Learning the lessons from WMSDs: A framework for reporting and investigation

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15th February 2016
Research report #: 105-0216-R01

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Acknowledgements

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Executive Summary

Work-related musculoskeletal disorders (WMSDs) represent a major burden on individuals, organisations and the healthcare system in Australia. When they occur, these injuries need to be treated as an opportunity for organisational learning and change. This report describes the development of a practical framework for optimising learning from reports and investigations into WMSDs. The development of the framework was based on contemporary theory regarding accident causation and learning from incidents, the evidence regarding the risk factors associated with WMSDs, and current practice in Australian organisations.

Chapter 1 of this report describes the theory underpinning the proposed framework. The framework integrates two key theories: the systems approach (1) and the learning cycle (2). In addition, the framework draws on previous research that has identified the conditions that optimise each stage of the learning cycle. These conditions are used as a benchmark for best practice in the framework.

Chapter 2 of this report describes the development of a prototype taxonomy of the potential contributing factors involved in WMSDs, to support the application of Rasmussen's (1) framework within reporting and investigation systems. This involved a comprehensive review of systematic reviews of the risk factors associated with WMSDs. A classification system was developed to categorise the risk factors identified across multiple systematic reviews. The prototype taxonomy provides a starting point for organisations wishing to develop their own domain-specific taxonomy to standardize the analysis of data and assist in the identification of recurring issues across multiple incidents.

Chapter 3 of this report describes the findings from a study that was conducted to identify the factors that facilitate or hinder learning in current practice. The study involved 19 large Australian organisations, including interviews with 38 OHS Managers and documentation review. The findings from the study were used to augment the prototype taxonomy proposed in chapter 2, and identify factors that facilitate or act as barriers to implementing the conditions identified as best practice in the framework.

The overall framework is summarised in Section 4. The proposed framework provides guidance on: the organisational resources required; the characteristics of best practice; the factors that facilitate or act as barriers to best practice; and the types of contributing factors and countermeasures that should be considered, in order to ensure that learning can occur within the organisation. Organisations can use the framework to evaluate and enhance their current incident reporting and investigation systems.

Introduction

Background and rationale

Work-related musculoskeletal disorders (WMSDs) represent a major burden on individuals, organisations and the healthcare system in Australia. There were over 48,000 workers compensation claims for "body stressing" injuries during the 2012-13 financial year in Australia; accounting for approximately 41% of serious claims (3). These statistics have remained alarmingly stable over the last ten years, despite the investment of considerable government resources in prevention strategies (4, 5). This indicates that current prevention approaches are not working.

There is now considerable evidence that WMSDs are caused by a complex system of factors, with risk influenced by a diverse set of interacting individual, work-related and cultural factors, in addition to the physical risks typically associated with demanding or repetitive work (6-8). Although understanding of the causes of WMSDs has advanced considerably, it is questionable whether these advances are realised in practice. Preliminary evidence suggests that there is a significant gap between knowledge about WMSD causation and incident reporting systems in practice (9, 10); however, studies designed specifically to evaluate this have not yet been conducted. Similarly, there is limited research available regarding the appropriateness of current investigation practices for learning from WMSDs.

Translating knowledge on learning from incidents and WMSDs into appropriate incident reporting and investigation systems is critical for injury prevention. However, currently, little academic research has been translated to guide industry in the development of appropriate reporting and investigation systems.

Purpose

The purpose of this research was to develop a practical framework that describes the systems and processes that organisations need to implement to learn from reports and investigations into WMSDs. In this context, learning is defined as the capability to extract experiences from incidents and convert them into measures and activities which will help to avoid future similar incidents and improve safety overall (11). The proposed framework provides guidance on: the organisational resources required; the processes that should be implemented; and the types of contributing factors and countermeasures that should be considered, in order to ensure that learning can occur within the organisation. The proposed framework is based on contemporary theory regarding accident causation and learning from incidents, the evidence regarding the risk factors associated with WMSDs, and current practice in Australian organisations.

Overview of the framework and report

The framework integrates two key theoretical models: Rasmussen's (1) Risk Management Framework and the learning cycle (2). Rasmussen's (1) framework describes how incidents occur in organisations from a systems perspective. The learning cycle describes the steps that are required during reporting and investigating to support learning from incidents. In addition, previous research has identified the conditions that optimise each stage of the learning cycle; these conditions are used as a benchmark for best practice in the framework. Together, Rasmussen's (1) framework and the literature on learning from incidents provide an

appropriate basis for developing effective reporting and investigation systems. This research is described in Chapter 1 of this report.

The framework also provides a prototype taxonomy of the potential contributing factors involved in WMSDs, to support the application of Rasmussen's (1) framework within reporting and investigation systems. To develop the taxonomy, a comprehensive review of systematic reviews of the risk factors associated with WMSDs was conducted. A classification system was developed to categorise the risk factors identified across multiple systematic reviews. These factors were then represented on Rasmussen's (1) framework to create a prototype taxonomy of the potential contributing factors involved in WMSDs. The prototype taxonomy provides a starting point for organisations wishing to develop their own domain-specific taxonomy to standardize the analysis of data and assist in the identification of recurring issues across multiple incidents. The findings from the literature review and the prototype taxonomy are described in Chapter 2 of this report.

Finally, the framework describes the factors that support or hinder learning in current practice. The factors were identified from a study of 19 large Australian organisations, involving interviews with 38 OHS Managers and a review of relevant documentation. The findings from the study were used to augment the prototype taxonomy proposed in chapter 2, and identify factors that facilitate or act as barriers to implementing the conditions identified as best practice in the framework. The key aspects of this study are summarised in Chapter 3 of this report.

The overall framework is summarised in Section 4. Organisations can use this information to evaluate and enhance their current incident reporting and investigation systems.

Chapter 1: The research on learning from incidents

Introduction

Understanding and learning from incidents has been the focus of significant research over the past four decades (12, 13). Primarily, two questions have driven much of this work. First, what causes incidents? This research has resulted in the development of models that describe how incidents happen in organisations and the types of contributing factors involved (14). Second, what do organisations need to do to learn from incidents? This research has resulted in models that describe the progressive stages required to learn from incidents. Together, models of accident causation and learning from incidents provide an appropriate framework for developing effective reporting and investigation systems.

The importance of using an appropriate accident causation model cannot be understated. In reporting and investigation, the underlying accident causation model determines the type of data collected, the method used to analyse the data, and the recommendations that will be proposed (15). The understanding of accident causation has evolved over time, resulting in the development of three distinct types of model: sequential, epidemiological, and systemic (16). Sequential models, such as Heinrich's (17) domino model, view accidents as a linear sequence of events. In these models, human error and mechanical failures are seen as the primary causes of accidents. Epidemiological models, such as Reason's (18) Swiss cheese model, view accidents as similar to the spreading of a disease and emphasise how latent conditions within the organisation result in unsafe acts made by operators at the so-called "sharp end". These models introduced the idea that organisational deficiencies play a role in human error. Finally, systemic models, such as Rasmussen's (1) Risk Management Framework, view accidents as the result of multiple decisions and actions across the overall system of work. These models build on earlier models in two important ways. First, by considering the broader regulatory and legislative context. Second, by introducing the idea that the factors involved in accident causation are not necessarily errors or failures, rather interactions between components in the system can also produce unforeseen and negative consequences.

The systems approach is now widely regarded as the most appropriate approach for accident analysis and prevention in safety-critical domains, including the workplace (19). The first section of this chapter describes the systems approach, its implications for reporting and investigation and how Rasmussen's (1997) framework applies to reporting and investigating workplace incidents.

Models of learning from incidents essentially describe the sequential steps that are required during reporting and investigation to ensure that information about the causes of incidents are translated into effective injury prevention activities. A number of models have been developed to describe learning from incidents during reporting and investigation (e.g. 2, 13, 20). The models are highly similar, as they are based on the organisational learning literature. The second section of this chapter describes one particular model of learning from

incidents, “the learning cycle" (2). This is followed by a brief overview of the literature describing how organisations can optimise the process for learning from incidents during reporting and investigation.

The systems approach

The systems approach to understanding accident causation is underpinned by three core principles (1, 21, 22).

First, safety is an emergent property of the decisions and actions of everyone in the system. This means that politicians, CEOs, managers, safety officers and supervisors all play a role in incidents, as well as the workers performing the tasks. Therefore, safety is the shared responsibility of everybody working within the system.

Second, incidents are caused by multiple, interacting, contributing factors, not just a single bad decision or action. For example, the use of poorly designed tools or technologies can be a consequence of decisions made by the purchasing department, which in turn may be the result of budgeting decisions made at the higher levels of the organisation, which in turn are impacted by financial constraints within the industry (19).

Third, the factors contributing to incidents do not necessarily have to be failures, errors or violations. As Dekker (2011) points out, incidents often happen when no parts within the system are broken. Goal conflicts and production pressures often determine the normal, day-to-day behaviours, which are routinely undertaken to get the job done. These normal behaviours often include workarounds, improvisations, and adaptations, but they are also usually seen as accepted practice. It is only with hindsight that these processes are identified as failures or violations of procedures, when they may have previously been accepted as normal (23).

Implications for reporting and investigation

These principles have a number of important implications for understanding incidents within workplaces. Most importantly, reports and investigations should not exclusively focus on the immediate context of the incident or on the behaviour of the injured worker (19). Rather, they should focus on the factors influencing behaviour in the work context. The injured worker is unlikely to have a complete understanding of the decisions and actions that contributed to these conditions. Therefore, as far as possible, investigations need to extend to all those who perform the task associated with the injury, supervision, planning and management. This approach should lead to understanding why the practices that may have resulted in an injury are “accepted”, rather than just labelling them as errors or violations of procedures.

The principles of the systems approach also have implications for the development of effective countermeasures. Attempting to eliminate violations of procedures (e.g. through warnings, information or retraining) is unlikely to have much impact on reducing future incidents, if the conditions of work are left untreated (24). In the example above, replacing the poorly designed tools may have a short term effect; however, in the long term the same decision making process and financial constraints will lead to inadequate tools being

brought into the workplace. Therefore, countermeasures should focus on addressing the factors that create hazardous conditions and unsafe acts, rather than on technology or human operators (e.g. 1, 25). By extension, the design of countermeasures should aim to identify networks of mitigating strategies, as any change will necessarily impact on other aspects of the system.

The key to understanding incidents and developing appropriate countermeasures lies initially in the adoption of an appropriate accident causation model. As discussed, it is widely accepted that systemic accident causation models are the most relevant for modern day complex sociotechnical systems. One model in particular, Rasmussen's (1) risk management framework, has been applied in many domains (23). This is down, in part, to two key aspects: first, the framework is generic and can be applied in any domain, and second, it provides the Accimap accident analysis method. Accimap is a usable and practical accident analysis method that has consistently shown its explanatory power for understanding accident causation in a wide range of domains (23). Therefore, Rasmussen's framework and the Accimap technique are recommended as an appropriate model and method to underpin the proposed incident reporting and investigation framework.

