited company reported "*we haven't had any fatigue related vehicle crashes recently, in actual fact we haven't have a fatigue crash for years … AFM works well for us".*

In relation to near miss incidents, only one operator reported that they recorded these types of incidents. From the twenty near miss incidents recorded only one of these incidents were fatigue related. The operator stated "*we had one fatigue near miss incident … the driver had a micro-sleep but woke up in time. He phoned his ops manager stating he was not fit to drive and we made alternative arrangements by organising another driver to do that run".*

It should be noted that from the AFM accredited companies that participated within the telephone interviews, only one fatigue-related incident was reported; a near miss incident (no damage). Although this is a positive result, memory recall by participants in relation to minor/property damage only incidents was low. Therefore, this potentially positive result should be viewed with this limitation in mind.

3.4 Perceptions of AFM by Operators

This section primarily reports the results obtained from three interview questions associated with AFM operators' perceptions regarding AFM accreditation. The three open-ended questions included:

- What do you like or not like about AFM?
- What do you think would improve AFM?
- In your opinion, why hasn't AFM been more widely accepted by the heavy vehicle industry?

The following sections outline the telephone interview responses to the above questions.

3.4.1 AFM Like and Dislikes

Firstly, it should be noted that one AFM operator who still had AFM accreditation stated that they did not utilise AFM. Basically, they received AFM accreditation too late, losing the contract which was the purpose of applying for accreditation (e.g., extended time/hours) - to meet contract requirements. The operator blamed the NHVR for taking too long to process their application and not returning email/telephone enquiries in a timely manner. However, this was the only AFM accredited operator who conveyed having a major issue with AFM and more specifically the application process.

The remaining 38 participants/operators during the telephone interview stated unanimously (100% of operators) that "flexibility" was the main reason they 'liked' or approved of AFM accreditation. For many participants flexibility meant having that extra time to safely get drivers home, travel to a safe and comfortable rest stop, finalise deliveries even if drivers are held up waiting to be loaded/unloaded, and meet additional contract requirements. For many of the AFM operators, they generally operate similar work/rest hours to the hours required under Basic Fatigue Management (BFM) and only utilise the extra hours under AFM on an as required basis. For example, one company owner/director suggested "*We base our operations around BFM hours because it's easier for drivers to understand, it's what they're used to. We only use additional hours under our AFM accreditation on an as-required basis, for instance to get a driver home safely".*

Whereas, those companies that contract to natural resources extraction projects stated that AFM provides the flexibility to meet specific project contract requirements. Most project operations are based on extended periods/days of work and rest beyond BFM and Standard hours, such as seven day on and seven days off or 14 days on and seven off, etc. Therefore, AFM accreditation provides the capability for operators to meet both heavy vehicle compliance and project contract requirements. A Health and Safety Manager stated "*we could not legally operate under the 'gas field' project requirements without AFM … its great we have no issues*".

The majority of interview participants stated that they had "*no issues*" in relation to AFM. However, the most frequently reported dislike of AFM accreditation by the participants was the AFM accreditation application process (n = 12). Participants stated that the process was difficult to understand, especially the RCS/Risk Assessment process requirements. This was especially the case for line-haul based (trucking) companies and owner operators who did not have adequate and previous exposure to similar risk management applications. One operator stated "*the application process was long, difficult to understand, heaps of required paperwork and resource extensive*". In addition, an owner/operator indicated "*the process is difficult for someone who hasn't done any similar work. I had to get a consultant to do the application for me. It was costly, but there was no way I could have done it. But it was worth it*". Although not an interview question, many participants (numbers were not recorded) stated that they engaged a consultant to perform the AFM application process and develop safety management system requirements. Most participants stipulated, that although costly it was worth the financial expense to undergo a generally 'issue free' application process.

Interestingly, the majority of participants that had current or prior health and safety based employment found the application process easier to understand and complete. This was especially the case for those companies that utilised AFM for specific project contracts (e.g., gas fields). Similarly, these participants were familiar with completing similar processes (e.g., risk management) within their health and safety employment and also within specific project contract documentation and processes. For example, one HSE Manager stated "*we did not have a problem with the AFM application process, we had to do a similar process for the project contract … plus in relation to health and safety, risk management is the basis for safety in Australia*".

Two participants stated that their AFM accreditation did not provide them with enough flexibility but also indicated that they had not yet enquired whether they could change their accreditation limits.

3.4.2 AFM Improvement

Given that the majority of interview participants had no issues with AFM or the application process, many stated that they could not think of anything to improve AFM. However, many of the participants who mentioned the application process as their major dislike of the AFM accreditation process suggested to improve AFM the NHVR should make the application process more user friendly. Alternatively, the NHVR should produce and disseminate additional information (and assistance) regarding the application process, especially the RCS requirements. One operator stated "*providing actual case studies would assist in the application process or have examples of completed applications*". Also, a few participants (n = 3) suggested improving the NHVR response time in relation to ongoing enquires during the application process would alleviate potential dissatisfaction and stress during this process.

3.4.3 Increasing AFM Industry Acceptance

Similarly to the previous section, the majority of interview participants could not suggest anything in relation to increasing industry acceptance and uptake of AFM. Most did not have any issues with AFM. However, a few participants (n = 3) suggested that the NHVR should investigate the application process to see if it could be made more user friendly or provide additional information and assistance during the application process. One participant suggested that "*the NHVR should organise events to promote AFM, address the myths, and communicate ways that are currently available to assist companies in applying for AFM … or suggest alternatives*".

In relation to the myths associated with AFM, it was mentioned by four interview participants that they felt that industry uptake of AFM was low because many operators believed that the AFM accreditation requirements and AFM application process "*were too difficult*". In contrast, two participants stated that the NHVR should not make the AFM process too easy by saying "*don't make it easier to apply we don't want everyone on AFM. The difficulties associated with the process keeps the cowboys out".*

3.5 Fatigue Risk Management System

3.5.1 Previous Fatigue Risk Management Systems

Responses from interview participants varied in relation to the question: *Did you have fatigue-related systems/processes in place prior to your AFM application that made it easy to transition to AFM?* Many participants (n = 22) stated that they did operate under BFM accreditation prior to applying for AFM. These participants stated that as part of BFM accreditation they were required to have a management system that addressed fatigue. For example, one company owner stated "*under BFM we were required to develop a form of management system to address fatigue … we have the required policy and procedures, we employed a Safety and Compliance Manager to conduct risk assessments and develop the system further, provide training and communications to drivers*". A few participants indicated that although they had developed a management system for BFM, this system was not comprehensive enough to meet AFM requirements. A Safety and Compliance Coordinator stated: "*our system under BFM had to be updated to meet AFM requirements and additional components or standards. Although we thought we could complete the AFM application ourselves, we were wrong. We had to engage a consultant to help us with our application*".

A result that emerged from the interview discussions was that many of the more traditional trucking/freight companies engaged a consultant to assist with their AFM application. Their main reasons for engaging a consultant included:

- their lack of experience and knowledge in relation to developing and applying risk assessment/management processes;
- a large amount of paperwork was required to be addressed and it was difficult to interpret all requirements; and
- there was limited timely assistance and information available from the NHVR.

In contrast, many of the companies (especially the larger companies) which had contracts in the natural resource extraction projects (e.g., LNG/gas fields) stated they did not have an issue with the application process. Many of these companies employed Health Safety and Environment (HSE) Managers/Coordinators from the natural resource extraction industry who were professionally conversant with the safety risk management approach and experience in the development of safety management systems. In addition, companies had already progressed through a similar process in addressing specific contractual applications for work and safety within the natural resource extraction industry. For instance, a HSE Manager stated "*we had no issues with the AFM application process. We went through a similar process when addressing the business requirements, including workplace safety, for our contract to work in the industry*". However, it should be noted that many of the smaller companies that provided 'people transport' services (e.g., bus transport to and from work sites) within the natural resource extraction industry did have to engage a consultant to develop their AFM application. This was due to a lack of experience and resources in place to address the requirements of the AFM application. For example, a small bus/transport company owner/director stated "*we are only a small company and cannot afford to hire a permanent safety manager to develop the AFM application, I know I couldn't do it … we hired a consultant to do the work, cost me an arm and leg but it was worth it in the long run, we got AFM with no issues".* In contrast, one company owner indicated "*although we employed a consultant to do our AFM, we still had problems during this process, however we did reach the end eventually and it has worked out fine".*

There were organisations (n = 9) that stated they already have a comprehensive safety management system which made it easier to include a system to address fatigue in relation to meeting AFM requirements. For instance, a Director from a large organisation stated "*we had no issues with AFM, we had already addressed fatigue within our safety management*

system and only had to include more specific processes to meet AFM requirements … yes it did mean we had to do a lot more training and development re AFM but even that worked well".

3.5.2 Management of Fatigue Risk

Interview participants were asked what aspects of their fatigue risk management systems they believed actually managed/reduced fatigue-related risk. In response, participants acknowledged a number of processes or strategies that they believed were the primary methods that reduced the risk of fatigue-related events within their organisation. These strategies and/or processes included:

- the commitment to safety and in particular fatigue risk management by all persons in their organisation.
- management commitment for fatigue risk management.
- in-vehicle technologies for monitoring or detecting driver fatigue.
- having a no blame approach (e.g., just culture) where drivers can discuss their safety issues freely with management.
- comprehensive safety system addressing fatigue, including thorough minor and major incident investigations, policy and procedures, regular training and updates, internal audits and safety inspections, tool box talks, and regular communication and collaboration in relation to fatigue and fatigue-related events.
- a continuously developing or evolving fatigue risk management system (continuous learning), including learning from errors or safety events.

Although response to the 'management of fatigue risk' or what participants believed actually managed or reduced fatigue risk was limited, there was consensus by many participants that for a fatigue risk management system to be effective there needs to be commitment from all levels of company personnel. One company owner/manager suggested "*everyone in the company has to be committed to safety otherwise the system fails … for example if managers don't have commitment towards safer operations then what changes, it basically becomes lip service and the drivers know it and so they are not committed also".* Likewise, some participants indicated that implementing a "*no blame*" workplace where causes of incidents are investigated to determine firstly what system failure(s) or other internal/external factors contributed to an incident rather than simply blaming the driver for all incidents. For example, a health and safety manager stated "*having a no blame system means you're more likely to get to the crux of the incident, what really occurred. If there is a culture where the driver is primarily to blame then information relating to an incident is generally not forthcoming from drivers – they don't want to seem to be responsible so they say nothing or say I don't know*".

