Mate, that was bloody close! A case history of a near-miss program in the Australian construction industry

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Conflict of interest

The authors of this paper declare no conflict of interest.

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Abstract

Safety performance improvement continues to be an important focus within the Australian construction industry. While near-miss reporting programs have received support from researchers and practitioners as an effective approach to safety performance improvement, little research has been conducted examining how these programs can be of benefit to Australian construction organisations. Furthermore, the important role that senior management play in the implementation and ongoing success of near-miss programs in the construction industry has been under-emphasised in the literature. Accordingly, this paper presents a case history of the implementation of a near-miss reporting program in the Australian asphalt and pavement industry which was developed and executed in collaboration with senior management. Due to the success of the program, as evidenced by the substantial reduction in total recordable injury frequency rates in line with increased near-miss reporting, key features of the program inform further development of practical guidelines for implementing near-miss reporting in the construction industry.

Keywords*:* Near-miss, leading indicators, tacit safety, explicit safety, construction industry, Australia.

Introduction

Use of 'leading', as opposed to 'lagging', safety indicators can improve safety outcomes in the Australian construction industry. Shea et al., (1) define leading indicators as those that identify antecedents of harm that can then be used to predict future harm. Conversely, Toellner (2) defines 'lagging' indicators as those that measure the outcomes associated with an accident that has occurred. The construction industry predominantly relies on lagging indicators to assess safety performance through standardised measures such as lost time injury frequency rates (LTIFRs) and total recordable injury frequency rates (TRIFRs) (3–5). However, use of these indicators is criticised in the literature as reactive and, in some cases, counterproductive (5, 6). Instead, leading indicators are considered proactive as they provide information to the organisation that can be used to develop appropriate interventions to prevent accidents from occurring thereby improving safety performance (3).

Use of appropriate leading indicators can contribute to more effective safety knowledge transfer among workers within construction organisations. For example, Hallowell (7) differentiates between explicit and tacit safety knowledge. Explicit knowledge represents the formalised safety procedures that are documented and easily transferred among workers, whereas tacit knowledge develops through experience and is transferred through interaction and communication between personnel (7). Hallowell (7) found that construction organisations that effectively managed safety included systems that converted tacit knowledge to explicit knowledge by developing best practice from worker feedback about safety matters. Thus, best practice in safety management is characterised by a systematic approach to obtaining feedback from workers about the hazardous situations they encounter daily (ie tacit knowledge) and using this to constantly improve explicit systems (eg policies, plans and procedures) (7–9).

Near-miss reporting, a leading indicator of safety events where injury did not occur at the time but could have occurred under slightly different circumstances, (10, 11) may provide an effective mechanism for obtaining tacit safety knowledge. Construction organisations can then use this tacit knowledge to continually improve the quality of explicit safety systems (12, 13). Similarly, Whiteoak and Mohamed (9) distinguish between a worker's sense of explicit safety, referring to workers' perception that management are responsive to potential hazards rather than reactive and process-driven (ie they walk the safety talk), and tacit safety, referring to a worker's sense of feeling safe at work. Thus, worker perception of management safety commitment plays an integral role in the effectiveness of safety program implementation (14, 15). While guidelines for near-miss program implementation in the construction industry have been forwarded in the literature, the role of management commitment has been understated.

The objective of this paper is to provide a case history of a near-miss program that was designed and implemented in collaboration with the senior management team of an organisation within the Australian asphalt and pavement industry (AAPI hereafter). As the program was considered a success (as evidenced by a substantial reduction in the TRIFR), the learnings derived from the case history are used to inform improvements to a literature-derived model for near-miss program implementation in the construction industry.

A literature-derived model for near-miss program implementation

Systematic investigation of near-miss program implementation in the construction industry is somewhat limited and is still considered an emergent area in the safety literature (16, 17). However, the extant literature converges around similar themes in relation to how near-miss programs should be implemented on construction sites. To illustrate this convergence, Table 1 provides a summary of specific guidelines that have been forwarded in the literature.