Rasmussen's Risk Management Framework and Accimap technique

Based on the principles described above, Rasmussen's (1) framework, represents work systems as hierarchies comprising multiple levels, as shown in shown in Figure 1. Typically, the following system levels are described:

- a *Government* level at which laws and regulations are developed;
- a *Regulatory* level at which industry standards are developed based on laws and regulations;
- a *Company* level where company policies and procedures are developed to govern work processes, based on industry standards;
- a *Management* level where company policies and procedures are implemented;
- a *Staff* level representing the activities and characteristics of workers performing the processes; and
- a *Work* level representing the equipment and environment within the work context.

Rasmussen (1) argued that in order to maintain safe operations, decisions at higher levels (i.e. Company, Regulatory, Government) should influence actions at the lower levels, while information about the work conditions (i.e. from workers) should transmit up the hierarchy and shape decisions around management, planning and budgeting (1, 26). The model argues that breakdowns in this 'vertical integration' lead to losses of control, which in turn creates incidents.

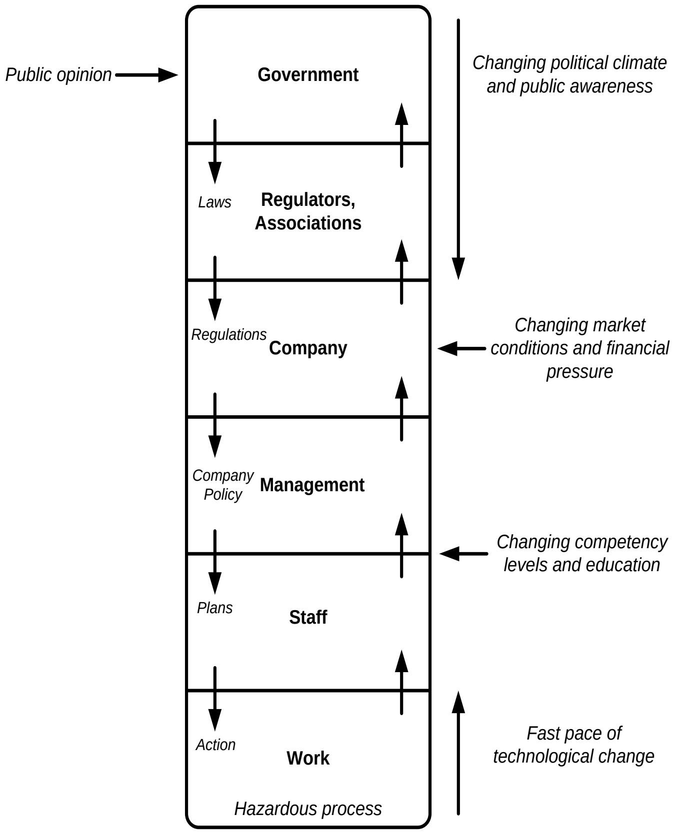

Figure 1 Rasmussen's (1997) Risk Management Framework (adapted from Rasmussen, 1997)

Building on this framework, Svedung and Rasmussen (27) developed the Accimap technique to graphically represent the conditions that produce incidents. The technique involves mapping the components, decisions and actions of the system in which the accident in question occurred, as well as the relationships between them, onto the levels of the framework. This provides a detailed representation of incident trajectories, incorporating contributory factors and their interrelations across the overall system.

There are a number of potential insights that can be gained from using the Accimap technique to graphically represent the system of contributing factors involved in incidents. First, it draws attention to the range of actors that potentially contributed to the incident, beyond the immediate context of the injury or adverse outcome. Second, it makes it easier to see the relationships between system components, and identify gaps and weaknesses in the work system. Third, it provides a useful aid for communicating the findings to those external to the situation or investigation (15). Figure 2 shows an example Accimap from an investigation into the factors influencing decision-making and behaviour during manual handling tasks in an air freight organisation (9). This investigation focused on three manual handling tasks that were associated with high rates of injury within the organisation. The investigation involved observations of task performance, interviews with workers involved in performing the task on a regular basis, direct supervisors, managers and senior managers. The factors identified, and the links between them, were then mapped onto Rasmussen’s (1) framework. The analysis from this study indicated that a number of reforms to the work system were required,

including addressing issues resulting from temporary workers, and conflicts between work schedules and management key performance indicators. This example illustrates how the technique provides a method for representing findings, and identifying potential countermeasures.

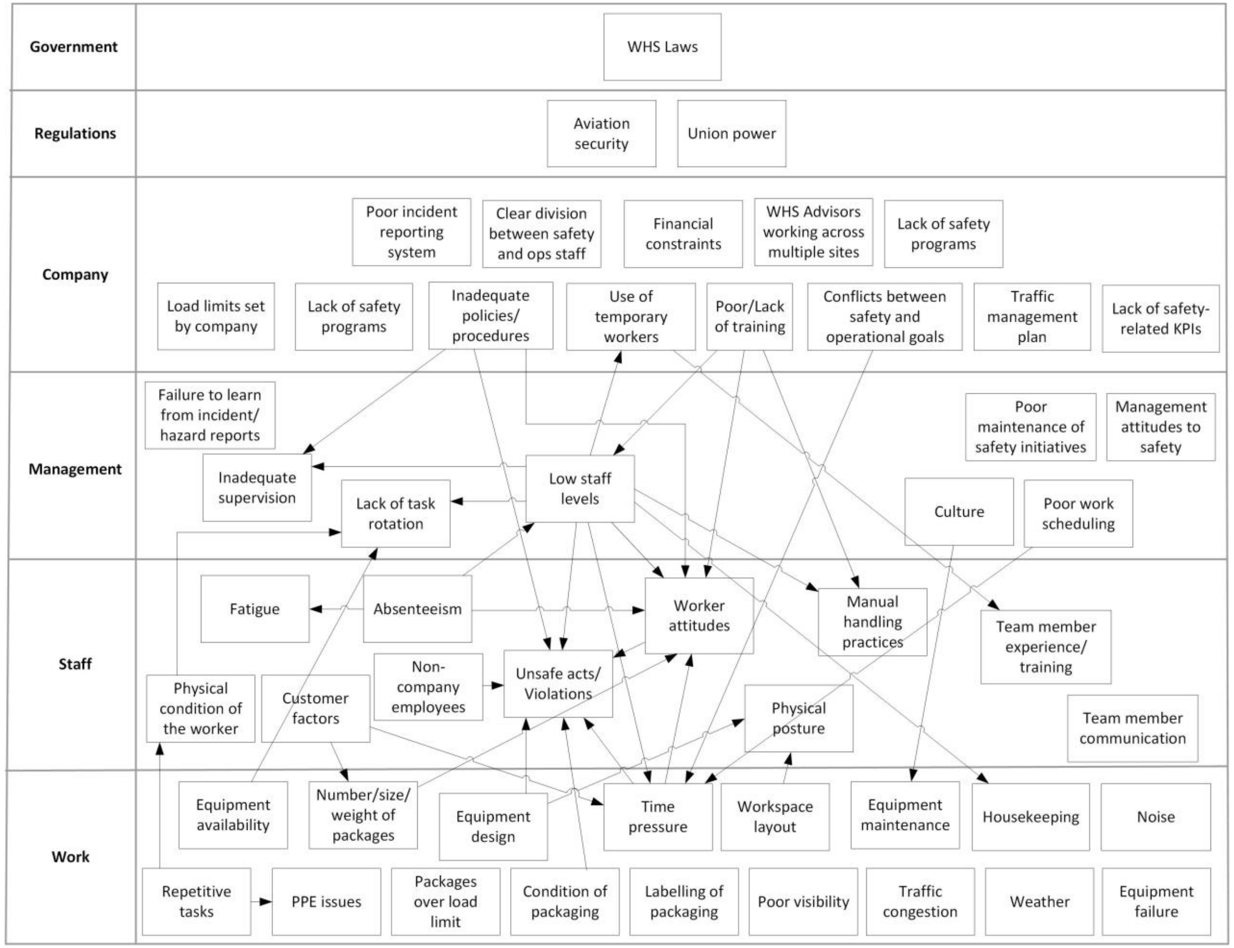

Figure 2 Example Accimap from an investigation into the factors influencing decision-making and behaviour during manual handling tasks in an air freight organisation (adapted from Goode et al. 9).

One limitation of Accimap is the lack of a taxonomy for coding the contributing factors and relationships identified from incident reports and investigations. For each analysis, the investigator is required to develop a taxonomy to categorise the contributing factors and relationships identified. This makes it difficult to aggregate Accimap analyses in order to derive useful summaries of the contributing factors involved in multiple incidents (28), which is critical for identifying reoccurring issues.

To overcome this limitation, Salmon et al., (28) recommend that organisations develop their own domain-specific taxonomy to support the application of Rasmussen's (1) framework and Accimap technique. The first and second authors of this report have recently developed a taxonomy for the led outdoor activity sector in Australia, which has been implemented in an incident reporting software tool (29). The taxonomy, shown in Figure 3, was developed based on analyses of: 1) the literature concerning the contributing factors involved in led outdoor activity incidents; 2) a series of fatal incidents investigation reports; and 3) 1000 reports of minor incidents. The prototype taxonomy was then refined in a series of tests using practitioners to code incidents reports. The implementation of the taxonomy within the incident reporting software tool guides the collection and analysis of incident data, allows for analysis across multiple incidents, and helps ensure reliability across multiple practitioners.

In summary, Rasmussen's (1) framework and Accimap technique provide an appropriate framework for collecting and analysing incident data from a systems perspective, which can be supplemented by the development of a domain-specific taxonomy. However, the collection and analysis of incident data is only one aspect of the processes required to learn from incidents. The following section describes the sequential steps that are required during reporting and investigation to ensure that information about the causes of incidents is translated into appropriate injury prevention activities and organisational change.