Participants were also informed that the NHVR's on-road compliance data (e.g., Operation Wake-Up and other operations) showed that there were fewer safety-related issues reported for drivers operating under AFM. Subsequently, participants were asked in their experience would they agree with this. Although most participants (n = 26) stated that they did not know if this was the case for other organisations, they stated that for their own organisation safety (especially fatigue safety management) had improved since obtaining AFM accreditation. Most stated AFM required a greater commitment from management and improved systems for the management of driver fatigue as the primary reasons for improved on-road compliance.

AFM operators were also requested to provide information related to their fatigue risk management system components. For example, AFM operators were specifically asked questions in relation to the self-management of fatigue and how non-conformances are identified and addressed internally. Participants stated that non-conformances are identified by:

- checking drivers' *National Driver Work Diary* sheets daily and during internal audits to check for breaches;
- thorough investigations into fatigue-related events;
- discussions with drivers and visually checking drivers are not fatigued and are "fit for duty";
- utilisation of technologies, such as IVMS or tracking systems to ensure drivers are compliant with their work and rest hours;
- monitoring detection technology alerts to identify at-risk drivers ; and
- Complaints/information provided by clients, other drivers and members of the public.

In relation to the use of the 'hierarchy of controls' in the risk management process, many participants stated that the process was utilised during the development and implementation of their fatigue risk management system by either their safety staff or by a consultant. One owner stated "*I really could not tell you much about the hierarchy of controls but I do know it was used by the consultant during the process. I do know it is about the level or type of control used to reduce the incidence of fatigue risk".* Many traditional trucking company participants acknowledged they knew about the hierarchy of controls but were not sure of the contents such as the priority associated with the level of risk controls.

However, there were also traditional trucking companies (primarily the medium to large size companies) that stated they were fully conversant with the hierarchy of controls. For example, one safety and compliance coordinator suggested "*I utilise the hierarchy of controls all the time, it is what I'm used to being employed previously in my previous job*". In contrast, AFM company participants who are contracted to natural resource extraction projects stated that they were fully conversant with the use of the hierarchy of controls. It should also be noted that many of these AFM companies also hired professional safety personnel from the natural resource extraction industry or similar high-reliability/high-risk industries. These safety professionals are fully conversant with health and safety practice and safety management systems and processes, including the hierarchy of controls.

3.6 Safety Culture and Safety Culture Maturity

This section disseminates AFM-related culture results across 9 themes associated with Safety Culture Maturity (SCM), including leadership, organisational goals and values, communication, supportive environment, responsibility, learning, resilience, engagement, and trust in people and systems. Operators during the telephone interviews were posed open-ended questions which provided a starting point for discussion and then prompting questions were utilised to elicit more specific information. The level of Safety Culture Maturity for each participating AFM company was determined from interview discussions and descriptors contained in Appendix C. The following sections provide results in relation to the nine themes associated with Safety Culture Maturity.

3.6.1 Leadership

Table 4 shows the majority of participant responses associated with the leadership component were classified in the "Proactive" stage (66%) with almost a third of participants classified in the "Calculative" stage. Two thirds of participants (Proactive stage) indicated that, as managers or persons responsible for safety and compliance, they were actively visible in the workplace and demonstrated an interest in safety to company staff. One company manager stated "*I make myself visible especially during daily loading and unloading just to check that the guys are doing things right, have a chat to see if they have any concerns and just generally check the worksite to see if something is unsafe".* However, there were participants who stated that although they actively addressed safety issues the primary priority was to manage safety risks and avoiding non-compliances. These participants were classified as being in the "Calculative" stage of SCM. For example, one health and safety coordinator stated "*we try to be more proactive but our main focus is addressing risk and ensuring all our operations firstly meet legislative requirements".*

Management commitment for safety was also identified as an important element for driving safety culture and ensuring safety culture and safety management system improvements. For example, one owner stated "*commitment by managers is important to ensure the system works and continues to work over time. Without commitment and drive from management safety improvement is restrained, drivers tend to do what they want or think is best and incidents increase".* In addition, a health and Safety Director suggested "*workers are more likely to follow if they see their manager doing it … a manager has to be visible and seen following correct safety processes if they expect workers or drivers to comply*".

	Pathological	Reactive	Calculative	Proactive	Generative
No. of Companies	0	0	11	26	2

Table 4: SCM Leadership Component

3.6.2 Organisational goals and values

Table 5 reports the organisational goals and values of AFM companies as determined via the telephone interviews. In relation to Organisational Goals and Values, approximately 46% were determined to be within the "Proactive" stage indicating that many companies view safety as top priority and safety contributed to financial gains and business improvements. For example, one manager suggested "*we treat safety including driver safety as top priority in our company. Having a safe driving schedules, safe trucks and safe drivers ultimately means trucks are on the road and we are able to make our clients' needs and on time. Incidents mean we could be short of vehicles and drivers and therefore cannot easily and safely meet business requirements. Safety is number one".* Although a similar number of participants suggested that also safety was a very important component within their business, it was also seen as a potential deviation from core business outcomes, such as meeting client transport requirements and freight/product delivered on time. For instance, a company director indicated "*Safety for us is important but we also need to get freight delivered and on time, if we don't we don't have a business".*

	Pathological	Reactive	Calculative	Proactive	Generative
No. of Companies	0	3	14	18	3

Table 5: SCM Organisational Goals and Values Component

3.6.3 Communication

Table 6 shows that two thirds of AFM companies are operating in the "Calculative" stage of SCM in relation to providing safety-related communication to heavy vehicle drivers. All participants stated that they did provide safety-related communications to staff, including their heavy vehicle drivers. However, it was noted by many that providing safety-related data posed a few problems. With many drivers operating at varying times, such as early morning commencement and late conclusion of journeys, it is difficult to provide one-on-one and face to face communication strategies. In addition, some drivers operate from an alternative site (e.g., different to the primary place of operations) and in some instances a site situated in another Australian State or regional location. Therefore, two way communication is limited as are traditional face-to-face strategies related to providing safety-related communication (e.g., tool box discussions). Due to operational requirements and driver working hours most communication is performed via in-cabin communications, telephone, email, or placing hard-copy documentation on a noticeboard or on each driver's information location in the "key room' at each company site. Usually any important safety alerts or information are provided directly through vehicle in-cabin communication (e.g., radio, telematics systems, telephone). The difficulties associated with providing adequate and timely communication means that in many instances only information that is deemed operationally important is provided to drivers. For instance, one operations manager stated "*we don't get a chance to talk one on one with drivers on a regular basis due to the starting and finishing times of drivers … some don't even start/finish at our base. If we need to contact them we will send an alert across our in-cabin system* (e.g., MTData system), *like an email. We also have the capacity to get the drivers to acknowledge reading of the alert so we can ensure all drivers have read and understood the alert by pressing a button at the end of the message".*

However, there were AFM companies that did provide more traditional face-to-face communication to drivers. The majority of these organisations operated in the natural resource extraction industry and the majority of workers started and finished work at the same place. For most workers in this industry daily pre-start work meetings or toolbox talks are mandatory. One Health and Safety Manager stated "*we perform regular safety communication to individuals and work groups including tool box talks, safety meetings and if required one-on-one meetings with managers/supervisors. For us, this is a mandatory requirement by the Principal Contractor and is included in our contract".* In this case, communication is regularly and routinely provided with content and delivery based on providing proactive safety information.

	Pathological	Reactive	Calculative	Proactive	Generative
No. of Companies	0	4	26	9	0

Table 6: SCM Communication Component

3.6.4 Supportive environment

Table 7 shows that 85% of participant responses indicated AFM companies are in the "Proactive" (approximately 59%) or "Calculative" (approximately 26%) stage of SCM in relation to the level of supportive environment of their operations. Many participants stated that work/driving was scheduled to enable drivers to have a meaningful work-life balance. In addition, drivers are able to state they are not fit for work due to fatigue at any time without fear of any reprisal. For example, a company owner stated "*we encourage our drivers to let us know if they are not fit to drive for any reason, we don't assign any blame onto them. We had one young guy who was being kept awake by a new born, he was stuffed and obviously not fit to drive. No issues we had a relief driver do his run and he had an extra day of rest".* In contrast, some participants stated that even though they maintain a supportive environment sometimes you just have to get the freight delivered. For instance, a company director inferred "*safety is important but drivers are difficult to get and good drivers are like 'hens teeth' and we need drivers to drive our vehicles … sometimes you have to make sure the freight is delivered, no freight no work".*

Some participants from companies representing the 'Proactive" SCM stage indicated that they have a company where safety is discussed openly at all staff levels. Some also stated that their more experienced drivers often cooperated in improving safety and sharing safety-related information with other drivers. For example, a safety and compliance manager indicated "*we have a great bunch of experienced drivers who are willing at any time to provide safety advice to the newer drivers. This works great as sometimes this peer advice is taken more seriously coming from another driver".*

Further, five companies were identified as "Generative" in relation to their SCM level. These companies exhibited increased levels of support across their respective organisations. Along with providing safe work/driving schedules and extended knowledge through additional fatigue-related training, some companies where willing to invest in innovative ways to reduce fatigue risk and create a safe place to work. For instance, three companies had installed "Seeing Machines" fatigue monitoring technology across their AFM fleet. For example, a company owner stated "*we wanted to protect our drivers from fatigue over and above normal procedures so we invested in Seeing Machines, worked great for us. At the least it provides piece of mind that if some procedure fails, for any reason, the driver is constantly monitored and from what we have seen so far any subsequent fatigue event will be alerted*".

	Pathological	Reactive	Calculative	Proactive	Generative
No. of Companies	0	1	10	23	5

Table 7: SCM Supportive Environment Component

3.6.5 Responsibility

Similarly, Table 8 illustrates the highest proportion of participant responses indicated that the AFM companies are operating across primarily the "Calculative" and "Proactive" stages of SCM. Although there were instances reported regarding willingness for all staff to take personal responsibility for health and safety issues (n = 3, Generative stage), many participants suggested that health and safety issues, especially fatigue related issues, were addressed as a company/systems issue with relevant managers and safety staff working with drivers to manage fatigue risk and decide on strategies to reduce or mitigate fatigue risk. For example, one manager stated "*Safety is the responsibility of every individual in the company and we all work together to ensure the best outcome".* Those companies representing organisations at the "Proactive" stage also mentioned that staff at all levels (including drivers) are able to report any incidents, relay any safety concerns or provide ideas for risk reduction without individual blame. For instance, one company owner/director stated "*we have a no blame workplace and we want drivers to report all incidents and even near misses. However, we have a problem in relation to near miss incidents drivers are still reluctant to report those incidents. I guess they don't want to complete the paperwork".*

There were instances reported where interview participants stated that certain drivers reported unsafe practices or behaviours of other drivers but either did not want to say anything to the offending individual in fear of argument/reprisal or they just believed it was not their responsibility to intervene. In addition, many companies identified as being in the "Calculative" stage stated that safety was the responsibility of the safety-related officer working with employees to ensure the safety event did not reoccur. These participants stated that although management and drivers (to some extent) are involved, reliance was on the trained safety person to deliver risk reduction/mitigation strategies/controls.