Table 1 Guidelines for near-miss program implementation in the construction industry

Reference	Context/ country	Guidelines
Cambraia et al. (11)	Medical facility construction site, Brazil	1. Identification: – On-site safety specialists should train workers in the procedures for identifying and reporting near-misses with the broader aim of raising risk awareness. – Inclusion of periodic questioning of the workers about the occurrence of near-misses (eg daily toolbox meetings). – Development of a safety culture that de-emphasises the search for culprits and emphasises the investigation of systemic causes of human error. – Multiple sources of data collection should be defined to motivate the participation of a larger contingent of workers and increase access to safety data. 2. Analysis: – Each near-miss event should be analysed according to: (a) traceability (b) nature (ie the physical characteristics of an event) (c) type of feedback to the safety management system including either positive (ie did the near-miss reflect the effectiveness of current safety procedures) or negative (ie did the near-miss reflect the absence/weakness of current safety procedures), and (d) risk (ie higher risk levels require prioritisation). 3. Dissemination: – A party responsible for communicating safety information to workers and management on a construction site should be designated to increase the speed of dissemination.

Table 1 Guidelines for near-miss program implementation in the construction industry

		– Communication of the actions taken in relation to near-miss events should be passed on to workers immediately even if these actions are provisional only. – Information on near-misses assessed as 'high risk' must be disclosed to the organisation's other projects.
Saurin et al. (19)	Various construction sites, Brazil	1. Reporting of near-miss incidents that are highly correlated with accidents should be prioritised. To ensure workers understand what constitutes a high-priority incident, different incident types need to be clearly defined in terms of the observable aspects of each incident to encourage reporting of relevant incidents only (ie traceable incidents). 2. All workers should be encouraged to participate in near-miss reporting. 3. Workers should be involved in proposing solutions for the problems identified from near-miss reporting by granting them the skills and authority to do so. 4. Reporting targets should be used with caution to ensure that near-miss reporting does not become a bureaucratic (ie box-ticking) exercise and continues to support safety management. 5. To clearly differentiate near-miss reports in relation to risk, the workforce should be trained on the criteria for scoring the severity and probability of near-miss events. 6. The assumptions about accident causation and prevention that are driving the near-miss program should be explicitly stated.
Marks et al. (16)	Natural gas construction site, United States	1. Identification – broadly, near-miss programs need to provide the skills and motivation to encourage the participation of workers in the reporting of near-miss events. – employees need to be trained to identify near-miss events and recognise high-risk events requiring stop work and hazard mitigation actions.

Table 1 Guidelines for near-miss program implementation in the construction industry

		2. Reporting – implementation of a systematic approach to reporting near-miss events, either electronically or paper-based, should maintain employee anonymity, involve database capability with individual reports structured according to a standard template that is based on a set of clearly defined criteria. 3. Root-cause analysis – determination of factors contributing to the near-miss event using a consistent approach to event categorisation (eg was the event driven by a skill-based, rule-based or knowledge-based human error). 4. Solution determination – considering the severity and consequences of near-miss events, remedial actions needed in the field should be identified to prevent re-occurrence of the conditions/behaviours that led to the event. 5. Dissemination and resolution – all site workers should be regularly informed of near-miss events and the corrective actions taken (eg daily toolbox meetings). – safety managers integrate learning from near-miss data into existing safety training which can be delivered to personnel across all the organisation's sites.

As demonstrated in Table 1, clear consistencies have emerged in relation to the implementation of near-miss programs on construction sites. Specifically, for near-miss programs to be effective, safety experts within the organisation need to prepare the groundwork through appropriate pre-implementation processes. These processes include establishing clear definitions for what constitutes a near-miss event and the different categories of a near-miss event and then educating all workers about how to recognise and report these events. Near-miss data should be de-identified and compiled in a database system to facilitate statistical analysis and the production of regular reports. In relation to specific near-miss events, an investigative team that includes safety experts and workers that are directly impacted by the event analyse the near-miss to determine corrective actions which are then implemented. Finally, the lessons learned from near-miss events need to be incorporated into formal training which is conducted across all sites within the organisation. Thus, a model for implementing an effective (ie one that contributes to the ongoing improvement of explicit safety systems) near-miss program in a construction context is presented in Figure 1.