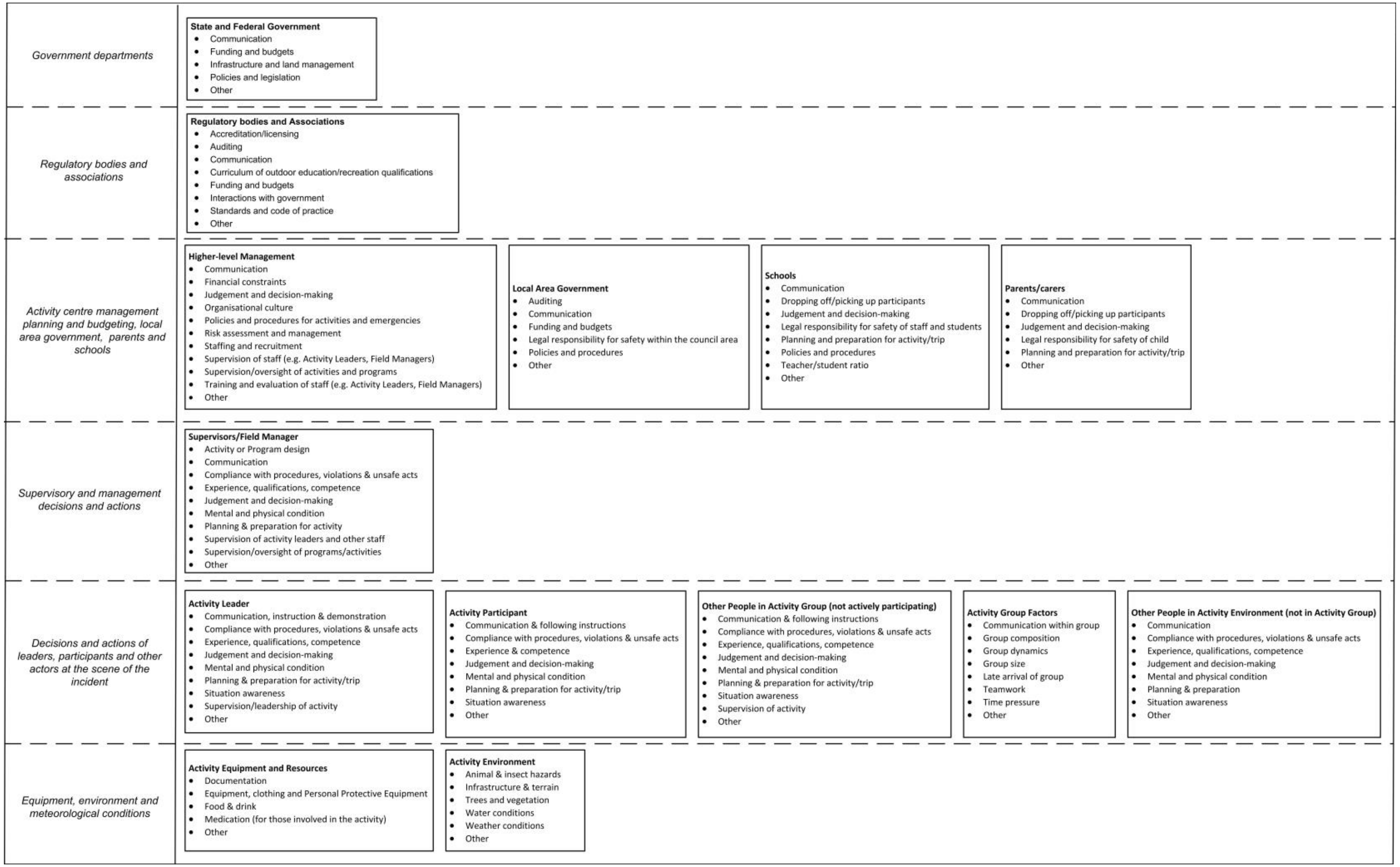

Figure 3 Example of a contributing factor taxonomy that has been developed to support the application of Rasmussen's (1997) framework and Accimap technique in an incident reporting system (29).

The process for learning from incidents

Several models in the literature describe learning from incidents as a step-wise process (e.g. 2, 13, 20). These models all describe similar steps and phases, and are based on the assumption that no one step can fail without affecting the end result (2).

Jacobsson et al.'s model (2, 11), the "learning cycle", describes the following steps:

1) Reporting and data collection;
2) Analysis and recommendations;
3) Decision-making;
4) Implementation; and
5) Follow-up and evaluation.

The first step, "reporting and data collection", includes the initial report of the incident and the collection of additional data through investigation if required. The second step, "analysis and recommendations", describes how the data is analysed, and the process used to translate this information into recommendations for preventing similar incidents. The third step, "decision-making" describes the process of selecting appropriate and effective recommendations for implementation. The fourth step, "implementation", describes the processes used to convert the decisions into action. The final step, "follow-up and evaluation", includes both monitoring the implementation of, and evaluating, the impact of the action. Each step also involves dissemination of information about the findings from the process throughout the organisation. Jacobsson et al., (2) argue that to optimize the learning potential this cycle should be iterative: the first cycle focused on a single incident and a secondary cycle focused on an aggregated sample of incidents.

The first two steps in the cycle essentially involve identifying the lessons to be learnt, while the latter three steps involve translating these lessons into organisational change. Studies examining incident learning processes in organisations have identified some of the conditions that contribute to optimising these outcomes, which are described in the following sections. In the proposed framework, these conditions are used as a benchmark for best practice within each stage of the learning cycle.

Identifying the lessons that can be learnt

Learning from incidents is not a simple endeavour; in particular, learning is not guaranteed through the mere reporting and investigation of adverse events. In order to optimise the lessons that can be learnt from incidents, organisations need to consider: (i) thresholds for reporting; (ii) the selection of incidents for investigation; (iii) data collection procedures; (iv) analysis methods; and (v) the process for designing recommendations.

Thresholds for reporting. There is large consensus in the literature that the thresholds for reporting should be as low as possible to optimise learning (2, 13, 30). Consequently, even incidents that do not result in an injury, or that have relatively minor consequences, should be reported. One caveat, however, is that all reports must result in an appropriate response, otherwise, this is likely to discourage reporting in the future and undermine the whole process (2, 31).

The selection of incidents for investigation. The information required for effectively selecting incidents for investigation should be collected through the initial report (13). Lindberg et al., (13) propose that the incidents selected for investigation

should be those from which as much information as possible can be extracted for prevention. There are a number of factors to consider in making this judgment. First, the incidents that can provide the most information are not necessarily those with the most serious consequences. Investigations of near misses, or relatively minor incidents, can be instrumental in avoiding more serious failures (32, 33). Findings also indicate that focusing exclusively on more serious events will lead to lessons pertaining to specific crisis procedures, rather than general practices (34). Second, from a systems perspective, investigations of incidents where new technology has been introduced or a work area has undergone significant change are likely to be particularly useful. These changes may have had unintended consequences across the system of work, resulting in new hazards and reducing the effectiveness of existing risk controls (1).

Data collection procedures. Previous authors have emphasized that investigations should:

- Involve independent investigators (35);
- Be undertaken as soon as possible after the initial report (2);
- Use a broad range of data sources, such as interviews, documentation, and records (13);
- Involve participants from all organisational levels (36); and
- Draw on previous relevant investigations or reports of other incidents (13).

Essentially, these factors all influence the scope of the investigation, where a broader scope is thought to support the identification of more "lessons learned". From a systems perspective, the scope of the investigation should be sufficiently broad so that data is collected on potential contributing factors across all levels of Rasmussen's (1).

Analysis methods. Increasing the scope of data collection increases the need to adopt a systematic method for data analysis. As discussed in the previous section, the method determines the contributing factors and the recommendations that will be identified from the analysis (14). Based on reviews of the literature, Lindberg et al., (13) and Katsakiori et al., (37) propose a "good" analysis method should:

- Result in a detailed description of the events and circumstances surrounding the incident;
- Identify both direct causes related to the specific events and the underlying causes in the organisation;
- Generate recommendations relevant to improving safety;
- Not require highly trained experts;
- Result in a written report; and
- Have evidence of reliability and validity.

According to Katsakiori et al., (37), a reliable method is evidenced by agreement between the findings of different analysts, whereas a valid method is evidenced by the correspondence between the analysis findings and reality. In regards to the latter, it is extremely difficult (if not impossible) to establish alignment between investigation findings and reality, as it is not possible in hindsight to establish a "true" picture of events (14, 21). Previous studies have used expert panel analyses as the 'true' picture of events; however, this is not without its limitations. The authors therefore suggest that some validity is assured if the analysis method is underpinned by an accident causation model that is supported by empirical evidence.

The process for designing recommendations. Two key issues need to be considered when designing recommendations. First, a number of authors have argued that involving participants from all organisational levels (e.g. workers, supervisors, senior managers etc.) results in more effective countermeasures (36, 38-41). One reason for this is that it increases different participants understanding of the tasks they do not directly influence, and the consequences of their decisions (Rollenhagen (38). Another reason is that potential barriers to implementation can be identified during this stage and potentially ameliorated.

Second, the network of contributory factors should be considered; in particular the relationships between factors. In many organisations, the current approach to developing countermeasures is to address each identified cause in isolation (14, 32, 42). This is problematic as changes to any of the components within a sociotechnical system will necessarily impact on others, and potentially lead to unintended, negative consequences (14, 43). Therefore, the interactive effects of recommendations should be considered during the design process.

The following section describes the processes required for effectively translating recommendations into organisational action and change.

Translating lessons into organisational change

There is a significant body of research that has examined the challenges associated with implementing and maintaining recommendations from investigations (e.g. 12, 44-48). The majority of this research has found that the same factors that contribute to an incident (e.g. lack of staff, funding, political biases) also impose constraints on implementation and maintenance of change over time, leading organisations away from the ideal of “what-you-find-is-what-you-fix” (45). Again, this challenge reinforces the need to involve participants from all organisational levels in the learning cycle, as often only senior managers have influence over these constraints.

Disseminating the lessons learned across the organisation is often seen as instrumental in overcoming the challenges associated with implementation and maintenance (2, 13, 44). Further, it is seen as a critical component in ensuring that workers continue to report adverse events and near misses (21). Opportunities to enhance learning through dissemination include: sharing the lessons learnt across areas of the organisation undertaking similar tasks (44); discussing incidents during training for new personnel (13); storing the lessons learnt in repositories for retrieval when the organisation subsequently encounters situations where the learning is relevant (44); and sharing the lessons learnt between organisations within the same sector or industry (32). These opportunities highlight the importance of storing the findings from investigations, as well as reports, in a searchable database (32).

To address these challenges and optimise the translation process, Jacobsson et al., (11) have proposed a method for evaluating the extent of organisational change resulting from an investigation. The method evaluates the effectiveness of recommendations on three dimensions: geographical application, degree of organisational learning, and time. More effective recommendations are those that have been applied across the organisation, targeted the redesign of organisational systems, and included plans for long term maintenance. These criteria can be applied retrospectively to evaluate the effectiveness of past recommendations, or proactively to evaluate potential recommendations. Applying this method to a set of

incidents could potentially provide information about the success of the incident learning system and identify areas for improvement.

Summary and conclusions

Together, Rasmussen's (1) framework, the Accimap technique and Jacobsson et al.'s (2) learning cycle provide an appropriate framework for developing effective reporting and investigation systems. Rasmussen's (1) framework and Accimap technique provide a method for collecting and analysing incident data from a systems perspective. The learning cycle describes the additional steps that are required during reporting and investigating to support learning. In addition, previous research has identified the conditions that optimise each stage of the learning cycle in organisations; these conditions can be used as benchmark for best practice during each stage of the learning cycle.

For the purposes of learning from WMSDs, the missing element is an appropriate taxonomy for classifying the contributing factors involved in these types of incidents. This is critical for standardizing analyses and identifying reoccurring issues across multiple incidents. To address this gap, the following chapter presents a prototype taxonomy based on the current evidence regarding the risk factors associated with WMSDs.

Chapter 2: Development of a prototype taxonomy of the contributing factors involved in WMSDs

This chapter presents the findings from a literature review that was conducted to develop a prototype taxonomy of the potential contributing factors involved in WMSDs, to support the application of Rasmussen's framework and the Accimap technique. The purpose of the prototype taxonomy is to provide a starting point for organisations wishing to develop their own domain-specific taxonomy, underpinned by systems thinking, to standardize the analysis of data and assist in the identification of recurring issues across multiple incidents.

The literature review focused on studies that have examined the risk factors associated with WMSDs, as very little research has examined the factors that directly cause WMSDs. It is important to note that a risk factor may not necessarily be a cause, as a risk is identified based on evidence of an association (i.e. co-occurrence). In addition, previous research has largely been undertaken from an epidemiological perspective, which focuses on identifying risks to individuals, rather than a systemic one, which focuses on risks within work systems. Therefore, the resulting taxonomy represents a limited set of the *potential* contributing factors that could be considered when reporting and investigating WMSDs.