	Pathological	Reactive	Calculative	Proactive	Generative
No. of Companies	0	1	13	22	3

Table 8: SCM Responsibility Component

3.6.6 Learning

Generally, most interview participants indicated that health and safety performance, particularly fatigue, is measured by both 'lagging' (e.g., incidents) and 'leading' (e.g., workers' experiences, company safety surveys) indicators. Although many used vehicle incidents and fatigue-related non-conformances (e.g., issues with *National Driver Work Diary* and breaches of driving hours regulations) as measures of fatigue safety performance, there were some companies that also utilised experiences of drivers (primarily at quarterly driver meetings, operational meetings and on an individual basis) as a measure of safety performance. During these meetings, drivers are informed of any risk reduction or operational improvement strategies. These strategies and other safety-related issues are discussed and perceptions of drivers are utilised to gauge drivers' potential acceptance level in relation to the strategies. For example, one health and safety manager stated "*we utilise our driver meetings to gather feedback and introduce new strategies or controls that are aimed at improving safety … we do this to see drivers' reaction and if necessary explain our reasons for implementing the strategies. Minutes are then sent to all drivers that are unable to make the meeting. The drivers' meetings are a valuable method for collaboration with the drivers after all they are one of our most valuable assets"*.

Participants stated that all incidents are investigated. On further investigation it was discovered that full investigations were performed for all fatality and serious vehicle incidents. However, it should be noted that the number of reported vehicle incidents for AFM accredited companies/drivers were low indicating that incident investigations are infrequent.

In addition, there seems to be some discrepancy between smaller AFM operators compared to larger AFM operators with the larger operators describing more comprehensive investigation procedures. The larger companies were more likely to investigate issues beyond driver/vehicle performance and explore other systematic contributing factors, including risk management processes, policy and procedures, operational practices, and organisational culture. For example, one company owner stated "*We don't just look at the immediate causes of incidents we look into what system elements may have also failed. You know, what could we have done better to prevent that and other similar incidents occurring".* Although many smaller operators also examined system elements during incident investigations this was not completed as comprehensively as potentially larger operators. This was primarily due to limited resources, time and experience in safety/incident investigations, with one company owner stating "*we do our best in regards to investigations mind you I cannot remember when we last had a serious incident. We just don't have the manpower or experience to conduct wider or larger investigations … generally we rely on Police reports".*

In relation to fatigue-related training, most participants stated that mandatory fatigue training is provided to all staff/drivers. In addition, fatigue issues are a major component of new driver inductions. However, only a few operators stated that they provided additional fatigue-related training over and above the mandatory training. For example, one health and safety manager indicated "*because fatigue is such a major issue in the heavy vehicle industry we like to do extra training in this area not only for all new drivers but also during current driver refresher training. We utilise film clips from Seeing Machines of drivers who have had a micro sleep in the past … it shows how easy it is. This, plus using other case studies to really enforce the impact of fatigue training works well, the drivers really take note and prefer the visual aids in the training, you can actually see what happens".*

	Pathological	Reactive	Calculative	Proactive	Generative
No. of Companies	0	3	18	18	0

Table 9: SCM Learning Component

3.6.7 Resilience

The Resilience SCM component questions address the effectiveness of organisational safety systems, including policy and procedures content and implementation of these policy and procedures within operational practice. Table 10 shows a majority of participants (approximately 54%) companies' operations were classified as being in the "Proactive" stage of SCM. The majority of these participants stated that their company had developed policy and procedures for all identified operational activities and risk management, especially related to driver fatigue issues. Furthermore, the participants stated that the policy and procedures are also integrated in training and new employee inductions. For instance, one company director identified "*we have developed policies and procedures for all our operational activities, particularly for fatigue and AFM operation. These policies and procedures are also utilised in our training and especially for new employee inductions … we make sure they fully understand and agree to the contents of the documents".* Whereas, a third of participants (33%) indicated that they had developed necessary policy and procedures to meet accreditation requirements and are basically used mitigate known risk and inform drivers of company requirements. For these organisations there SCM stage would be classified as "Calculative" – having systems in place to manage safety-related hazards and risks.

The results also suggested that five participating companies were described as being in the "Generative" SCM stage. Participants in this group all stated that they value staff/driver input into the development and review of safety policy and procedures and encourage driver feedback. One owner stated "*when any documentation such as policy and procedures are developed we provide a draft to our driver safety group for feedback. Quite often they come up with some amendments which does improve the document".* Some participants also indicated that they implement new policy/procedures/other documentation on a trial basis and review after a period of time to see if it still meets requirements.

	Pathological	Reactive	Calculative	Proactive	Generative
No. of Companies	0	0	13	21	5

Table 10: SCM Resilience Component

3.6.8 Engagement

In relation to engagement, a majority of participants' answers strongly suggest that workers/drivers are encouraged to participate in health and safety issues, albeit the proportion of drivers did vary across many of the organisations. For instance, Table 11 shows a majority of participants (59% - Proactive SCM) stated that they encouraged all staff/drivers to

provide feedback on any safety-related documentation/activity (including policy and procedures) and on many occasions managers actively seek feedback from drivers on operational and safety issues. For example, one operational manager stated "*we encourage feedback and input from drivers on safety issues, it makes them feel included and their feedback is value to us and the process".*

Participants did indicate that sometimes it was difficult to request and receive feedback from drivers. This was primarily due to the availability of drivers with most unavailable due to logistics, including "*not commencing or finishing shifts at the depot"* or just *"being away from the home office for periods of time".* Certain companies try to remedy this situation by providing hard copies of documents for review with drivers' pay sheets or via email.

In contrast, some participants indicated that although they did encourage input from and engage in consultation with drivers regarding safety issues/activities, this was performed with only a select group of drivers. Generally, it was stated that management engage with more experienced drivers and those who have provided feedback previously.

	Pathological	Reactive	Calculative	Proactive	Generative
No. of Companies	0	2	12	23	2

Table 11: SCM Engagement Component

3.6.9 Trust in people and systems

In relation to the SCM component "trust in people and systems", Table 12 reveals that a majority of AFM participants were classified as being in the "Proactive" stage. Most of these participants stated that within their organisation procedures are continually updated to reflect change either during regular periodic review, if additional risk is identified or any changes to work processes occurs. Participants also stated that the majority of vehicle incidents and non-conformances (e.g., fatigue related) are reported and investigated to ascertain not only event details but also potential contributing factors of incidents, including failure of system processes. For example, one health and safety coordinator stated "*our organisation ensures that all incidents are reported and investigated at least at some level, it's a requirement of our contract and is also good work practice. We use a no blame approach and look beyond the driver and investigate if any systematic errors had occurred".* Whereas, some companies that were classified within the "Calculative" stage indicated that although within their procedures all incidents are to be investigated, some incidents do not get reported by drivers. For instance, a company director suggested "*some blokes are reluctant report incidents for fear of reprisal or ridicule. We have tried to tell them we will not simply blame them, unless they have done something wrong, but unless there is a ding in the truck and its noticed they generally don't report the incident".* Some operators within the Calculative stage also indicated that policy and procedures were developed so all staff are aware of company rules and provides a platform to enforce those rules when required.

Interestingly, there were participants who acknowledged the importance of staff satisfaction. This was evident in those companies in the "Generative" stage and to a lesser extent the "Proactive" stage. One owner stated "*I treat my drivers as individuals not as a company employees, I believe the drivers feel comfortable talking to me about any concerns including safety. It's the best way to see if something is not right or unsafe".*

	Pathological	Reactive	Calculative	Proactive	Generative
No. of Companies	0	1	11	22	5

Table 12: SCM Trust in People and Systems Component

4 Discussion of Research Findings

The following section discusses the key findings in relation to the results obtained from AFM operator contacts who agreed to participate in the research.

4.1 Demographics

Currently, there are 50 operators who currently operate under AFM accreditation and all 50 companies were contacted and asked if they would like to be involved in the research project. In total, 39 operators agreed to participate in the research resulting in a response rate of 78%. This response rate could is considered a high rate of participant response and therefore enabling increased reliability in relation to the validity of results.

Company contacts who agreed to participate included primarily top-end staff, such as owners, owner/operators, Operations Managers, Health and Safety Managers/Coordinators. Although the large proportion of senior or top-end staff/management who participated in the research indicates the potential importance of AFM within the industry, this also potentially introduces research bias. For example, there may be an increased risk of bias based on the perceptions of participants or towards reporting safer options in relation to questions asked about safety practices, managerial procedures and safety culture in their company. To reduce research bias, additional questions and prompting statements were utilised to better determine the safety culture of respective AFM companies and ascertain an accurate SCM level. In addition, future research may consider interviewing other staff levels (including drivers) within each of the AFM accredited companies to gain a wider cross section of perceptions in relation to AFM (hence reducing research bias/errors).

The results illustrated that the more than half of AFM accredited companies were based in Queensland (n = 23, 59%) with New South Wales being the next highest with 9 companies. This result suggests an opportunity for the NHVR to further promote and encourage operators from all Australian States and Territories to apply for accreditation. Further, study participants were asked questions relating to their fleet size and number of drivers. Results indicate that a majority of AFM accredited companies operate relatively small - medium fleets (e.g., <50 vehicles) and drivers (e.g., <50 drivers). It has been stated previously that fleet size may influence the extent and sophistication of safety management practices that a company adopts (Eakin et al., 2010; Knipling et al., 2011; Mooren et al., 2014). Likewise this research showed that fleet size did have an influence on safety management and strategies designed to reduce safety-related risk (including fatigue management). For instance, companies with larger fleets reported an increased capability to provide additional resources and experience to developing and implementing safety management systems including strategies aimed at safety improvement (e.g., fatigue monitoring technologies). This result suggests that smaller operators may require additional assistance in developing and implementing AFM. Although many AFM operators engaged consultants to assist in AFM application, many smaller operators indicated the high cost of consultants as a financial burden to their company and also stated these high costs as a potential deterrent for other heavy vehicle operators not applying for AFM.