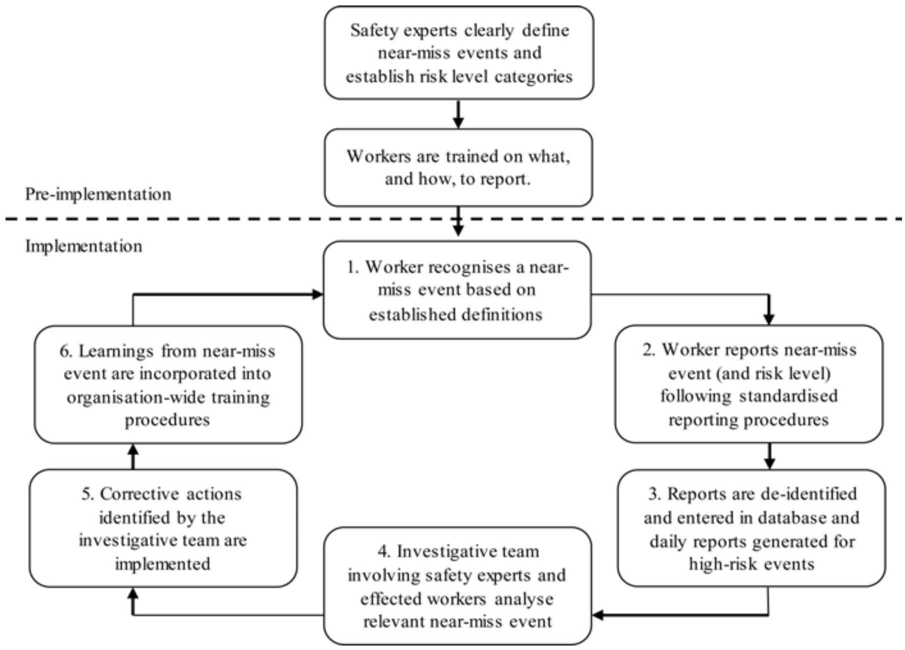

Figure 1

Model for near-miss program implementation on construction sites

Source: adapted from Cambraia et al., (11) Marks et al. (16) and Saurin et al. (19).

As shown in Figure 1, the emphasis of the guidelines provided in the near-miss literature in relation to near-miss program implementation is on the behaviours and processes workers need to engage with to ensure program effectiveness (ie the transfer of near-miss data into ongoing improvements to safety systems). However, the guidelines neglect the role of senior management. This is an important gap in the literature considering that: (1) workers' perception of management safety commitment drives their own engagement in safety behaviours and (2) senior management commitment to a new program facilitates organisation-wide commitment and enhances the likelihood of successful implementation (14, 15). The aim of this paper is to examine the implementation of a near-miss program that was designed in collaboration with senior management and to identify additional guidelines for the use of near-miss programs in the construction industry.

Method

To meet this paper's aim, a case history is provided describing the implementation and outcomes of a near-miss program that was designed and implemented in collaboration with the senior management of a large Australian construction company between 2012 and 2015. The program was implemented within a division of the company that is responsible for building and repairing road infrastructure as well as managing road assets, predominantly on behalf of State and Local Government clients in metropolitan and regional New South Wales, Australia. The division has an approximate turnover of $100 million dollars per annum.

At the time of the near-miss program roll-out, the frontline workforce consisted of approximately 300 FTUs (including 80% permanent and 20% casual employees) and was supported by approximately 500 supply partners. Worker turnover in the division was relatively stable given the 5% annual turnover of staff and average length of tenure of 12 years. The workforce consisted of a mix of semi-skilled and unskilled workers who were predominantly male (85%) with an approximate age range of 16 to 65 years.

Program design involved three stages. Stage 1 involved obtaining unequivocal support and commitment from the senior management team. To this end, an explicit goal statement was developed (ie to create a more engaged and proactive approach to safety in the business through the introduction of an effective near-miss program) and presented to senior management. While the initial proposal was met with a range of concerns, senior management ultimately saw the value of a near-miss program for improving overall safety and program development was able to commence.

Stage 2 involved the development of a near-miss definition using language that was accessible to the predominantly blue-collar workforce. Specifically, a near-miss was defined for the workers as an incident that might cause you to say/think '*mate, that was bloody close*'. In addition, the graphic in Figure 2 was created to depict an accident situation (ie a box falling and hitting a worker) compared with a near-miss event (ie a box falling and landing close to a worker). The definition and graphic together provided the central marketing messages of the program.

Figure 2

Near-miss reporting graphic

A set of guiding principles for the program were established in collaboration with senior management. These principles were considered core to the program and were guided by the literature guidelines (see Table 1). The principles included: (1) anonymity for reporters of near-miss events, (2) no punitive or disciplinary action to be taken in relation to a reported near-miss event, (3) responsive and transparent feedback/communication for near-miss events and (4) processes were developed to manage and act on near-miss event reports. To further reinforce management 'buy-in', the program was tied to managers' key performance indicators (KPIs). Senior management figures were also involved in a 'top-down' approach to generating division-wide commitment to the program with key management personnel involved in training workers at an 'all-day' event where the program was officially launched.