As numerous systematic reviews of the risk factors associated with WMSD have been published in the literature, we limited our review to:

- Identifying the systematic reviews that have examined the risk factors associated with WMSDs;
- Providing a quality assessment of each review using the AMSTAR (A Measurement Tool to Assess Systematic Reviews) checklist;
- Developing a taxonomy for classifying the risk factors identified across multiple systematic reviews; and
- Summarising the findings from the review and assessing the level of evidence for each risk factor identified in the taxonomy.

The findings are presented in the context of Rasmussen's framework. The discussion considers the implications of the findings for allocating resources during investigations, evaluates the comprehensiveness of the prototype taxonomy, and identifies additional sources of data that could be accessed for further taxonomy development.

Method

This review of systematic reviews provides a summary of evidence relating to the risk factors associated with WMSDs. The methodology underpinning this review is based on best practice principles of reviewing to ensure systematic, transparent and rigorous evaluation according to an agreed protocol (49). The following sections outline the review processes.

Search Strategy

Online searches in Google Scholar, the Cochrane Database of Systematic Reviews and Science Direct were carried out to identify relevant systematic reviews. The following search strategy was used in Google Scholar and the Cochrane Database: "All in title: review AND musculoskeletal OR hazard OR risk OR cause". The

following search strategy was used in Science Direct: “"work-related" AND "systematic review" AND musculoskeletal OR hazard OR risk OR cause”; limited to journal articles. Both searches were limited to English language articles from the time period 2000 to 2014. The year 2000 was chosen as a start date for the review, as the National Research Council and the Institute of Medicine (50) published an extensive systematic review on this topic spanning the years 1979 to 1999, which was included in this review. The results of the searches were managed within the EndNote bibliographic software package.

Selection of eligible studies

One reviewer undertook the initial record selection based on the title and abstract, and removed all obviously irrelevant records (e.g. non-work related). This resulted in a list of potentially relevant systematic reviews.

The full papers were then assessed for relevance by one reviewer and checked by a second reviewer. In order to be included as a systematic review, the paper had to meet the following inclusion criteria:

- A stated research question;
- A statement of the inclusion and exclusion criteria which guided the selection of studies for the review;
- An extensive search for relevant studies, i.e. searches beyond MEDLINE;
- A description of study selection methods;
- A synthesis of the included studies (narrative or statistical);
- A list or table of included studies; and
- An assessment of the quality of the included studies.

The reference lists of the reviews that met these criteria were then searched to identify any additional reviews.

Quality Assessment

The quality of the included systematic reviews was assessed using the following criteria from the AMSTAR tool (49):

- Was an ‘a priori’ design provided (i.e. research question and inclusion criteria provided)?
- Was a comprehensive literature search performed (i.e. at least two electronic sources)?
- Was there duplicate study selection and data extraction?
- Was the status of publication (i.e. grey literature) used as an inclusion criterion?
- Was a list of studies (included and excluded) provided?
- Were the characteristics of the included studies provided?
- Was the scientific quality of the included studies assessed and documented?
- Was the scientific quality of the included studies used appropriately in formulating conclusions?
- Were the methods used to combine the findings of studies appropriate?
- Was the likelihood of publication bias assessed?
- Was the conflict of interest stated?

The quality assessment was conducted by two reviewers, and any disagreements were resolved through discussion. A quality rating was then calculated based on the

number of criteria met by the paper (Low = 0-4; Moderate = 5-8; High =9-11; 51). The full quality assessments of each systematic review are presented in Appendix A.

Assessment of level of evidence

The rubric for the level of evidence is adapted from the work of Côté et al., (52):

- *Strong evidence.* Consistent findings (i.e. more than one study) across more than one review.
- *Evidence.* Consistent findings (i.e. more than one study) from one review.
- *Limited evidence.* Limited evidence (i.e. a single study) from one review.
- *Evidence varies.* We report that the evidence varies when multiple reviews do not agree on the presence or direction of an association between a risk factor and the incidence of WMSDs. However, we recognize that this may be due to methodological differences (e.g., measurement of variable) or to effects that are specific to populations (e.g. specific occupations, females only).

Data Extraction

A data extraction template was developed to extract the following information from the included reviews:

- Citation;
- Review objectives;
- Years of coverage;
- Type of MSD;
- Population;
- Outcome measures; and
- Number and design of included studies.

Development of taxonomy for classifying risk factors

The software tool Nvivo 10 was used to develop the taxonomy for classifying the risk factors identified across the included systematic reviews. This involved, first, coding the risk factors that were assessed within each paper. All factors discussed were included regardless of whether evidence was found to support an association. Second, the factors were then classified into higher level themes adapted from the work of Côté et al., (52) and Faucett (53). Third, sub-categories were developed to better reflect the range of factors examined within the literature. Finally, the taxonomy of factors were then classified according to the levels of Rasmussen's (1) framework (Government, Regulatory bodies and associations, Company, Management, Staff, and Work).

Results

Search Results

The study identification flowchart is shown in Figure 4.

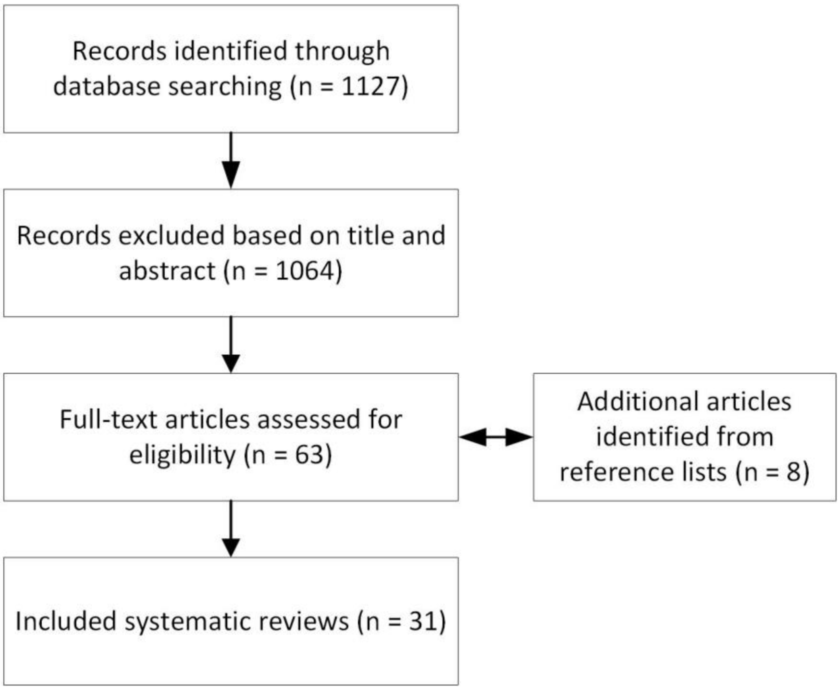

Figure 4 Flow diagram showing the systematic review identification process

Description of included systematic reviews

Table 1 describes the systematic reviews that were included in the review in terms of their: objectives; study dates; body area of MSD; population sample; outcome measures; and number and design of studies included in the systematic review.

Table 1 Characteristics of the included systematic literature reviews

Citation	Review Objectives	Years of Coverage	Body Area	Population Sample	Outcome Measures	Number and Design of Included Studies
Ariens et al., (54)	To identify physical risk factors for neck pain.	1966-1997.	Neck.	Working population or a community-based population.	Self-reported or a clinical diagnosis.	22 cross-sectional, 2 prospective cohort, 1 case-referent study.
Ariëns et al., (55)	To identify psychosocial risk factors for neck pain.	1966-1997.	Neck.	Working population or a community-based population.	Self-reported and clinical diagnosis.	28 cross-sectional, 1 prospective cohort study.
Bernal et al., (56)	To estimate the association between psychosocial risk factors in the workplace and MSDs in nurses and aides.	2001-2014.	All.	Hospital nurses and nurses aids.	Self-reported symptoms, pain or injury.	14 cross-sectional, 4 prospective cohort studies.
Bongers et al., (57)	To review the role of psychosocial risk factors for upper limb problems.	1980-2000.	Shoulder, elbow, hand and wrist.	Workers.	Self-reporting questionnaires or medical records.	28 cross sectional studies.
Coenen et al., (58)	To assess and quantify the effect of lifting at work on incidence of LBP.	-2014.	Low back pain (LBP).	Workers exposed to lifting.	Health impact assessment.	8 longitudinal studies.
Côté et al., (52)	To identify and describe the prevalence and incidence of neck pain	1980-2006.	Neck.	Workers.	Self-report questionnaires, physical examination,	19 cohort studies, 1 randomised control trial.

	and disability in workers.				sick leave, self-reported symptoms	
Crawford et al., (59)	To identify risk factors of MSDs within the telecommunications industry.	-2008.	All.	Telecommunications workers, call centre and service technicians.	Survey.	41 cross-sectional studies, 2 randomised control trials.
da Costa and Vieira (60)	To evaluate evidence of risk factors for WMSDs.	1997-2008.	All.	Workers.	Not reported.	51 prospective cohort, 1 historical cohort, 11 case-control study.
Gallagher and Heberger (61)	To identify interaction of force and repetition in relation to MSD risk.	1980-2011.	All.	Workers.	Self-reported pain or discomfort.	10 cross-sectional, 2 prospective cohort studies.
Hartvigsen et al., (62)	To determine the level of evidence for exposure to poor psychosocial work environments influencing presence of LBP.	1990-2002.	Low back pain (LBP)	Workers.	Self-reported pain.	40 prospective cohort studies.
Hauke et al., (63)	To investigate the proposed effects of adverse psychosocial working conditions at the onset of MSDs.	2000-2009.	Neck/shoulder, upper extremities, and LBP.	Workers.	Self-reported data from questionnaires and interviews.	54 longitudinal studies.
Heneweer et al., (64)	To evaluate the evidence on the association between physical activity	1999-2009.	Low back pain (LBP)	Community-based population or working population.	Self-reported back pain.	30 cohort, 6 case–control studies.

	and LBP.					
Ijmker et al., (65)	To examine relationship between duration of computer use and the incidence of hand-arm and neck-shoulder symptoms and disorders.	1950-2005.	Hand–arm and neck–shoulder.	Computer workers.	Self-report measures.	5 cohort studies.
Janwantanakul et al., (66)	To identify risk factors for the onset of LBP in office workers.	1980-2011.	Low back pain (LBP)	Office workers.	Self-reports.	3 prospective cohort studies.
Koch et al., (67)	To examine whether there is an association between psychosocial factors ascertained using the effort-reward imbalance model and WMSDs.	1996-2012.	Shoulder, neck, back, upper extremity, lower extremity, upper limb, lower limb, OR hip areas.	Workers.	Secondary analysis of questionnaire.	15 cross-sectional, 3 prospective cohort, 1 case-control study.
Kraatz et al., (68)	To analyse the effect of work-related psychosocial risk factors on the development of neck and shoulder disorders.	-2009.	Neck and shoulder.	Workers living in industrialised countries.	Self-reporting / questionnaire.	18 prospective longitudinal studies.
Lang et al., (69)	To review evidence on the lagged effect of psychosocial risk factors on MSDs in industrialised	-2009.	Lower back, neck, shoulder, and/or	Working populations in industrialised countries.	Self-report /questionnaire.	50 longitudinal studies.