Analyses revealed two major AFM participant groups, those that provide traditional freight transport (e.g., line-haul, truck-related general transport) and companies that have contracts in and operate within the natural resource extraction industry (e.g., people transport – buses, water cartage, and excavation). Although discussed further in following sections, the type of heavy vehicle operations did have an impact on AFM applications. For example, those operating traditional truck/line-haul operations reported considerable difficulty in developing an AFM application due to a lack of experience and knowledge of risk management processes, the Risk Classification System and capability to produce a comprehensive safety case. In contrast, AFM companies working within the natural resource extraction industry reported already having the necessary experience and knowledge required to easily meet the requirements of AFM application. In essence, these companies employed health and safety personnel with experience in the industry and similar processes had already been completed in relation to acquiring a “contract” in the industry (e.g., contract applications).

4.2 Heavy Vehicle Incidents

A key finding of the research was that AFM operators reported limited vehicle incidents. For example, a majority of operators indicated that they had not incurred any fatal or serious type incidents during the last 12 months, with many stating it was a long time since one of their drivers had been involved in a fatal or serious incident. The NHVR’s Operation Wake Up, in part, supported these results identifying no fatigue-related offences incurred during fatigue check intercepts (both field based and camera based intercepts). These results suggest that AFM operators are generally operating safely and drivers are following suit by driving safely and complying with company safety systems.

Only one operator stated that they reported heavy vehicle near miss incidents. Near miss incidents are warning signals for organisations to reflect on current safety systems and practices (Lingard et al., 2014). Unfortunately, this result suggests that operators are not utilising valuable data that could be utilised as a learning tool to inform the potential improvement of their safety systems and operational practices. Further, the reporting and investigation of near miss incidents and application of the data to inform further safety-related strategies, policy and procedure amendments, and general improvement of the safety management system (e.g., fatigue risk management system). Further movement through the stages of SCM would require the heavy vehicle industry to utilise near miss reports and data to also assist safety system improvement.

A lack of data in relation to minor or property damage only incidents was identified and was primarily due to limited memory recall by participants. Although they could not remember actual numbers of minor incidents, they did mention that there were no fatigue-related incidents (apart from minor driving diary entry breaches) and total number of incidents would be low. Most AFM participants stated that they ensured all fatigue-related incidents are brought to their attention and are investigated. Future research requiring the collection of data frequencies, such as crash data numbers

should ensure that participants are provided with these specific requests prior to the telephone interviews. This would enable participants to provide more accurate data in relation to numbers and as this data involves frequencies it would not influence research results or introduce any substantial study bias or errors.

4.3 Perceptions of AFM

The majority of participants (all but one) stated that flexibility was the primary reason they "liked" or approved of AFM. For most of the AFM operators, they generally operate similar work/rest hours to the hours stipulated under BFM of which many operators had undertaken prior to moving to AFM and only utilise additional hours allowed under AFM accreditation on an as required basis. For these operators, the flexibility offered by AFM meant having that extra time to safely get drivers home, travel to a safe and comfortable rest stop, finalise deliveries even if drivers are held up waiting to be loaded/unloaded, and meet additional contract requirements. In contrast, for companies operating under contract to natural resource extraction projects AFM provided the flexibility to meet specific contractual requirements, such as working for periods of time (e.g., 7 or 14 days straight). Therefore, flexibility could be considered the major strength associated with AFM accreditation and should be utilised to further promote the benefits of AFM accreditation and encourage further uptake of AFM within the heavy vehicle industry.

Although most AFM operators stated that they had no issues in relation to AFM or the application process, there were certain issues identified that also influenced the perceptions of AFM operators in relation to increasing the uptake of AFM across the heavy vehicle industry. Previous research associated with AFM by Dawson, Blahous and Williamson (2019) reported that the low uptake of AFM by operators was due to:

a) The lack of industry expertise,
b) The lack of regulatory guidance materials',
c) The prohibitive expense of developing an individualised safety case for their operations, and
d) The difficulty in predicting the likelihood of approval by the regulator.

This research project identified similar factors AFM operators' perceived as influencing AFM uptake by other companies in the heavy vehicle industry, including difficulty with the AFM application process was the primary factor identified by AFM operators as deterring other heavy vehicle company participation in AFM. Also, the AFM application process was the major dislike by operators of the AFM process. Research participants indicated that the process was resource intensive, costly, difficult to understand, there was a lack of guidance information and lack of timely response from the NHVR regarding questions and approval during the application process. In addition, participants also noted that completing the requirements of AFM application required considerable health and safety and risk management knowledge and experience, of which many did not currently have. Therefore, this meant either employing a suitable person to manage the requirements of AFM or hire a consultation to develop the fatigue risk management system, RCS and safety case. Although this exercise was costly and resource intensive, it was short lived and many AFM operators believed it was worth the additional effort and expense. Basically the benefits outweighed the negative aspects of the AFM accreditation application process. To encourage further uptake of AFM accreditation the NHVR would need to develop and promote additional guidance material and potentially case studies to assist heavy vehicle organisations within the AFM application process. In addition, the NHVR may require a review of internal communication processes with an aim to improve AFM applications and all enquiries in a timely manner.

There have been schemes designed to assist organisations develop and implement systems designed to improve health and safety. The Injury Prevention and Management (IPaM) program developed and implemented by Workplace Health and Safety Queensland (WHSQ) aims to work with employers across Queensland to prevent and manage the outcomes of workplace injuries. There is no charge to participate in the program and it is available to any Queensland employer with a WorkCover Queensland policy, regardless of size or business maturity. The program aims to build on existing expertise to introduce or enhance injury prevention and management within organisations and create long-lasting and positive change. When entering the program, organisations are allocated a dedicated IPaM advisor who takes the time to understand an organisations' individual business needs and provide tailored advice and support, including developing a plan of action and support through the implementation of that plan. The NHVR may consider a similar type of strategy to assist those heavy vehicle operators who have identified a lack of expertise and require additional assistance in developing appropriate fatigue risk management systems and AFM processes.

4.4 Fatigue Risk Management Systems

Many AFM participants stated that prior to AFM accreditation they operated under BFM. Although through BFM they had developed a substantial amount of fatigue risk management system elements (including policy and procedures)

required in the AFM process, a higher level of documentation and subsequent knowledge of safety systems was required to successfully meet the requirements of the application process.

During the interviews, AFM participants acknowledged a number of limitations exhibited by companies in relation to risk management processes and developing and implementing a fatigue risk management system. These limitations included a lack of knowledge and experience, a large amount of paperwork is required during and after AFM application approval, and there was limited assistance available for developing a safety management system and also completion of the application process. By providing more specific and detailed guidance material and information for prospective operators wanting to access AFM accreditation may assist further uptake of AFM across the industry. In contrast, companies operating in other high-risk or high-reliability industries such as natural resource extraction stated they had limited difficulty associated with the AFM application process or developing and implementing a fatigue risk management system. Primarily, this was due to the level of 'experience' working with such safety systems and risk management by specialised health and safety staff employed within these companies. In addition, completion of the AFM process required similar processes to be completed within their contract applications which also required specialised safety systems. These results suggest that the industry requires access to specialised training in relation risk management processes and safety management system development and implementation. Alternatively, additional guidance material and potentially case studies of actual applications that meet the requirements of AFM accreditation. Typically, such guidance material would address the limitations identified within many of the traditional trucking/freight companies.

AFM participants were also asked questions in relation to their fatigue risk management system elements and any improvement strategies implemented within their organisation. Participants noted that management commitment and support was integral for the effectiveness of their fatigue risk management system and the implementation of improvement strategies. Basically similar to previous research (Lingard et al., 2014; Maierhofer et al., 2000) observable management commitment and support for safety is a key factor in organisational compliance and safety improvement. Management commitment is further discussed in Section 4.5.1

Reporting and investigating all incidents was identified as an important data collection strategy that can inform current risk management and also strategies for further improvement of the fatigue risk management system. It was also noted that encouraging trust in management and systems and applying a "no blame" system where drivers can discuss safety issues or incidents freely was essential for continuous safety system improvement.

There were a few organisations who implemented fatigue monitoring/detection technologies within their heavy vehicle fleet. Interestingly, the companies that introduced the technology (e.g., Seeing Machines) stated that it was the primary method that reduced the risk and incidence of fatigue-related incidents within their organisation.

Fatigue and drowsiness detection devices monitor and assess a driver's level of alertness and provide a warning when this is determined to have degraded beyond a pre-determined threshold (NTC, 2018). Whilst actual fatigue itself is hard to measure, technology can monitor eyelid movements of a driver, monitor and assess steering wheel movements and speed of steering movements, to calculate an approximate level of driver fatigue. Anecdotal evidence from commercial companies operating vehicle fleets; including heavy vehicle operators; that have installed fatigue/distraction detection technology suggest that fatigue-related safety has improved through the use of the technology. Although implementation of these technologies within vehicle fleets have indicated reduced risk of a fatigue-related driving event, previous research suggests that they should not be utilised as the sole means of fatigue risk management (Dawson et al., 2014). For example, the technology would not prevent a worker driving while tired. However, it may prevent a fatigue-related incident occurring by warning the driver. Subsequently, fatigue monitoring/detection technologies have the capability to provide advanced fatigue risk management by potentially eliminating (or at least reducing) the adverse outcomes of driver fatigue (e.g., incident caused by driver falling asleep at the wheel). Therefore, fatigue monitoring/detection technologies could be considered a valuable strategy as one component within any fatigue risk management system.

The following section provides additional information related to the safety culture of AFM accredited heavy vehicle companies and its influence on fatigue risk management systems.

4.5 Safety Culture and Safety Culture Maturity

The H&S Culture Maturity Model can be used by organisations wishing to understand the maturity of their H&S culture and to plot a course for improvement. The following sections discuss SCM in relation to AFM operations and the current maturity stage of AFM organisations' safety culture.

4.5.1 Leadership

Two thirds of AFM participants acknowledged the importance of leadership and especially management commitment as a major factor in organisational compliance and safety culture improvement. Previous research suggests that managerial behaviour is recognised as a key aspect of organisational culture in general and health and safety culture specifically (Lingard et al., 2014). For example, the underlying values and observable behaviours of managers are influential in shaping organisational cultures and health and safety performance. Basically managers act as powerful role models in the workplace (Maierhofer et al., 2000). When managers clearly and explicitly express their strong health and safety values and reinforce these values with consistent behaviour, health and safety is more likely to be regarded as an unconditional 'way of doing things' in the workplace.