Stage 3 involved the collection, analysis and dissemination of near-miss report data. To collect the data, an automated telephone number was created and made accessible through all staff phones. Workers had the option of leaving a confidential recorded message about the near-miss incident and a standardised follow-up protocol was developed for managers to contact callers who provided their names. Analysis of the data was carried out by trained administrative staff who identified trends and produced regular reports of near-miss incidents. A range of communication channels were used for dissemination of program outcomes. For example, near-miss reporting became a regular part of all toolbox meetings. In addition, weekly summary reports were printed and made freely available in all lunch room areas. Near-miss conversations were also made a mandatory part of meeting agendas from the senior management team down to individual business unit meetings. Electronic variable message signs were also used to display near-miss information which was updated daily (see Figure 3).

Figure 3

Variable Message Signs indicating near-miss reports and actions

Results

The number of near-miss reports generated during the program data collection period is provided in Figure 4. While the program was ongoing, the data collection period for the study outlined in this paper ended in September 2015.

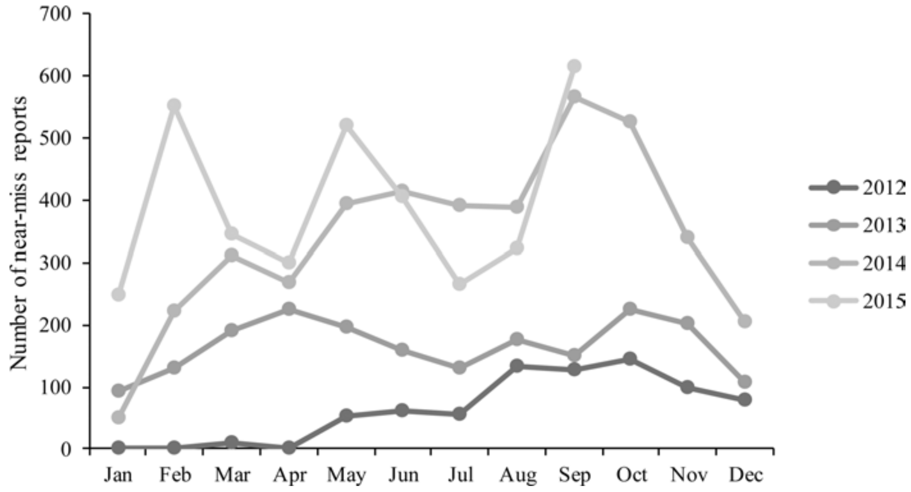

Figure 4

Near-miss report numbers 2012–2015

As depicted in Figure 4, each year of the program saw an increase in the monthly average number of near-miss reports (ie 64 for 2012; 165 for 2013; 339 for 2014; 397 for 2015). During the same period, the TRIFR reduced from 9.84 (2012) to 1.14 (2015). To put this reduction into perspective, the average TRIFR for construction organisations accredited by the appropriate Australian Federal Government workplace health and safety scheme (including the subject organisation in this paper) for 2015 was 14.29 (18). Thus, the results provide support for concluding that the near-miss program was successful when assessed using the industry standard TRIFR statistic.

Discussion

Based on the success of the program in reducing the TRIFR, key features of the program are identified as the basis for suggested improvements to the literature-derived model (see Figure 1). Specifically, three recommendations for improving the model are presented in Figure 5 which presents a practical framework for near-miss program implementation in the construction industry.