	work settings.		upper back, upper extremity, and lower extremity.			
Linton (70)	To examine the published evidence concerning the role of psychological workplace factors on back pain.	1985-2000.	Neck pain, back pain, or musculoskeletal pain.	Workers.	Questionnaire and self-report.	21 prospective or longitudinal studies.
Long et al., (6)	To identify risk factors for and functional consequences of upper quadrant WMSDs in midwives, nurses and physicians.	1996-2010.	Upper quadrant MSDs.	Nurses and physicians.	Self-reported pain or symptoms.	15 cross-sectional, 2 longitudinal studies.
Mayer et al., (71)	To answer the question for which work-related physical exposures exists evidence for a causal influence on the incidence and/or prevalence of neck and/or shoulder disorders.	1975-2009.	Neck and/or shoulder.	General and working population in industrialised countries.	Surveys, questionnaires, interview, medical records and physical examinations.	21 longitudinal studies.
National Research Council and	Focused on the science base supporting current concepts of WMSDs.	1979-2001.	Low back and upper extremity	Workers.		161 prospective, case controlled and randomised control trial

Institute of Medicine (50)			MSDs.			studies.
Osborne et al., (72)	To establish risk factors for the development of MSDs among farmers.	1990-2009.	All.	Farm workers.	Self-report, interviews, physical examination.	6 case control, 4 cohort, 5 cross-sectional studies.
Pincus et al., (73)	To assess evidence suggesting that psychological factors influence the transition to chronicity in LBP patients.	1982-1999.	Low back pain (LBP).	Patients with acute or sub chronic LBP and measurement of at least one psychological variable.	Unclear.	25 prospective cohort studies.
Roffey et al., (74)	To assess causal relationships between workplace manual handling or assisting patients and LBP.	1966-2008.	Low back pain (LBP).	Workplace manual handling or assisting patients.	Self-reports.	2 prospective, 1 one-sectional survey, 2 case-controls, 1 cross-sectional, 1 prospective cohort study.
Sherehiy et al., (75)	To evaluate the evidence concerning the association between specific risk factors and MSDs.	1966-2003.	All.	Nurses.	Self-report, interview, clinical, X-ray examination, review of medical records.	15 cross-sectional, 2 case-control, 14 prospective studies.
Sobeih et al., (76)	To examine the evidence of the relationship between psychosocial	-2006.	Lower back, neck and shoulder,	Construction workers.	Not clear.	2 prospective cohort, 6 cross-

	factors and MSDs.		knee, MSD of the entire body.			sectional studies.
Taylor et al., (77)	To meta-analyse the incidence estimates of LBP and risk factors.	-2012.	Low back pain (LBP).	Community-dwelling and occupational populations with no history of LBP.	Descriptive analysis and the PRISMA guidelines.	41 longitudinal, observational, cohort designed studies.
Treaster and Burr (78)	To critically evaluate evidence regarding a significant gender difference in prevalence of UEMSDs.	1984-2004.	Upper extremities.	General and working populations.	Questionnaire, physical examination, Interview and medical records.	56 (design not included).
van Rijn et al., (79)	To assess the exposure–response relationships between WMSDs.	1966-2007.	Elbow.	Workers.	Self-reporting with questionnaires, physical examination.	9 cross- sectional, 2 case–control, 2 cohort studies.
Village et al., (80)	To critically evaluate evidence between computer work and MSDs.	1990-2005.	Hand, wrist, forearm, and elbow.	Computer users.	Physician examination or self-reported symptoms	11 prospective, 22 cross-sectional studies.
Wærsted et al., (81)	To critically review evidence of different aspects of computer work and neck/upper extremity MSDs.	-2010.	Neck and upper extremity.	Computer users.	Physical examination.	11 prospective, 2 case-control, 9 cross-sectional studies.

Summary of evidence

In the following sections the evidence for each risk factor identified in the reviews is presented according to the levels of Rasmussen's (1) framework (Government, Regulatory bodies and associations, Company, Management, Staff, and Work).

Government

No reviews identified studies that examined risk factors classified at the *Government* level of the framework.

Regulatory bodies and associations.

No reviews identified studies that assessed risk factors classified at the *Regulatory bodies and associations* level of the framework.

Company

No reviews identified studies that assessed risk factors classified at the *Company* level of the framework.

Management

Twenty-three reviews examined risk factors that were classified at the *Management* level of the framework. These risk factors were further classified into three broad categories: functional, interpersonal, and temporal. The functional category describes how work is structured or designed; the temporal category describes the overall physical pace of work; and the interpersonal category describes social interactions within the work system. The findings relating to the specific risk factors within each of these categories are summarised in the following sections.

Functional. Twenty reviews examined risk factors that were classified under the category "Functional"; a summary of the findings is presented in

Table 2.

Table 2 Summary of findings regarding risk factors classified under the category "Functional"

Factor	Evidence			
	Assessment of evidence	Positive association	No association	Inconsistent findings
Job design (including high physical job demands, low job control, and low task diversity)	Strong	6, 50, 52, 55-57, 59, 60, 63, 66, 68-70, 72, 75-79, 81		

Interpersonal. Eighteen reviews examined risk factors that were classified under the category "Interpersonal"; a summary of the findings is presented in Table 3.

Table 3 Summary of findings regarding risk factors classified under the category "Interpersonal"

Factor	Evidence			
	Assessment of evidence	Positive association	No association	Inconsistent findings
Low supervisor support	Strong	55, 59, 66, 70, 75		
Supervisory methods	Evidence	69		
Low co-worker support	Varies	55, 56, 63, 66, 68, 76, 77, 79	6, 50, 52, 57, 60, 62, 69	

Temporal. Twenty-three reviews examined risk factors that were classified under the category "Temporal"; a summary of the findings is presented in Table 4.

Table 4 Summary of findings regarding risk factors classified under the category "Temporal"

Factor	Evidence			
	Assessment of evidence	Positive association	No association	Inconsistent findings
High pace combined with a low level of rewards	Evidence	67		
Access to resources	Limited	52		
More organisational change	Limited	6		
Work scheduling	Varies	6, 59, 72	52	
Limited breaks	Varies	6, 80	50, 52	55

Staff

Twenty-five reviews examined risk factors that were classified at the *Staff* level of the framework. These risk factors were further classified into six broad categories: demographics; general health characteristics; health behaviours; individual psychological factors; worker perceptions; and worker strain and recovery. The findings relating to the specific risk factors within each of these categories are summarised in the following sections.

Demographics. Twelve reviews examined risk factors that were classified under the category "Demographics"; a summary of the findings is presented in Table 5.

Table 5 Summary of findings regarding risk factors classified under the category "Demographics"

Factor		**Evidence**		
	Assessment of evidence	Positive association	No association	Inconsistent findings
Occupation	Strong	6, 52, 59, 64, 72, 74, 75		
Income level	Strong		52, 77	
Age (older workers more at risk)	Varies	52, 59, 60, 72		6, 75
Duration of employment (longer duration)	Varies	6, 72, 75, 80		52
Education level	Varies	72	6	52
Ethnicity	Varies			6, 52
Gender (females at greater risk)		52, 59, 60, 77, 78, 81		6
Marital and family status	Varies		6	52

General health characteristics. Six reviews examined risk factors that were classified under the category "General health characteristics"; a summary of the findings is presented in Table 6.

Table 6 Summary of findings regarding risk factors classified under the category "General health characteristics"

Factor		Evidence		
	Assessment of evidence	Positive association	No association	Inconsistent findings
History of MSDs	Strong	6, 52, 60, 66, 77		
Physical capacity	Strong	52, 77		
Headaches	Limited	52		
High BMI	Varies	60, 72		52, 77
Self-reported health problems	Varies	60		6
Sleep issues	Varies	72, 77	52	

Health behaviours. Five reviews examined risk factors that were classified under the category "Health behaviours"; a summary of the findings is presented in Table 7.

Table 7 Summary of findings regarding risk factors classified under the category "Health behaviours"

Factor		Evidence		
	Assessment of evidence	Positive association	No association	Inconsistent findings
Smoking	Strong	6, 52, 60		
Alcohol consumption	Limited		6	
Physical activity outside of work	Varies	64	60	6, 52, 54

Individual psychological factors. Seven reviews examined risk factors that were classified under the category "Individual psychological factors"; a summary of the findings is presented in Table 8.

Table 8 Summary of findings regarding risk factors classified under the category "Individual psychological factors"

Factor			Evidence	
	Assessment of evidence	Positive association	No association	Inconsistent findings
Depressive or emotional symptoms	Varies	50, 52, 72, 73	66, 79	
Personality variables	Varies	52, 75		Koch et al., 2014

Worker perceptions. Five reviews examined risk factors that were classified under the category "Worker perceptions"; a summary of the findings is presented in Table 9.

Table 9 Summary of findings regarding risk factors classified under the category "Worker perceptions"

Factor			Evidence	
	Assessment of evidence	Positive association	No association	Inconsistent findings
Low job security	Strong	52, 55, 59, 63, 69		
Lack of opportunities for career development	Limited		52	
Value that workers place on promotion	Limited	59		

Worker strain and recovery. Seventeen reviews examined risk factors that were classified under the category "Worker strain and recovery"; a summary of the findings is presented in Table 10.

Table 10 Summary of findings regarding risk factors classified under the category "Worker strain and recovery"

Factor		Evidence		
	Assessment of evidence	Positive association	No association	Inconsistent findings
Need to recover after a day of work	Limited		52	
High stress or strain	Varies	6, 50, 52, 59, 63, 66, 68, 70, 76-78, 81, 82		55, 60, 62, 75

Work

Eighteen reviews examined risk factors that were classified at the work level of the framework. These risk factors were classified into four broad categories: ambient conditions; equipment; postures; and task factors. The findings relating to the specific risk factors within each of these categories are summarised in the following sections.

Ambient conditions. Three reviews examined risk factors that were classified under the category "Ambient conditions"; a summary of the findings is presented in Table 11.

Table 11 Summary of findings regarding factors classified under the category "Ambient conditions".

Factor		Evidence		
	Assessment of evidence	Positive association	No association	Inconsistent findings
Working in cold temperatures	Strong	50, 72		
Overall work environment (i.e. Lighting, temperature, air quality, room size and acoustics)	Limited	52		

Equipment. Twelve reviews examined risk factors that were classified under the category "Equipment"; a summary of the findings is presented in Table 12.

Table 12 Summary of findings regarding factors classified under the category "Equipment"

Factor	Evidence			
	Assessment of evidence	Positive association	No association	Inconsistent findings
Keyboard positioning	Strong	52, 59		
Extended mouse use	Strong	65, 80, 81		
Desk height	Limited	59		
Use of telephone rests	Limited	52		
Exposure to vibration	Varies	50, 54, 71, 72	77	60, 79
Workstation design	Varies	59		54
Extended computer use	Varies	80, 81		65
Extended keyboard use	Varies	80, 81		65
Mouse positioning	Varies			52
Screen height	Varies	59		52
Aspects of chair design	Varies	59		52

Postures. Fifteen reviews examined risk factors that were classified under the category "Postures"; a summary of the findings is presented in Table 13.