Management commitment is seen as a core component of a positive health and safety climate (Flin et al., 2000) and is also seen as an important cultural driver of health and safety performance by all employees, irrespective of their level of seniority in an organisational hierarchy (Arboleda et al., 2003). Likewise, AFM operators identified management commitment as an integral component for safety compliance and safety culture improvement. A lack of management commitment and support, as well as a culture where the vehicle driver is seemingly seen as the cause of work-related driving incidents, may have additional negative ramifications associated with driver attitude. For example, drivers may display a "do not care attitude" or perceive driving performance is beyond their immediate control, which may subsequently increase the risk of engagement in aberrant driver behaviours. Therefore leadership and management commitment toward fatigue-related safety should be considered a primary requirement for further advancement of an organisations' level of SCM within the heavy vehicle industry.

Similarly, leadership provided by the NHVR in assisting companies with understanding AFM and the AFM application process is vital if other heavy vehicle operators are to be encouraged to apply for AFM accreditation. For instance, the NHVR is well positioned to dispel the myths associated with AFM and develop additional information products and services to assist the application process. A major implication of a lack of leadership from all stakeholders for AFM is that nothing will change and therefore numbers of AFM operators will remain limited. Further, a lack of management commitment and support would hinder any strategies aimed at safety culture improvement and actions directed at mitigating heavy vehicle driver fatigue risk.

A majority of AFM participants (e.g., two thirds of AFM participants) were categorised within the 'Proactive' stage of SCM. This result suggests the leaders associated with AFM are mostly committed to safety within their respective companies and show genuine concern for health and safety of staff/drivers. The management of these companies are less likely to blame their drivers for all incidents and more likely to investigate why the incident occurred and which safety system elements failed or contributed to the incident(s). To move to the 'Generative' stage, management of these AFM accredited companies would require to increase their visibility and communication in the workplace and personally discuss fatigue safety with drivers (e.g., walk the talk). Although this was performed by many in the proactive stage, there were indications that a certain proportion of drivers were not included within this activity, due primarily to different and remote work locations. Similarly, a third of AFM companies were categorised in the 'Calculative' stage of SCM due to a lack of visibility by management and active commitment to fatigue safety. In addition, although these companies had systems in place to manage fatigue related-safety their primary commitment was to ensure compliance with heavy vehicle regulations.

4.5.2 Organisational goals and values

What is valued, and what the organisation and its members aspire to be, are fundamentally shaped by the basic assumptions of the heart of the organisational culture (Lingard et al., 2014). In addition, the relative priority placed on health and safety within an organisation (or subunit) has been identified as a component of the prevailing health and safety culture. For example, Guest et al. (1994) defined safety culture as *… the underlying beliefs and assumptions in the organisation or among a subgroup about risk, danger and safety. It will include the way these issues are viewed and the priority attached to them in determining day-to-day behaviour.* Although a majority of AFM participants stated that safety was a priority over productivity, there were organisations that implied that although safety compliance was important they also had a duty to deliver freight on time. Therefore for these companies to move into a higher stage of SCM they would require to deliver strategies aimed at changing both management and staff perception regarding the importance of safety as a priority.

Research indicates that the balance maintained between safety and pressure for production is a key safety component of a health and safety culture (Flin et al., 2000). Analysis of serious organisational incidents often reveals the existence of cultural drivers that 'normalised' unsafe practices and led people to ignore early warning signs in order to maintain production or project progress (Hopkins, 2006). Workers need to accurately perceive organisational goals and values

regarding safety. According to Zohar (2000), workers' perception of the relative priority of the safety goal is developed by observing and experiencing patterns of managerial behaviours. Management must demonstrate consistent behaviours, reflected in:

- Congruence between statements and actions – they must 'walk the talk', and
- Consistent managerial responses to safety in different situations (for example, when facing adverse project events such as delays or disruptions).

Much of the previous research in this area suggests that management behaviour and actions influence the way staff/drivers react. For instance, if drivers feel valued and they trust management are ensuring their safety they are more likely to participate in safety-related activities including taking personal responsibility for safety.

4.5.3 Communication

Open and frequent communication about health and safety is identified as an important component of a positive health and safety culture (Lingard et al., 2014). Health and safety-related communication serves to:

- inform workers about health and safety hazards, risks and ways of working safely'
- elicit information about workers' experiences and concerns, and
- elicit suggestions for ways to improve health and safety.

AFM operators identified both formal and informal modes of communication were utilised to relay safety related issues and messages to all staff including heavy vehicle drivers. Formal methods included: tool box discussions, safety meetings, in-vehicle communications, telephone, email and hard copies provided at various sites (e.g., vehicle key room, with employee timesheet or on company noticeboards). However, participants also noted that it was difficult to introduce formal means of communication due to the nature of the industry. For example, operators noted that due to drivers starting early and finishing late normal meeting based communication (e.g., tool box discussions, safety meetings) are difficult to arrange. This is also an issue for drivers that operate from alternative sites (e.g., within a different state or territory) and cannot make regular safety-related meetings. In contrast, operators working within the natural resource extraction industry stated that formal communication channels were a requirement of many project contracts, including pre-start meetings or tool box discussions.

Informal communication channels enable managers to verbally communicate the importance of safety and to listen to workers' concerns. Examples include conducting management tours and 'walking the job, talking to people and listening to people' (HSE, 2001, p. 67). This direct communication conveys managers' commitment to and concern for workers' health and safety (Cheyne et al., 2002). Similarly, Olive et al. (2006) suggest that 'management by walking around' is a key indicator of a company with good communication between different levels. This research identified those managers in companies operating in the "proactive" stage or greater conducted regular walk-arounds to talk to staff about their safety issues or concerns and to view their work practice. These walk-arounds by management emphasise the importance of managers' physical presence in a workplace, observing work procedures and processes. Managers can develop a deeper understanding of the health and safety issues by actively discussing health and safety challenges and issues with workers. Meaningful face-to-face communication can help to cultivate trust, which enhances workers' willingness to voice health and safety concerns and problems (Lingard et al., 2014).

Workers' willingness to voluntarily raise health and safety concerns is greater when managers are perceived as supportive and willing to listen (Mullen, 2005). Previous research shows that developing mutual trust relies on open communication (Conchie & Burns, 2008; Conchie, Donald & Taylor, 2006). Similarly, many operators, especially the owner/director of AFM accredited companies, indicated that if you want to obtain information from your staff you need to treat them as individuals and not just workers under their control, to listen to them and action any quality suggestions made by staff. Research suggests that open communication about health and safety risks significantly contributes to workers' trust in risk management processes and decisions (Conchie & Burns, 2008). Essential for moving forward through the SCM stages is trust, not only between the employer and employees, but also trust in and knowledge of the current safety system.

4.5.4 Supportive environment

A supportive work environment has been identified as a facet of health and safety culture (Cox & Cheyne, 2000) and research confirms that features of the physical and psychosocial work environment influence health and safety-related behaviour and performance (Christian et al., 2009). Parker et al. (2001) reported that workers' adoption of safe working practices is positively predicted by workers' perceptions that their employing organisation provides a work environment that is supportive of good supervision, training adequacy, job security and communication quality. AFM operators also identified visible management commitment and support for safety, an environment where the sharing of ideas are

encouraged and additional practical strategies aimed at improving systems and processes rather than blaming the driver as important for an open and safe supportive environment. Having a supportive work environment is believed to influence health and safety in a number of ways. A direct effect is likely to flow from the open and effective communication, appropriate levels of training and supervisory concern for health and safety. An indirect effect has also been suggested: organisational support is believed to produce higher levels of organisational commitment (Barling et al., 2003), job satisfaction (Parker et al., 2001) and trust (Zacharatos et al., 2005). For instance, AFM operators who regularly walked around and talked to drivers believed this process increased the levels of trust and willingness for drivers to partake not only in improvement strategies but also to provide their thoughts, beliefs and feedback relating to safety issues. This was viewed as supporting drivers by enabling them to communicate in an informal and unthreatening environment.

Perceptions of organisational support have been linked to a strong and positive safety climate, workers' compliance with organisational health and safety policies, and reduced involvement in work incidents (Gyekye & Salminen, 2007). Therefore, developing strong and positive climates for safety is the mechanism by which global perceptions of a supportive work environment positively influence safety outcomes.

4.5.5 Responsibility

Organisations with a positive safety culture ensure that all employees are aware of their health and safety responsibilities. It has been argued that an organisation with a good safety culture promotes a caring atmosphere in which workers at all levels take some personal responsibility for health and safety (Pidgeon, 1991). Generally, AFM participants acknowledged that safety is the responsibility of everyone in the workplace. However, it was also noted that some drivers did not report any unsafe behaviours by drivers for fear of reprisal or confrontation. Promoting personal responsibility for safety is important for health and safety performance. Research has shown that there is a positive relationship between individual safety responsibility and the level of safety activities (Cheyne et al., 1998). Individual safety responsibility influences the extent to which the level of safety activities is prioritised among other organisational variables (such as safety management, and safety standards and goals) and group processes (including personal involvement and communication).

Research suggests that managers perceive safety as their responsibility to a greater extent than workers do (Harvey et al., 2002). In addition, managers and supervisors need to raise employees' awareness of taking personal responsibility for safety. AFM participants, many of whom are at a management level, also indicated that if a company wanted to increase safety responsibility across its organisation, a no blame approach should introduced. Previous research indicates that when managers and supervisors have a caring attitude, workers are motivated to pay more attention to safe working practices (Jannadi, 1995). For example, Parker et al. (2001) reported that when team leaders' adopted a considerate and coaching oriented approach to accepting personal responsibility for safety, workers were motivated to put greater effort into safe working practices. In addition, lower injury frequencies were reported if workers' ideas were considered seriously by supervisors, and if they were praised for good work performance (Jannadi, 1995). Further, previous research suggests that workers will develop a caring attitude if they trust management's commitment to safety (Burt et al., 1998). In contrast, in a non-caring environment workers might not alert management and other co-workers to a hazard created by a co-worker if they feel that management may punish the worker who created the hazard.