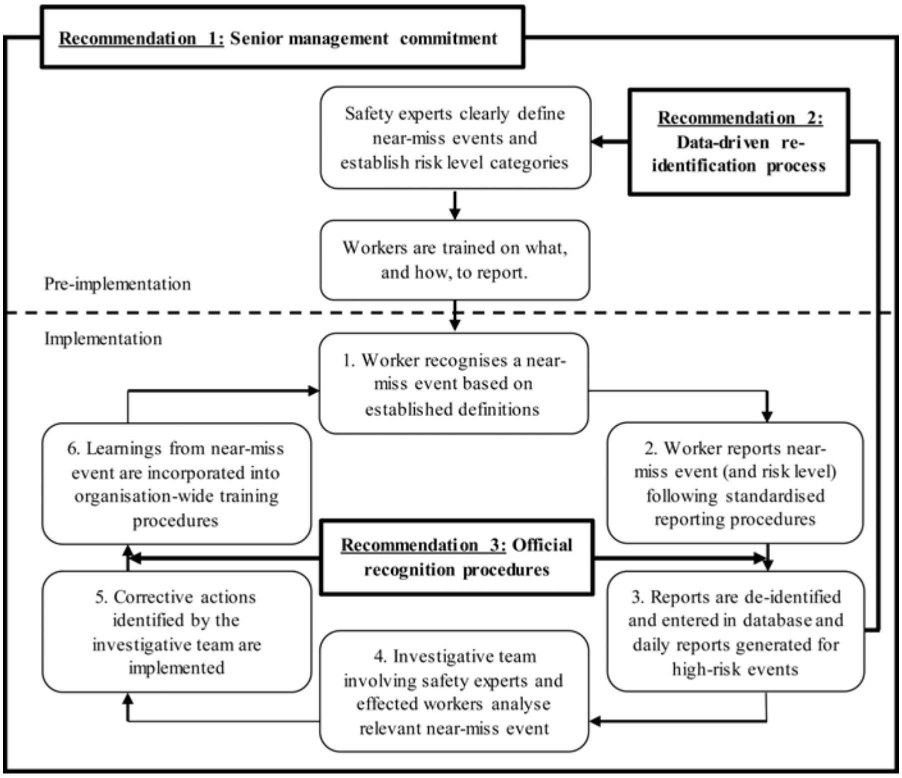

Figure 5

Model of near-miss program implementation incorporating recommendations

Recommendation 1. The first recommendation aims to formalise obtaining the strong commitment of senior management as critical to successful near-miss program implementation. As demonstrated by the case history in this paper, educating senior management to recognise both the safety and strategic value of a near-miss program was a critical first step that: (1) drove division-wide commitment to the program; (2) enabled effective program implementation through appropriate resource allocation and (3) ensured ongoing resourcing to address program challenges. Therefore, near-miss programs are more likely to achieve their aims when senior management are fully committed and provide a supportive framework within which the program can operate (depicted by the outer frame in Figure 5).

Recommendation 2. The second recommendation involves using near-miss data to refine (ie re-identify) definitions and risk-level categories after a certain period. Approximately six months after introduction of the program, the substantial increase in volume of near-miss reports overwhelmed the collection, analysis and dissemination systems that were in place. While this was problematic, it was also seen as evidence that workers trusted the core principles of the program (eg anonymity and no punitive action). At this point, it would have been beneficial to statistically analyse the available data to categorise near-miss reports according to risk level. These risk levels could then have been used to develop different reporting and dissemination strategies that prioritised high-risk reports over low-risk reports. For example, initiation of an automated process involving the compilation of low-risk incidents in a monthly report that was directly emailed to workers would free-up resources for improving the reporting and dissemination of high-risk near-miss events.

The need to re-identify risk-level categories suggests that a phased approach to near-miss program implementation may be beneficial for some organisations. Specifically, program implementation may involve an initial phase where all near-miss reports are processed in the same way. A second phase is then initiated after a set period (eg six months) where the data obtained is used to clearly define risk categories that form the basis for new reporting and dissemination strategies. This approach would increase the validity of the risk-level categories as categorisation is driven by analysis of site-specific data. As shown in Figure 5, by connecting the identification process to the database function via a feedback loop, pre-implementation processes become part of the iterative improvement cycle that characterises the implementation processes. This feedback loop can also benefit near-miss programs that utilise risk categorisation from the outset as it can be used to either confirm or refine existing risk categories.

Recommendation 3. The final recommendation is designed to encourage workers' ongoing engagement with safety improvement measures and to develop a culture that recognises the important role workers play in developing safety excellence. Specifically, it is recommended that official recognition procedures be incorporated into the model of best practice to acknowledge and encourage those workers who provide near-miss reports and participate in the development of innovative safety solutions to address site-specific problems.

Conclusion

This paper provided a case history of a near-miss program as implemented by a construction division within the AAPI. While the limitations for generalising the findings of a single case history to other contexts are acknowledged, the paper contributes to the safety literature by developing a practical model for near-miss program implementation in the construction industry. In addition, the paper demonstrates the features of a successful near-miss program that moves workers from being passive stakeholders in a safety bureaucracy, to engaged and collaborative stakeholders of a safety culture characterised by constant worker-driven improvement. Furthermore, the collaboration of senior management figures in the development of an anonymous and non-punitive safety system may contribute to an increase in workers' sense of tacit and explicit safety within the workplace and a concomitant increase in worker engagement and productivity (9). Future research could provide a more detailed examination of the relationship between near-miss programs and increased worker engagement as mediated by perceived tacit and explicit safety.

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