Table 13 Summary of findings regarding factors classified under the category "Postures"

Factor	Evidence			
	Assessment of evidence	Positive association	No association	Inconsistent findings
Awkward postures	Strong	50, 52, 54, 60, 61, 64, 66, 71, 72, 75, 77, 79-81		
Working with hands above shoulders	Strong	52, 59, 71, 77		

Neck flexion	Strong	52, 54, 71		
Prolonged standing at work	Limited	64		
Prolonged work in sedentary or static positions	Varies	71, 80		50, 52, 54

Task factors. Thirteen reviews examined risk factors that were classified under the category “Task factors”; a summary of the findings is presented in Table 14.

Table 14 Summary of findings regarding factors classified under the category “Task factors”

Factor		Evidence		
	Assessment of evidence	Positive association	No association	Inconsistent findings
Manual handling (i.e. Lifting, forceful work, loading and manual handling)	Strong	52, 54, 58-61, 64, 71, 72, 74, 75, 77, 79		
Repetitive and precision work	Strong	52, 54, 58-61, 64, 71, 72, 74, 75, 77, 79		

Prototype taxonomy and discussion

The aim of this review was to identify the risk factors associated with WMSDs, in order to develop a prototype taxonomy of potential contributing factors. Figure 5 presents the prototype taxonomy, with a summary of the level of evidence available to support the inclusion of each factor. As Figure 5 shows, 15 factors were identified with strong evidence; 2 factors were identified with evidence; 10 factors were identified with limited evidence; and 24 factors were identified with varying evidence. Based on the available evidence, all the factors identified in the literature are included in the taxonomy, with the exception of income level. However, the strength of the evidence provides a basis for prioritising the consideration of some factors over others during investigation and the analysis of incidents. The gaps in the evidence provide insight into the sources of information that are likely to be useful for further taxonomy development.

Regarding the strength of the available evidence, one notable conclusion from the review is that almost all the risk factors underpinned by at least some consistent evidence are modifiable. For example, job design, low supervisor support, low job security, and awkward postures all reflect conditions within work systems that can be changed. The findings from the review suggest that it would be appropriate to collect data on the contribution of these factors during investigations, and that recommendations targeting these factors are likely to have a reliable impact on preventing WMSDs. In contrast, many of the factors underpinned by variable evidence are non-modifiable, particularly at the staff level of the taxonomy. For example, the age, gender, health problems, ethnicity, physical activity outside of work and personality of the injured worker are typically not easily open to change within occupational settings. The findings indicate that these factors are not reliable indicators of increased risk of WMSDs. This suggests that they should not be the focus of incident analysis, investigations or prevention efforts. Overall, the prototype taxonomy combined with the evidence from the review provides a basis for designing incident analyses, directing resources during investigations and selecting recommendations for implementation.

One caveat to this conclusion is that Figure 5 shows that there are some obvious gaps in the current evidence and resulting prototype taxonomy. Specifically, no studies were identified in the review that examined factors at the top three levels of Rasmussen's framework, and relatively few factors were identified at the management level. This result was anticipated as the majority of studies examining the risk factors associated with WMSDs have been undertaken from an epidemiological perspective, which focuses on identifying risks to individuals. Currently, very little research in this domain has been undertaken from a systems perspective (see 9, 83).

There are a number of sources of data that could be used to further develop the taxonomy at the higher levels of the framework. First, the findings presented in the following chapter regarding the barriers to implementing recommendations could be used to populate these levels of the framework. Previous research has found that these barriers are typically identical to the factors that contribute to incidents within organisations (45). Second, organisations could extend the taxonomy by undertaking an analysis of their

historical incident report and investigation data on WMSDs. This would involve using the prototype taxonomy to classify the contributing factors identified within the data, and developing additional categories to capture new contributing factors. This process would also allow organisations to refine and adapt the taxonomy to their specific context (e.g. healthcare, construction), although the comprehensiveness of the resulting taxonomy would be constrained by the level of detail within the available reports and investigations. Third, investigations into WMSDs underpinned by a systems approach would provide the most comprehensive source of information for further taxonomy development; this is an avenue for future study.

Another gap in the evidence and resulting prototype taxonomy are the equipment and task factors. The equipment factors are limited as the majority of studies examined in the review focussed on the link between aspects of workstation design and increased risk of WMSDs. While office workers represent a large proportion of the working population in Australia, there are many other occupations exposed to hazardous manual tasks and potential WMSDs. In these industries, organisations should extend the taxonomy to include the equipment-related factors that are most relevant to their work-role task. Similarly, the task-related factors identified through the review are currently too broad and domain-general to be of much use during an investigation. Industry-specific risk assessment tools designed to assess the physical risks associated with tasks would be a useful for refining and adapting the taxonomy to a particular context.

In conclusion, the prototype taxonomy provides the first step for organisations wishing to develop their own domain-specific taxonomy. However, further refinement and development is required. The following chapter presents the findings from a study that was conducted to examine the processes that Australian organisations currently use to report and investigate WMSDs; the findings will be used to further develop the prototype taxonomy.

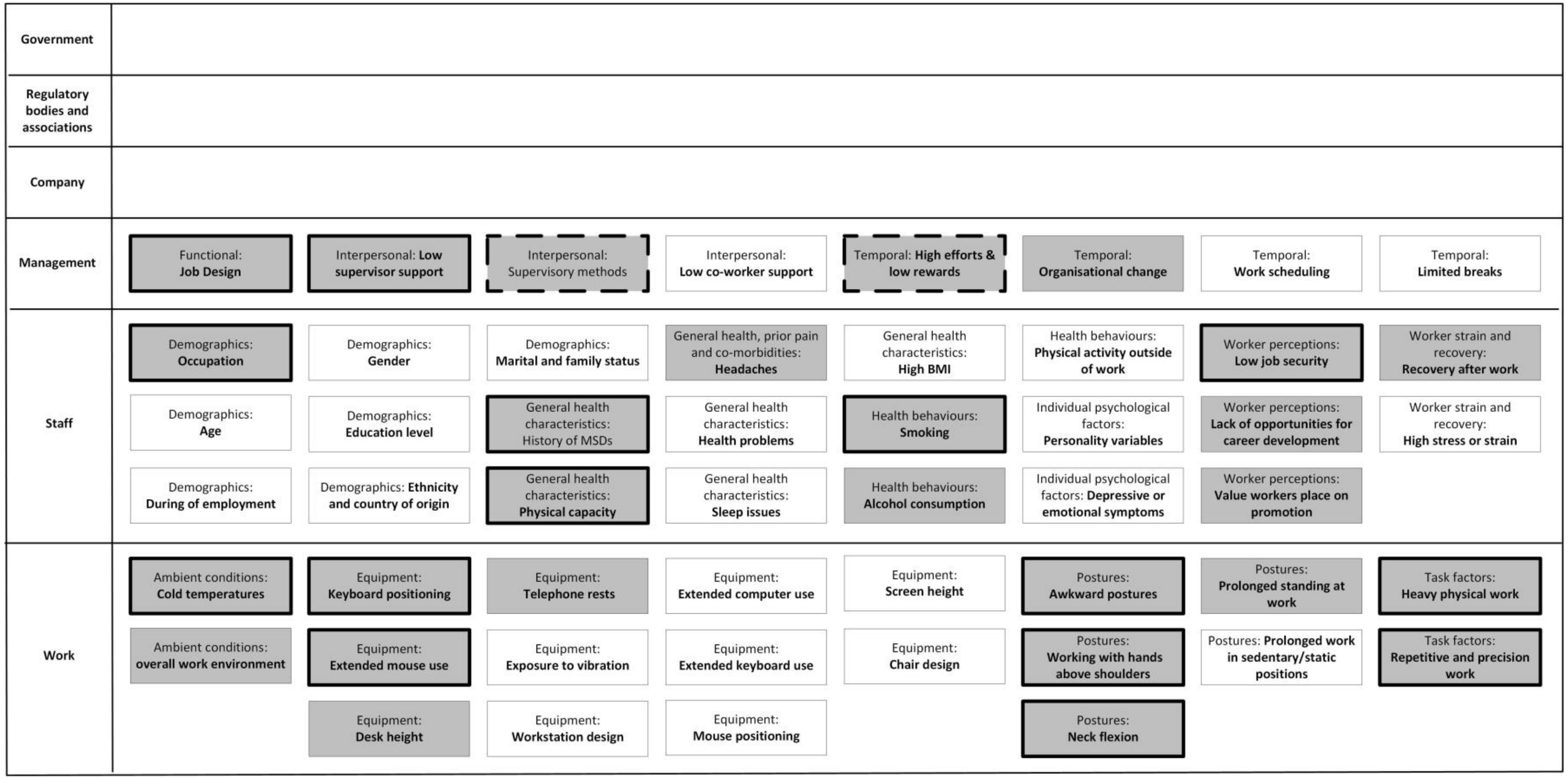

Figure 5 Summary of the evidence identified through the review and prototype taxonomy. Note that the shading represents the level of evidence associated with each risk factor identified in the review. A shaded box with bold outline indicates strong evidence; a shaded box with bold dashed outline indicates consistent findings from more than one study; a shaded only box indicates limited evidence (i.e. one study); and an unshaded box with a normal outline indicates that evidence varies. Risk factors with evidence of no association with increased risk of WMSDs are not represented on the diagram

Chapter 3: Does current practice support learning from WMSDs?

This chapter presents the findings from a study that was conducted to examine the processes that Australian organisations currently use to report and investigate WMSDs, and the extent to which the processes adopted support or hinder learning. Specifically, the study examined:

1. The systems currently used for reporting and investigating WMSDs (organisational resources);
2. How these systems are implemented in practice (steps in the learning cycle);
3. The perceived strengths and weaknesses of current practice; and
4. The types of contributing factors and recommendations that are typically considered in relation to WMSDs.

The aim of this chapter is to identify the practices (positive and negative) that influence whether the potential for learning from WMSDs propagates throughout the organisation. This information will be incorporated into the framework, presented in chapter 4. Therefore, the findings from the study are presented in the context of the learning cycle (2) and Rasmussen's (1) framework; the implications for learning are discussed throughout the results section. The discussion summarises the key strengths and weaknesses of current practice for learning from incidents.

Method

Design

A multi-methods design was used to examine reporting and investigation of WMSDs in a sample of large Australian organisations. This involved a review of relevant documentation and semi-structured interviews with the employees primarily responsible for reporting and investigation. A large organisation was defined as having more than 50 employees.

Ethics approval

The University of the Sunshine Coast Human Research Ethics Committee approved the study. Additional approvals were obtained for organisations requiring approval from specific ethics committees. Written consent was obtained from a relevant manager within the organisation and interview participants.

Sample: Organisations and interview participants

Nineteen organisations participated in the study; Table 15 shows descriptive statistics for the organisations involved in the study. In total, 38 interviews were conducted; Table 16 shows the demographics for interview participants. All participants were in occupational health and safety (OHS) roles (e.g. OHS Managers/Advisors/Officer, risk manager, manager of safety services, health, safety and wellbeing co-ordinator etc.).[1] Nine participants held a Certificate IV, 17 held a Graduate Diploma, 4 held a Bachelor's degree, and 3 held a Masters in Workplace Health and Safety. Six participants had no formal qualifications in occupational health and safety; however, all of these participants held qualifications in physiotherapy or occupational therapy.