4.5.6 Learning

A mature safety culture can emerge only if an organisation is a learning organisation (Fleming, 2000). Research (IAEA, 2002A; Saw et al., 2010; Weick et al., 1999) has identified essential characteristics of a learning organisation, including:

- striving for continuous improvement and new ideas,
- ensuring that all the individuals and teams are aware of the benefits of improving safety'
- learning from one's own experience and from the experience from others'
- sharing ideas and information internally and externally, and being open to and encouraging innovation'
- being mindful that things can go wrong and tolerating (but learning from) legitimate mistakes'
- allowing flexibility in searching for safer ways of working'
- actively learning from errors and failures rather than seeking to blame and/or find a scapegoat'
- questioning commonly held assumptions about what is safe and working to uncover latent (hidden) hazards in work systems' and
- fostering knowledge sharing throughout the organisation, crossing boundaries of teams, disciplines or divisions.

Reason (1997) identified a learning culture as a vital component of an organisation's safety culture. In addition, a learning culture encompasses ongoing reflection about current safety practices and beliefs, and the ongoing search for

ways of eradicating or minimising risks (Pidgeon, 1998). Further, a learning organisation should proactively seek feedback and suggestions (e.g., collaboration and communication) from employees at all levels (Hale, 2003). Findings of this research also identified a number of ways AFM accredited companies created a form of learning culture including collaboration with drivers to further develop driver training and inductions as well as identifying and implementing improvement strategies. The utilisation of driver experience was reported as assisting the learning process. Less experienced drivers were more willing to listen and learn from experienced drivers, during both formal training to informal roadside/depot discussion.

Wiegmann et al. (2004) suggest that an effective incident reporting system is the keystone in identifying vulnerabilities associated with existing safety management before an incident occurs. However, an effective system improves safety only if an organisation is willing to learn proactively and to adapt its operations. Improving safety is maintained by organisations' willingness to learn proactively and to adapt their operations based on incident reporting (Wiegmann et al., 2004). An effective reporting system provides workers with timely and valuable feedback, informs them that their reporting has been reviewed and that appropriate actions will be taken (Wiegmann et al., 2004). There was variability in responses by AFM participants regarding incident reporting and investigation. However, those AFM accredited companies that completed incident reporting and investigation for all incidents also reported higher levels of staff collaboration and use of the incident data to improve systems and minimise current and future safety risk. Although reactive in nature, the use of incident data as a tool to inform potential safety improvement is a necessary component for increasing the level of SCM within organisations.

Hale (2003) argues that causes for incidents and opportunities for improvements should be sought in the interaction of many causal factors rather than in individual behaviour. Therefore, solutions and safety improvement should be sought in many places and from many people, most notably those who are performing the actual work (e.g., frontline workers). AFM operators also noted that employee trust in management and an environment that did not place blame solely on drivers increased the likelihood for drivers to provide accurate feedback in relation to the causal factors of incidents.

Research suggests that near miss incidents differ from actual incidents only by the absence of the final trigger event and the presence of chance (Pidgeon, 1998). Near miss incidents are warning signals for organisations to reflect on current safety systems and practices. Unfortunately, the majority of AFM companies did not report near miss incidents. In order to increase the level of SCM within an organisation, companies would need to report and use near miss data as another tool to inform system and practice improvement strategies. This is especially the case in an environment where the actual numbers of vehicle incidents are low. In this case, a review of near miss incidents may provide the necessary information to prevent similar incidents occurring.

4.5.7 Resilience

An organisation with a positive safety culture will have a high level of resilience, defined as: *… the intrinsic ability of a system to adjust its functioning prior to, during, or following changes and disturbances so that it can sustain required operations under both expected and unexpected conditions* (Hollnagel et al., 2011, p. xxxvi).

An organisation's resilience is reflected by the flexibility and variability in operations. For many of the AFM participants the flexibility provided by AFM accreditation alleviates many of the constraints to operations due to insufficient hours to complete a task for travel under BFM or Standard hours. Many organisations attempt to reduce the number of unsafe acts by requiring employees to comply rigidly with procedures. They see errors and violations as workers' deviations from standard procedures and subject to sanctions and disciplines. Unfortunately focussing on punishment leads to the organisations' loss of opportunities to reflect on current procedures and analyse the systematic causes of workers' unsafe acts. The majority of AFM participants stated that their company had developed adequate policy and procedures addressing the majority of operational activities and risk management. They also suggested that they instilled a 'no blame' approach regarding the reporting on non-conformances and incidents which encouraged drivers to engage in safety (especially fatigue risk management) and provide feedback and input for safety-related strategies. The results suggest that many AFM operators have the making of a strong and resilient safety culture.

In contrast, there were AFM companies that still maintained a primary focus of meeting productivity and compliance requirements. Although stating 'fatigue safety' as the primary focus for these companies, they further indicated that sometimes productivity requirements needed to be met to ensure continued operation in the heavy vehicle industry. For these companies strategies are required to maintain a balance between safety and productivity/compliance issues.

4.5.8 Engagement

An organisation with a positive safety culture actively engages its employees in safety activity development and decision making processes (Cox & Cheyne, 2000; O'Toole, 2002). Employee engagement is defined as:

Personnel from all levels of the organisation are involved in decision making, safety planning and providing ideas for improvement. Employee participation and feedback are actively sought (HSE, 2005B).

Within the current research, there was considerable variation between AFM accredited companies in relation to the level of engagement exhibited within their respective organisations. Although many AFM companies suggested they encouraged greater engagement between drivers and management, some companies suggested this was not possible in many instances due to the availability of drivers, with most on the road during normal working hours. However, certain companies found ways around this issue by utilising alternative communication such as telephone or in-vehicle communications or by engaging with drivers during loading/unloading at customer sites. These companies acknowledged the importance of driver engagement in the safety process rather than requiring them to just to comply. Drivers were more likely to comply with safety systems if they had a role in its development and implementation.

Safety participation is described as 'helping co-workers, promoting the safety program within the workplace, demonstrating initiative, and putting effort into improving safety in the workplace' (Neal et al., 2000, p. 101). Research suggests that workers' safety participation is associated with reduced accident occurrence (Christian et al., 2009; Neal & Griffin, 2006). In addition, Clarke and Ward (2006) reported two influencing tactics available to leaders to engage employees in safety participation – consultation and rationale persuasion. In organisations where leaders share relevant health and safety information with workers, involve them in decision making and encourage worker involvement, the safety climate is more positive and workers are more active participants in workplace health and safety processes. Interestingly, those AFM companies that reported higher levels of driver engagement and participation in safety process/system development also reported greater trust, willingness to provide further input, reduced fatigue-related events and non-conformances.

A crucial aspect of safety is to engage employees in high quality interaction and cooperation across organisational functions and hierarchical levels. As implied by the current AFM research, interaction and cooperation are supported by mutual trust, empowerment and listening well.

4.5.9 Trust in people and systems

Trust is defined as an individual's tendency to rely on other people or entities in a risk situation. For health and safety, trust is described as individuals' attitudes to, and expectations of, other people and the organisational systems embedded within the institutions (Jeffcott et al., 2006). Trust was identified by AFM participants as a major factor for ongoing safety compliance and the continuous development and improvement of fatigue risk management systems. It was noted that drivers were more likely to provide feedback and input into safety systems and partake in improvement strategies if they trusted management would not blame but listen and take action on their suggestions. In addition, most drivers generally trusted the experienced drivers within the organisations. The use of experienced drivers or "stories" from these drivers regarding safety was seen as an effective strategy to assist the promotion of safety and provision of 'real life' situations during fatigue-related training.

Ultimately, if an organisation cannot maintain trust in people and systems then staff/drivers are more unlikely to provide input in relation to safety processes and partake in safety improvement strategies. Therefore, trust in people and systems could be considered integral to the further improvement of a safety culture and subsequent SCM.

4.6 Research Limitations and Future Research

A limitation regarding the demographic results was the lack of information recall by participants in relation to their drivers' age range. Due to the lack of information provided in relation to the age range of drivers employed by AFM accredited operators, drivers' age was not included within the results. Similar future research may require certain questions to be added to the introduction email indicating certain questions that may be asked. This enables potential participants to have the data available during the interviews.

Similarly, regarding the number of vehicle incidents/crashes most participants had difficulty remembering actual figures. For instance, although participants could recall the number of fatal and serious-type incidents due to the rare occurrence of such events, they found it difficult to remember the number of minor or property damage incidents or near misses (if reported). Similar to drivers' age, future research should enable potential participants' prior access to certain questions that require responses to identify frequencies of more common or regular occurrences such as minor vehicle incidents or near misses.

It should be noted that responses to the Safety Culture Maturity component questions relate to the AFM company contacts' perceptions and beliefs. Consequently, with most AFM contacts being company owners/directors/managers

there could be some bias by participants towards reporting safer options in relation to questions asked about safety in their company and managerial procedures.

Another limitation of this research is that it only investigates those companies operating with AFM accreditation. Therefore, the research only examines AFM and does not compare results pertaining to AFM with other companies within the heavy vehicle industry (e.g., Standards hours or BFM). Future research should utilise a comparison group(s) to assess the level of safety management and fatigue risk associated with AFM operators compared to the rest of the industry.

5 Conclusion and Recommendations

This qualitative research project explored AFM accredited operator perceptions in relation to AFM and associated safety system, processes and culture. To date, there has been limited research conducted regarding AFM, fatigue risk management and safety culture maturity within the heavy vehicle industry.

The majority of AFM companies were classified as being in either the "Calculative" or "Proactive" stage of SCM. Although this is a good result, there is room for SCM improvement. This result suggests that safety is in the forefront of AFM companies with the majority of companies operating with a well-developed and implemented fatigue risk management system. Those companies that actively communicate with drivers and where management are visible in the workplace discussing safety issues with staff are more likely to develop trust and receive meaningful collaboration and engagement from staff for identified safety issues, reporting incidents and participate in safety improvement strategies.

Although current AFM operators indicated that the flexibility associated with additional work hours or periods of time (e.g., work on 14 consecutive days on in the natural resource extraction industry) was the major benefit of AFM accreditation, industry uptake is low across the industry. The primary reason identified by current AFM operators for this low uptake of AFM by the heavy vehicle industry is that it is believed the application process is too difficult, time consuming and costly for most operators, especially those that do not have the expertise in developing and implementing appropriate and adequate fatigue risk management systems.

Although it is the responsibility for operators to develop, implement or improve processes to meet the requirements of AFM accreditation, the NHVR can assist by providing necessary guidance material (or change current processes) to assist in AFM accreditation applications. The NHVR is uniquely positioned to provide additional resources, information and advice to eliminate the myths associated with AFM accreditation and assist operators during the AFM application process. The Regulator and/or other agencies could also assist heavy vehicle operators in increasing their level of SCM. By utilising the SCM model it enables those companies without considerable expertise in the management and development of improved safety culture to engage in culture change in manageable (and measurable) steps. The NHVR could develop the necessary information and assistance to further develop fatigue safety culture within the heavy vehicle industry.

The current AFM research identified a number of recommendations aimed at improving AFM, fatigue risk management and AFM uptake by other heavy vehicle organisations, including:

- Promotional strategies are required to encourage greater uptake of AFM nationally. Currently, the majority of AFM accredited companies are located in Queensland and New South Wales with limited numbers from other Australian States and Territories.
- Comprehensive guidance material should be developed by the NHVR to assist organisations in the AFM application process and requirements. This recommendation reflects AFM operator's perceptions regarding potential operator dislikes to the AFM process and potential strategy to promote a greater uptake of AFM within the heavy vehicle industry.
- Additional ongoing advice and guidance material should be developed to assist organisations to develop and implement elements of a fatigue risk management system, especially for the general trucking industry. The NHVR may consider a similar type of strategy to WHSQ's IPaM program (mentioned in section 4.3) to assist those heavy vehicle operators who have identified a lack of expertise and require additional assistance in developing appropriate fatigue risk management systems and AFM processes.
- AFM operators should engage in additional leadership strategies aimed at increasing management commitment and support for fatigue risk management as a priority over and above legislative compliance and productivity. For example, some operators found that by being visible in the workplace and discussing safety, management can instil greater heavy vehicle driver engagement, responsibility and trust.

- Operators should introduce a just culture approach (i.e., no blame approach) to the reporting and investigation of incidents and driver error. All staffing levels within organisations should be included within these processes. For example, a “no blame” workplace where causes of incidents are investigated to determine firstly what system failure(s) or other internal/external factors contributed to an incident rather than simply blaming the driver for all incidents. Previous research suggests that organisations that operate under a “no blame” approach have increased participation and collaboration in safety activities and increased personal responsibility for safety-related issues.
- The research identified a variance across AFM operators in relation to incident reporting, recording, and investigation, especially near miss incidents. Although reactive in nature, incident data provides valuable information in relation to informing safety strategy development, implementation and evaluation. For instance, near miss incidents are warning signals for organisations to reflect on current safety systems and practices (Lingard et al., 2014). Consequently, AFM operators should develop procedures that require all incidents and near misses to be reported, recorded and investigated. This data should be utilised as information for future safety improvement strategies.
- A major problem associated with communication between drivers and management within the heavy vehicle industry is the capability of companies to communicate safety issues with all staff. For instance, strategies should be developed that ensure all drivers receive safety-related communications, including those that work remotely from operators’ home sites or do not regularly return to a home base of operations.
- Further research should be conducted to compare the results reported within this research project with those operators performing heavy vehicle operations under potentially BFM and/or Standards Hours. This would provide a comparison in relation to the effectiveness of AFM operators compared to other operators within the heavy vehicle industry.

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Appendix A

AFM Survey Protocol, Questions & Prompts

Why is the NHVR conducting this telephone survey?

Recent roadside operations have reported considerable safety-related compliance particularly by AFM operators and their drivers. This increased on-road safety is a credit to all under AFM. As you may/may not be aware the number of operators in AFM is small in comparison to the overall number of operators. The NHVR would like to increase the number of AFM accredited operators and would appreciate your assistance by partaking in this short survey (approximately 20 minutes). Generally, we would like your views of AFM including what you think could improve the system, encourage other operators to participate, and how you address fatigue-related safety risk.

All information is confidential. Prefer to report aggregate data but if you make a statement with a publishable insight we might quote that insight anonymously.

Demographics

Organisation/Company name:

Your position in the company:

Location/State:

Areas of operation:

How many vehicles do you operate?

How many drivers do you employ?

Do you utilise contract drivers? How often?

What is the age range of your drivers?

Do you operate a mixed fleet or just AFM?

Two to three word description of your type of business e.g., type of freight, medium, large, etc?

What is your scheduling in relation to driving hours under AFM?

Heavy Vehicle Incidents/Crashes

In relation to heavy vehicle incidents – previous 12 months (or longer?):

Have you had any fatality crashes in the previous 12 months (or longer?)? If yes, how many and details.

How many were fatigue related?

Have you had any serious crashes (e.g., injury/hospitalisation)? If yes, how many and details.

How many were fatigue related?

Any minor or property damage incidents? If yes, how many, type and details.

How many were fatigue related?

Any near misses? If yes, how many, type and details.

How many were fatigue related?

General AFM Related Questions (open-ended questions)

What do you like or not like about AFM?

What do you think would improve AFM?

In your opinion, why hasn't AFM been more widely accepted by the heavy vehicle industry?

Did you have fatigue-related systems/processes in place prior to your AFM application that made it easier to transition to AFM? (e.g., from BFM)

What aspects of your system do you think actually manage/reduce fatigue risk?

The NHVR's on-road compliance data shows fewer issues for driver operating under AFM. Would you agree with this in your experience?

In relation to self-management of fatigue-related compliance, how is non-compliance identified and how is it addressed internally?

Is the Hierarchy of controls (e.g., risk management) utilised in this process?

Safety Culture Maturity

Pathological	Reactive	Calculative	Proactive	Generative

1) Leadership

Describe how is fatigue-related safety is managed within your operations?

- Policy and procedures related to AFM operations? Is it reviewed and how often?
- Interest/visibility of management within operations (e.g., only if something goes wrong, visible in the workplace, walk the talk, etc).

Are drivers disciplined for poor behaviour/attitude in relation to fatigue safety and AFM procedures/requirements? (if yes, how – just discipline, mentoring, continual monitoring)

Is prior fatigue-related performance identified (e.g., question to referees) during new driver recruitment processes?

2) Organisational Goals & Values

How is fatigue-related safety prioritised in your organisation/company? Describe process

- For example, productivity over safety, dependent on costs, safety is top priority, safety is integral business activity).

3) Communication

How are fatigue safety-related issues communicated within your organisation/company?

- How is communication provided – face-to-face, email, phone message, in cabin devices, other.
- Fatigue-related training/education provided.
- Staff/driver induction process.
- Contractor induction into company's procedures/expectations.
- Fatigue-related tool-box talks, discussions work group meetings, alerts, e-alerts.
- All staff levels (including driver base) consulted regarding fatigue-related issues.
- Are relevant driver behaviours/attitude challenged? How/process?
- Are people who positively impacted fatigue safety recognised and/or rewarded? Process/how?

Are there any difficulties associated with communication?

- Availability of drivers/staff (e.g., majority long haul or do not often return to company base).
- Time, resources, costs.

4) Supportive Environment

How is work designed to meet both operational productivity and safety requirements?

- Time pressure, excessive hours, unsafe work stopped when observed or continued to get the job done, work designed to positively promote health and work life balance.

How is potential fatigue risk addressed within your organisation? Formally (office/system based and in the field).

- Carry out risk assessments related to fatigue and AFM?

- Conduct risk assessments for changes in procedure?
- Carry out ongoing internal reviews/audits relating to AFM?

5) Responsibility

Who is responsible for driver and vehicle safety? Especially in relation to fatigue.

- Willing/unwilling to take personal responsibility. At what level is fatigue addressed/targeted.
- Reporting unsafe behaviours.
- Notify work colleagues if observed being unsafe.
- Additional/proactive initiatives.

6) Learning

Are all fatigue-related driving incidents investigated?

- To determine who is to blame.
- Just because it is an OHS requirement.
- To identify possible causes.
- Identify systematic causes of incident (e.g., culture, risk management).
- Rigorously uncover systematic causes.

What fatigue-related training is provided within your organisation? Reactive/proactive

- Competency assessments of drivers? At induction and ongoing?
- Only legislative required training completed.
- When there is an incident.
- Additional and ongoing training/awareness activities provided.

7) Resilient

Why are fatigue-related policy and procedures developed within your organisation?

- E.g., to comply with legislative requirements, integrated within training, staff/contractors consulted on their development and/or review. Exceed level of just compliance (e.g., goes beyond that which is required for compliance)

Policy and procedures related to AFM operations? Is it reviewed and how often?

How are contractors notified (if/if not) in relation to your company's fatigue-related policy and procedures?

Do you conduct driver performance appraisals? Is fatigue safety a component in employee/driver performance appraisals?

Do you conduct internal audits of your AFM? How often?

8) Engagement

What level of engagement is encouraged/required within your company on fatigue-related issues (e.g., risks, risk control, etc)?

What levels? Contractors?

- For example, are certain levels not required, systems are only developed to meet compliance, all in organisation are encouraged to participate, workers/drivers feel comfortable to participate.
- How is this done within your organisation?

9) Trust in People and Systems

Are drivers/contractors trusted to always do the right thing in relation to fatigue safety?

In your opinion, do drivers/contractors trust management (in relation to fatigue safety)?

What is the main purpose of fatigue safety systems?

- Protect company profits, legal compliance, most/all safety issues reported/and investigated.

Appendix B

Hi

The Heavy Vehicle National Law (HVNL) that regulates heavy vehicle driver fatigue is currently being reviewed and the NHVR is working with the National Transport Commission and other stakeholders to build better rules for the future.

As part of this, I have been asked to assess the performance of AFM safety operations within the heavy vehicle industry by Andreas Blahous, the NHVR's Fatigue Specialist.

As a leader in heavy vehicle safety, we would appreciate your assistance via a short telephone survey. Phone calls will commence next week from 23 July, 2019.

Why is the NHVR conducting this telephone survey?

Recent roadside operations have reported positive safety-related compliance outcomes by AFM operators and their drivers. This increased on-road safety is a credit to all under AFM.

As you may/may not be aware the number of operators in AFM is small in comparison to the overall number of operators. The NHVR would like to increase the number of AFM accredited operators and would appreciate your assistance by partaking in this short telephone survey (approximately 20 minutes).

Generally, we would like your views of AFM including what you think could improve the system, encourage other operators to participate, and how you address fatigue-related safety risk. All information is confidential.

Your assistance and time relating to this matter would be greatly appreciated. The NHVR is strongly committed to safety and your assistance would help us to initiate valid and reliable initiatives and strategies to promote further AFM uptake within the heavy vehicle industry.

If you have any preferred date/time that I may telephone you, please reply to this email.