[1] For clarity, participants are referred to as OHS Managers or the OHS Team in the results section.

Table 15 Descriptive statistics for the organisations involved, including industry group, number of interviews per organisation, and the main occupational groups supported by the OHS Team. The industry groups are based on Australian Bureau of Statistics classifications.

Industry group	No. of interviews	Main occupational groups
Construction	1	Plant Operators, Tradesmen, Labourers, Administration, Managers.
	1	Engineers, Environmental Specialists, Architects, Project Management, Administration, Managers.
Education	1	Administration, Academics, Facilities Management, Managers
	2	Administration, Managers, Outdoor Activity Leaders, Operational Staff
	1	Administration, Academics, Managers
Emergency Services	3	Fire Fighters, Administration, Managers
	2	Fire Fighters, Administration, Managers
Health	3	Clinical Staff, Administration, Facilities Management, Domestic Services,
	3	Clinical Staff, Allied Health, Administration
	2	Nursing, Carers, Administration, Maintenance, Volunteers, Drivers
	1	Clinical Staff, Food Services, Administration, Facilities Management
	5	Clinical Staff, Administration, Patient Support, Food Services, Allied Health, Scientists, Operational Staff, Carers
	3	Clinical Staff, Allied Health, Operational Staff, Volunteers, Administration, Managers
Manufacturing	1	Labourers, Packers, Plant Operators, Administration
Mining	2	Plant Operators, Engineers, Administration, Management
	2	Technicians, Labourers
Retail and trade	1	Sales Assistant, Stocking, Managers
Transport, postal, warehousing	3	Caterers, Clerks, Warehouse Operator
Electricity, gas, water and	1	Engineers, Scientists, Field Operators, Land Management

waste services	

Table 16 Demographic information for interview participants (male = 22, female = 16)

Descriptive	Mean	Standard Deviation	Range
Age (years)	42	9.02	28 - 59
Experience in an occupational health and safety role (Years)	10	7.52	.5 – 30
Time spent on tasks related to incident reporting and investigation (%)	37%	23%	5% to 90%

Materials

Interview schedule. The interview schedule was developed to examine the strengths and weaknesses of *organisational resources* and *each stage of the learning cycle* (2) for reporting and investigation.

The questions relating to *organisational resources* examined seven types of resources: 1) the people responsible for the reporting and investigation process; 2) accident causation models; 3) policies and procedures; 4) incident report forms; 5) data collection tools for investigation; 6) software; and 7) training.

The stages of the learning cycle were examined separately for reporting and investigation. Participants were asked to describe and reflect on the strengths and weaknesses of the following aspects of the reporting process, giving examples relating to WMSDs:

- initial reporting;
- recommendations on reports proposed by managers;
- analysis;
- recommendations proposed by OHS Team;
- Implementation; and
- follow-up and evaluation.

Participants were asked to describe and reflect on the strengths and weaknesses on the following aspects of the investigation process, giving examples of WMSDs:

- the selection of reports for investigation;
- the goals of investigation;
- the scope of investigation (information collected and contributing factors);
- analysis;
- implementation; and
- follow-up and evaluation.

Procedure

Documentation review. The contact person at each organisation was asked to provide a copy of any policies, procedures, or documentation relating to incident reporting, investigation and WMSDs.

Semi-structured interviews. The majority of interviews were held in a private room at the participant's workplace, averaging 1.5 to 3 hours per participant. Four interviews were conducted via telephone, due to scheduling difficulties. All interviews were recorded using a Dictaphone and transcribed verbatim using Microsoft Word. All interviews were conducted by the lead author, who has significant experience in the use of semi-structured interviews.

Data analysis. The analysis was undertaken using a qualitative data analysis software tool, Nvivo 10. The interview transcripts were thematically analysed using the conventional approach to content analysis (84). This involved, first, reading through the transcripts a number of times to obtain a sense of all the responses. Second, the transcripts were then coded to the interview probes, as participants tended to remember more information relating to earlier probes and expand on their responses throughout the interviews. For example, all content relating to software used to store and analyse information about incidents was coded to "Software". Third, the responses to each probe were coded to: "descriptions of current practice", "strengths" and "weaknesses". Fourth, these responses were then coded into highly specific themes (e.g. "the equipment was not available on the ward" was coded to the theme "equipment availability"). Fifth, the specific codes were then grouped into meaningful themes (e.g. "equipment availability", "problems with equipment", "equipment serviceability" were all grouped into "equipment"). As recommended by Hsieh and Shannon (84), this process then was repeated until there were less than 10 to 15 themes, to keep themes broad enough to assist in reporting. Frequency counts of the number of interviewees who articulated each theme in response to each question were performed. Finally, the codes relating to the probes "contributing factors", "recommendations" and "factors influencing the implementation of recommendations" were mapped onto Rasmussen's (1) framework to show where they reside within the work system.

As the different organisations provided a huge range of documentation, for the purposes of developing the framework only the incident reporting forms were analysed in detail.

Results and implications for learning

Organisational resources

People responsible for the reporting and investigation process. In all organisations, the injured person was responsible for submitting the initial report. The report would then be reviewed and approved by a direct manager (and sometimes a number of other managers), or go directly to the OHS Team.

The responsibility for the immediate follow-up of the report varied across organisations. In ten organisations, the manager of the injured person was required to conduct an investigation following a report. The level of investigation ranged from a brief review to a full investigation. A brief review typically involved completing an additional page on the incident report, with prompts to identify contributing factors and recommendations. A full investigation involved using the same process as the OHS Team. In both cases, the OHS Team would review the findings and recommendations proposed by the manager, and if required follow up with an

additional investigation. In the other organisations, the OHS Team were responsible for immediately following up on reports and investigating if required.

In 14 organisations, the OHS Team also developed recommendations based on clusters of incident reports (e.g. 2nd loop learning). In some cases, the analysis would trigger an additional investigation to gather more details about the contributing factors involved in incidents across a particular work area or task (e.g. HS_5; Trans_1; Ret_1; Min_1). The work area would then be involved in the design of the recommendations.

Responsibilities for implementing recommendations were unclear in the majority of organisations (n = 16). In organisations where the manager of the injured person was required to conduct the initial investigation, they also had primary responsibility for ensuring that the resulting recommendations were implemented; however, it was unclear how responsibilities were assigned if recommendations related to broader changes across the organisation. In three organisations, responsibilities were assigned during the development of recommendations and senior managers were directly involved in the design process.

Accident causation model. The majority of participants (n = 22) did not refer to a particular model of accident or injury causation for the purposes of reporting and investigation. Of the participants who did refer to a model (n = 12), the most frequently cited model was Reason's (18) Swiss Cheese model (n = 8). All of these participants had undertaken Incident Cause Analysis Method (ICAM) investigation training, which is underpinned by Reason's model. The other participants referred to models that are actually methods for conducting investigations or analysing accidents, including: the five whys (n = 1); taproot (n = 1); Haddon's matrix (n =1); event tree analysis (n = 1); and fishbone diagrams (n = 1). This suggests that there is some degree of confusion about accident causation models. Notably, participants from the same organisation often referred to different models or methods, indicating that they were not embedded within the organisational processes or systems.

Policies and procedures. All participants stated that their organisation had a range of policies and procedures relating to reporting and investigation. However, none of these had specific elements relating to WMSDs. Information relating to WMSDs was embedded within specific documents such as report forms, manual handling polices, risk assessment templates, workstation assessment guidelines, training presentations.

Data collection tools: incident reports. All incident reports tended to capture the same broad types of information, as shown in

Table 17. The majority of questions were intended for the injured person. In nine organisations, the report also included questions for the injured persons' direct supervisor or manager.

Table 17 Information typically captured in incident reports

Information provided by injured person	Information provided by injured persons' direct supervisor or manager
• Demographic information • Type of incident (e.g. injury, near miss, hazard) • Type of injury • Location of injury • Mechanism of injury • Task associated with the injury • What happened unexpectedly?(free text • What happened? (free text) • Contributing/causal factors (free text or categories) • Rating of the risk or severity of the incident • Suggestions for changes to prevent future recurrences	• Task associated with the injury • What happened unexpectedly?(free text • What happened? (free text) • Contributing/causal factors (free text or categories) • Corrective or remedial actions to be undertaken (free text)

The authors identified three potential issues with the categories used to classify the type of injury on reporting forms. First, this field often included overlapping sub-categories. For example, in one report the category "type of injury sustained" had sub-categories including: "dislocation", "lifting injury (manual handling injury)", "pain", and "sprain/strain" (HS_3_1). Second, this field often required medical knowledge to accurately diagnose the appropriate sub-category, and lacked options to record instances where the injured person was unsure of the appropriate classification. Third, few reports included sub-categories for "pain" or "discomfort" which would be required to capture reports of low severity WMSDs. One participant noted that injured workers often used the category "superficial injury" to describe these issues, which was problematic as these incidents would be perceived as not requiring a response (Min_1_1). Overall, it seems likely that these issues contribute to the data quality issues discussed in later.

Many report forms encouraged the selection of only a single contributing factor (n = 4), or made little distinction between contributing factors and the mechanism of injury. For examples, including contributing factors categories such as "manual task" (Con_2), "manual handling" (Trans_1). No report forms encouraged reporting of relationships between contributing factors.

Some report forms included fields designed to capture information specific to WMSDs (n = 3). For example, one report included a supplementary "manual handling incident checklist" providing a series of tick boxes e.g. "were any lifting aids being used", "were corrective lifting practices being applied", was there any issues with equipment maintenance" (HS_3). Similarly, two organisations included a specific questions designed to capture information around patient handling injuries e.g. "Did this incident involve a patient" "Were staff available to help move", "Was the Patient/Client/Resident assessed as a high risk of Falls?", ""Number of persons who

undertook the task" (HS_4; HS_5). This type of categories are useful for later analysis identifying clusters of reports for further investigation.

Data collection tools: investigations of WMSDs.

As shown in

The biggest weakness, however, with the tools identified by participants is that the majority target the collection of data about the immediate context of the incident (e.g. risk assessments, observations). While potentially, interview questions could be used to gather information about organisational factors and the conditions of work, the questions described by participants typically focussed on the behaviour of the injured person.

Table 18, a wide range of data collection tools were used by participants to investigate WMSDs. Often participants within the same organisation used completely different data collection tools. For example, in one health service (HS_6), one participant would apply a particular manual handling risk assessment to all investigations into WMSDs, while another relied exclusively on unstructured interviews. These differences are likely due to a lack of standardisation of investigation procedures within the organisations, combined with the wide range of experience and qualifications represented in the sample. It suggests that the investigations conducted by different people within the same organisation are likely to have different findings and recommendations.

The majority of participants did not use formal interview schedules or questionnaires, relying instead on experience or "common sense" to formulate questions and lines of inquiry (n = 27). Given that many participants did not refer to an accident causation model, this is likely to result in biases or gaps in investigations. Exceptions were participants from Con_1 and Min_1, who used witness statements including a series of probes to collect information about the conditions and events leading up the incident, the incident itself, and the actors involved. However, one limitation of these statements for investigating MSDs is they are designed for incidents where there is a sudden loss of control over hazardous processes. Therefore, they may not be appropriate for cumulative onset injuries.