Kind regards

Bevan Rowland

Appendix C

Safety Culture Maturity Descriptors					
Culture Component	**Pathological**	**Reactive**	**Calculative**	**Proactive**	**Generative**
Leadership	• Managers respond negatively to all criticism. • Managers and workers are suspicious about each other. • Managers are more concerned with operational issues.	• Managers are not interested in safety until something goes wrong.	• Safety is about managing risk and avoiding prosecution.	• Managers will actively ask about safety and procedures. • Senior managers are visible in the workplace and demonstrably interested in safety. • Workers feel comfortable talking about their concerns to managers at any level.	• Managers at all levels actively walk the talk and demonstrate H&S. • Safety is driven by genuine concern for people. • Managers are consistently good role models.
Organisational goals and values	• Profitability is the only concern of managers. Safety is seen as costing money. • Managers prioritise cost minimisation at the expense of safety.	• Cost is important but there is some investment in preventing work injuries and illnesses. • Work scheduling and cost reduction pressures dominate decision making.	• Safety and productivity are juggled (as opposed to being balanced). Managers make public statements about the importance of H&S but do not 'walk the talk' consistently. • Expenditure on H&S is regarded as discretionary. • Managers ensure that H&S standards are maintained, even if this costs money/time. • Safety is regarded as a bureaucratic impediment to the work.	• The organisation states that H&S is top priority. • The rationale for this is that H&S contributes to financial success. • H&S and profitability are juggled and the organisation accepts some work-related delays to ensure H&S standards are met.	• H&S and profitability are well balanced. • H&S is an integral part of all business activity and decision making. • H&S is understood to make a positive contribution to the future of the business.
Communication	• Managers do not communicate with drivers and contractors except to tell them not to cause	• Limited and intermittent H&S information is communicated to workers and contractors.	• Managers share limited H&S information with drivers and contractors. • Despite the frequency of	• H&S information is routinely and regularly communicated to drivers and contractors. • Two way communication is	• The organisation actively and openly shares H&S information with drivers and contractors.

	problems. • Communication is one way and directive. • Important H&S information is not communicated to drivers and contractors. • Conflicting messages about the importance of H&S are conveyed.	• Safety messages when given are sometimes unclear. • Communication is mainly top-down usually occurring to resolve an issue. There is little or no opportunity for bottom-up communication of H&S concerns or ideas for improvement.	top-down and bottom-up communication, drivers' suggestions and ideas for safety improvements have little impact.	actively encouraged. • Suggestions and ideas by drivers for H&S improvement are taken seriously and implemented where possible.	• H&S communication is frequent, open and effective. • H&S communication is a strong and consistent two way process. Managers receive as much H&S information as they give.
Supportive environment	• Work is designed and scheduled in a way that creates excessive time pressure, workload, stress and fatigue. • Obstructive and uncooperative relationships exist between individuals and groups. • A 'silo mentality' exists. • People feel overwhelmed and unable to drive in a safe manner.	• Managers and drivers deal with workload problems and fatigue as they arise. • Safety is treated as an individuals' responsibility. • There are low levels of cooperation and poor information flows as the priority is to complete the work.	• An effort is made to improve driver safety but driving schedules still demand excessive hours. • Managers are aware of the importance of managing H&S. They pay 'lip service' to H&S. There is often a gap between organisational H&S policies and procedures and accepted practices. • Levels of cooperation and communication reflect functional roles and relationships.	• Work is restructured or rescheduled so far as possible to support safety. • Functional teams and individuals work hard at sharing and cooperating to improve H&S.	• Work design and scheduling positively promote health and work-life balance. • Effective cross functional cooperation and team work. • All staff feel they have the knowledge, skills, and ability to work in a healthy and safe way. • Willing to invest in innovative ways to provide a safe and healthy workplace.
Responsibility	• Managers believe that H&S is each individual's responsibility and people should 'look after themselves'. • There is widespread unwillingness to take responsibility for H&S. • People are reluctant to accept that they each have a role in H&S. • People turn a blind eye if they observe an unsafe practice.	• Everybody feels bad when something goes wrong but won't accept responsibility. • Assumption that incidents 'just happen' and that some individuals are more prone than others. • People are concerned but do not intervene.	• Safety and compliance personnel assume the role of policing the workplace. • Incidents of unsafe practices are reported but personal responsibility is avoided. • In relation to H&S, we work within the law.	• H&S is treated as a line responsibility and advisors provide technical input. • Staff/drivers stop unsafe practices when observed. • Managers, workers/drivers and contractors are developing a commitment to H&S and care and concern for the H&S of themselves and others.	• The safety and compliance role is assumed by everyone. • At every level there is a willingness to take personal responsibility for H&S. • Managers look inwards as well as outwards to look at causes for H&S issues. • All personnel actively demonstrate care and concern in looking after their H&S and that of others. • Collective norms and expectation drive H&S

					behaviour.
Learning	• Staff fear that if they report incidents, errors or safety issues they will be regarded as trouble-makers. • The causes of incidents, errors and deviations from procedures are not analysed. • The analysis of incidents, errors and deviations from procedures focusses on identifying someone to blame. • H&S performance data is not systematically collected and analysed. • No actions are proposed for ongoing H&S improvement. • Feedback is not sought from drivers/workers and others about the effectiveness of H&S policies and procedures. • H&S training provides basic minimum requirements only.	• H&S performance is measured using only the incidence of serious injury (that is, lost time injury frequency rates). • Incident investigations focus on identifying immediate cause of incidents. • Preventive actions recommended are mainly 'behavioural'. • Feedback is sought from workers/drivers and others about the effectiveness of H&S policies and procedures but feedback is never acted upon. • H&S training is generic and compliance focussed.	• H&S performance is measured using 'lagging' indicators, such as the occurrence of incidents, injuries and illnesses. • Incident investigations consider broader workplace conditions and work processes as possible causes. • Recommended preventative actions address workplace and work process improvements. • Feedback is sought from workers/drivers and others about the effectiveness of H&S policies and procedures, and feedback is sometimes used to inform H&S improvement actions in some instances (usually only when a serious incident has occurred). • The organisation provides structured training programs to its workers/drivers and stakeholders. • H&S training is passive and procedural.	• H&S performance is measured using mainly 'lagging' indicators but some 'leading' indicators are also used. • Incident investigations attempt to identify systematic causes of incidents including those relating to the organisational culture, risk management processes, and design and scheduling of work. • Preventative actions address organisational issues. • Feedback from workers/drivers and others about the effectiveness of H&S policies and procedures is sought and often (but informally) used to inform H&S improvement actions. • Training is engaging and produces a knowledgeable worker/driver.	• H&S performance is measured using a balanced mix of 'lagging' and 'leading' indicators, including surveys of workers'/drivers' experiences and perceptions. • Incident investigations rigorously uncover the systematic causes of incidents, including those relating to the organisational culture, risk management processes, and design and scheduling of work. • Preventative actions address 'upstream' issues, including safety in design and work planning. • Feedback is actively encouraged from workers/drivers and others about the effectiveness of H&S policies and procedures, and feedback is systematically analysed and considered in formal H&S planning processes. H& S training is reflective and allows for applied and intelligent application.
Resilient	• H&S policies and procedures are rigid documents that cover all eventualities. • Managers are complacent and believe that 'paper' H&S system is a failsafe way to avoid incidents.	• The organisation makes H&S policies and procedures to comply with minimum legislative requirements. • Policies and procedures are restrictive documents produced to avoid litigation.	• H&S policies and procedures are developed with good intentions to prevent incidents from occurring. • Policies and procedures are written in response to particular H&S hazards/risks and are intended to regulate	• H&S policies and procedures comprehensively cover the organisation's activities. • Policies and procedures are extensively integrated into training provided to workers/drivers and contractors.	• Managers trust workers/drivers and contractors to recognise situations in which H&S policies and procedures need to be challenged. Workers/drivers and contractors' feedback about

			individuals' behaviour.		practical issues is incorporated in the review of H&S policies and procedures. • The culture supports creative thinking (mindfulness) to envisage new solutions and designs.
Engagement	• Workers/drivers and contractors are not engaged in organisational or work level H&S activities. • Managers have no interest in engaging workers/drivers and contractors in H&S activities.	• Workers/drivers and contractors are invited to participate in H&S activities only after a serious incident has occurred. • Managers will only ask for workers'/drivers' and contractors' input into H&S activities when required to do so.	• Some workers/drivers and contractors are involved in H&S related activities. • Managers engage in limited consultation with workers/drivers and contractors on basic H&S issues like training and fatigue management.	• Workers/drivers and contractors are generally encouraged to participate in H&S activities. • Managers actively seek input from workers/drivers and others relating to operational aspects of H&S in the organisation, including daily work scheduling and safe work procedures.	• All workers/drivers and contractors feel actively involved in and able to influence H&S activities in the organisation. • Managers actively seek input from workers/drivers and others concerning strategic aspects of H&S in the organisation, including issues of safety in design, scheduling, and design of the fatigue risk management system. • Workers/drivers tacit knowledge about H&S is valued and used in a positive way.
Trust in people and systems	• Incidents are denied and shrouded in secrecy. • Systems are designed to protect the company and its profits. • Systems are unstructured and poorly documented.	• Procedures are developed in response to incidents after the event, like a band aid. • Systems are constructed for legal compliance and paper trails. • Systems are developed to identify the guilty party after an incident. • Systems do not change as a result of the incident. • Workers/drivers do not report H&S issues because	• Procedures are used to enforce the rules. • Well-structured and thorough safety system reporting in place. • Procedures produce lots of data and action items, but opportunities to address real issues are often missed. • Despite formal reporting systems, many incidents, errors and deviations from procedure are not reported.	• Procedures are continually updated to reflect change. • Reporting looks for WHY rather than WHAT and WHEN. • Processes are meaningful to workers/drivers. • Cross auditing inside and outside the organisation encourages systems improvement. • Most incidents, errors and deviations from procedures	• All incidents and near misses are genuinely reported. • There is a continuous informal search for non-obvious problems to assist in identifying new ideas and solutions. • Investigations are open, transparent and search for a deep level of understanding of how incidents happen. • There is systematic follow up to ensure change following

		they believe nothing will be done to resolve them. • Systematic causes of incidents may be identified, but there is no resolution.	• Workers/drivers feel uncomfortable reporting incidents, errors and deviations from procedures and are reluctant to do so.	are reported and investigated. • Workers/drivers are somewhat uncomfortable reporting errors or deviations from procedures but are willing to do so because they hope that this will result in H&S improvement.	an investigation. • All incidents, errors, and deviations from procedures are reported and investigated. • Workers/drivers feel comfortable reporting errors or deviations from procedures and firmly believe that this will result in H&S improvements.

(Adapted from Ayers et al., 2013; Filho et al., 2010; Lingard et al., 2014; Parker et al., 2006)