The most common form of data collection tool was an investigation template (n = 18). Three types of templates were described. The first type focused on "what happened", using prompts such as "who, what, when, where and why" or instructing the investigator to "apply the five whys". One participant stated that this involved asking the injured person: "Why did you do that? But why did you do that? But why did you do that? So you ask why, why, why, why, why" [HS_2_2]. The second type focused on categories of contributing factors (e.g. equipment, environment, organisation), using either open text fields or checklists. Participants using these two types of templates raised concerns about relying on the investigator to generate appropriate questions, because "the overall outcome and quality of the investigations is largely dependent on the individual running it, and their capability" [Min_1_1]. The third type of template focused on "problem area sub-categories s", using specific question such as: "Was the task appropriately supervised?" or "Was the required equipment available?" Participants using the last type of template identified both strengths and weaknesses, depending on how the prompts were framed. In some organisations, the participants felt that the prompts focussed on identifying fault and blame, i.e. the prompts "require a line manager to admit, "I haven't done this right. I haven't

supervised" [HS_2_3]. In other organisations, participants felt the prompts were appropriately focussed on identifying areas for prevention activities, such as the availability of patient handling equipment on a particular ward [HS_6_1].

The biggest weakness, however, with the tools identified by participants is that the majority target the collection of data about the immediate context of the incident (e.g. risk assessments, observations). While potentially, interview questions could be used to gather information about organisational factors and the conditions of work, the questions described by participants typically focussed on the behaviour of the injured person.

Table 18 Data collection tools and techniques used during investigations into WMSDs. Note: these results are not presented by organisation as participants within the same organisation often used different tools.

Data collection tool or technique	No. of participants
Investigation template	18
Unstructured interviews or informal chats with injured person and others in work group	16
Witness statements from injured person and others	7
Work station assessment	6
Risk assessment	5
Evaluation of training history records	5
Gathering information from external Subject Matter Experts (SMEs)	4
Observation of tasks	4
Written statements from injured person and others in work group	4
Medical reports	3
Photos of work area or task	3
Technical info on equipment	3
Facilitated discussions within workgroup on incident	2
Equipment maintenance logs	2
Procedures	2
Structured interviews with injured person and others in work group	2
Biometric force measurement	1
CCTV footage of task performance	1
Content of training	1
Discussions with OHS team about causes	1
Current research	1
Phone call with injured worker	1
Phone call to manager to verify facts	1

Physical tests of injured person	1
Recorded interviews	1
Review of patient involved in incident	1
Rosters	1

Software for reporting and investigation. All organisations involved in the study used a software database to record and store incident report data. In most organisations (n=17), the same software was used to store investigation data. The majority of organisations had databases that allowed all employees to directly enter reports from their own computers (n = 16). Three organisations (healthcare = 2; education = 1) required employees to submit paper reports that were subsequently entered into the database by the OHS Team or administrative staff. Participants identified paper reports as a significant barrier to initiating investigations, and from an administrative perspective.

Throughout the interviews, participants discussed a number of features of the software used by their organisation that either facilitate or act as barriers to learning from incidents, as shown in Table 19 and Table 20, respectively. There are a few points of note in relation to the features identified as barriers. First, the issues identified relating to the theme "data entry" are all barriers to initial reporting, increasing the amount of time to submit a report. Second, the issues identified relating to the theme "fields in the system" all represent barriers to using the information collected for developing appropriate recommendations. For example, participants reported:

> "You don't get the level of detail that would actually be effective for doing interventions" [Edu_2_2] and

> "They're very generic categories and trying to pinpoint exactly what happened is quite hard" [EM_1_3].

Finally, the issues relating to the theme "analysis" all represents barriers to using the data collected to support the identification and analysis of clusters of incidents (i.e. second loop learning). Overall, these issues indicate that often the design of software intended to collect data about incidents presents significant barriers to learning from incidents.

Table 19 Features of software tools that facilitate learning from incidents. N = number of participants identifying this feature.

Feature	N
Enhancing the ease of reporting	
Software accessible online from any computer or mobile device	7
Simplicity of questions	6
Same software used to report different types of incidents and hazards	5
Interface easy to use	4
Definitions embedded into software tool	1

Supporting the learning cycle	
Automatic email reminders for implementation	2
Automatic notification of incidents to relevant people	4
OHS Team can modify questions to suit their needs	2
Multiple people can add information about an incident	2
OHS Team can change categorisations selected for an incident	1
Automatically notifies senior managers if investigation is not completed in a timely manner	1

Table 20 Features of software tools that act as barriers to learning from incidents. N = number of participants identifying this feature.

Theme	N
Data entry	
Difficult to enter reports e.g. fields do not match paper form, system is slow, interface confusing	11
Staff cannot fill out form online	5
Multiple reports may need to be submitted for same incident	4
Multiple systems for different types of incidents, hazards and near misses	3
Staff cannot submit report if something is entered incorrectly	1
Does not allow near miss or hazard reporting	1
Does not allow multiple people to enter information about an incident	1
Fields in the system	
Categories are not useful for preventing injuries	12
Categories are unclear	10
Missing fields	5
Investigation findings not recorded	3
Categories do not align with organisation's model of accident causation	2
Extremely difficult to change questions	2
Mandatory and non-mandatory fields confusing	2
Too many questions and categories	2
Free text fields have low word limit	1
Language is blame-orientated	1
Analysis	
Difficult to extract data in a format useful for aggregate analysis	8
Automatic reports not useful for designing countermeasures	6
Manual coding of data required	5

Search function does not allow you to identify clusters of incidents	1
And difficult to generate reports	1
Follow-up	
Allows managers to close off incidents without action	1
Managers can delete reports they don't perceive as important	1

Training. The majority of participants identified a lack of, or inadequate, training in reporting and investigation as significant issues. Often training was only provided during induction (n = 24), or not at all (n = 8). Six participants stated training was provided on an annual basis. Training at induction was seen as problematic as "it may well be 18 months, 2 years before they report an incident at all, and at that point in time, they may not know" [EM_2_1].

A number of participants felt that the training at induction was inadequate as it was only provided online (n = 7). The problems identified varied from overwhelming staff with too much information, and providing too little information, e.g.

> "twenty minutes and most of that's the emergency response process in the building" [Con_2_1].

However, the costs associated with face to face training was also identified as a significant barrier in large organisations, e.g.

> "we've got 90% of all individuals trained in how to use [the incident reporting software]….huge costs, probably upwards of $500,000 to do that training component" [EM_1_2].

A quarter of participants expressed concern that managers lacked the skills to appropriately conduct investigations (n = 9). A number of gaps in the training were identified, including: lack of training on how to identify causes and appropriate recommendations (n = 8); training was not specific enough to their organisational context as it was outsourced to external providers (n = 6); training focused on compliance rather than learning (n =1); and non-mandatory training (n = 1). These problems were also reflected in participant's descriptions of the contributing factors and recommendations identified by managers discussed later, which tended to focus on blaming the injured worker.

Some organisations provided ICAM training to managers required to undertake investigations. One participant raised the concern that "generally I think it gives people a false sense of their capability around investigation…if you haven't done any investigation before…do the ICAM training for three days, you'll leave [the course] as a lead investigator…all it does is give them a sense of power and authority" [Min_1_1]. Similar concerns were raised about other training from external providers, "I just think the actual scenarios used are very generic.…they would never happen to me in my lifetime as a [organisation name] operator" [Util_1_1].

Thirty-four of the participants conducted investigations, and all raised concerns that they had few opportunities to reflect on their skills or receive feedback. Only twenty participants had undertaken formal training, such as ICAM (n = 8); a TAFE course or diploma (n = 9), or a one-off investigation course (n = 3). In all cases, participants

reported that the training did not include specific components relating to the investigation of WMSDs.

The reporting process

Definition of what should be reported. Twenty-one participants stated that their organisations' documents (e.g. policies, procedures, incident report form) included a definition of the types of incidents or conditions that should be reported by employees, and sixteen stated that there was not or that they were unsure. The most common definition given was "any injury" (n = 8), followed by "everything" (n = 4), "all incidents and near misses" (n = 3), "categories of types of injuries and illnesses" (n = 2), "all incidents with potential for harm" (n = 2), "lost time injuries (LTIs)" (n = 1), "notifiable incidents" (n = 1) and "aligns with the harmonised legislation definitions of incidents and notifiable incidents" (n = 1).

Four participants stated that there is a lack of clarity around terms such as "near miss", "hazard", and "pains and strains." For example, "people know to report an injury. But they don't know to report a strain or shoulder pain…there should be a mechanism in place where people who feel strains and pains report" [Edu_1_1].

Barriers and factors facilitating initial reporting. Participants identified a large number of barriers and factors facilitating initial reporting, as shown in Table 21. The majority of barriers relate to the lack of clarity around the type of incidents that should be reported, while the facilitating factors are programs or technologies that have been introduced to encourage reporting. All participants identifying the need to report to more than one system as a barrier were from the health sector. This problem arises because WMSDs to staff often co-occur with incidents involving patients (e.g. patient falls), which are reported in a separate system.

Table 21 Barriers and factors facilitating initial reporting. N = number of participants who identified this theme.

Theme	N
Barriers	
Employee perceptions that injury is not bad enough to report	18
Nothing will happen as a result of the report	10
No clear definition of what should be reported	6
The need to report to more than one system	6
Database hard to access on the job	6
Database hard to use	5
Facilitating factors	
Workcover and reporting system linked	4
Free treatment options	3
Early intervention programs	2
Safety culture programs	2
Telephone line to report hazards and near misses	2

Anonymous online hazard reporting	1
Provision of tablets to report incidents for offsite staff	1
One system for reporting all types of incidents and hazards	1
Simplification of reporting system	1
Targets for reducing LTIs	1
Wellbeing programs	1

Quality of information recorded on incident reports. The majority of participants stated that the quality of the description of the incident tended to be poor (n = 29). The most commonly stated issue was that the reporter provided no or little information in the free text fields (n = 15), e.g. reporting "I hurt my back" [EM_1_1], "sore back from end of shift" [HS_1_3], "twinge in my back" [EM_2_2], and "hurt back, going to doctor" (Trans_1_1). In addition, multiple categorical fields were often left blank. Another issue was that the description of causes or contributing factors tended to be poor (n = 14).

A number of issues were discussed specifically relating to the causes of WMSDs, including: it is difficult to describe contributing factors for degenerative conditions (n = 5); and that workers and managers lack knowledge about risk and MSD causation (n = 4). One participant commented "we often would get a report stating that they noticed a gradual onset of symptoms throughout the shift, and they attribute it to being busy, without any specific incident occurring or any specific patient" [HS_5_5].

Participants were asked about the types of causal or contributing factors that were typically reported regarding WMSDs. Five participants stated that these fields were often left blank. The types of factors described are shown in the left hand side of Figure 6, classified according to Rasmussen's (1) framework. It is interesting that the factors that are commonly reported are outside of the control of the injured person. This is in contrast to the majority of recommendations proposed by managers, which are described in the following section.

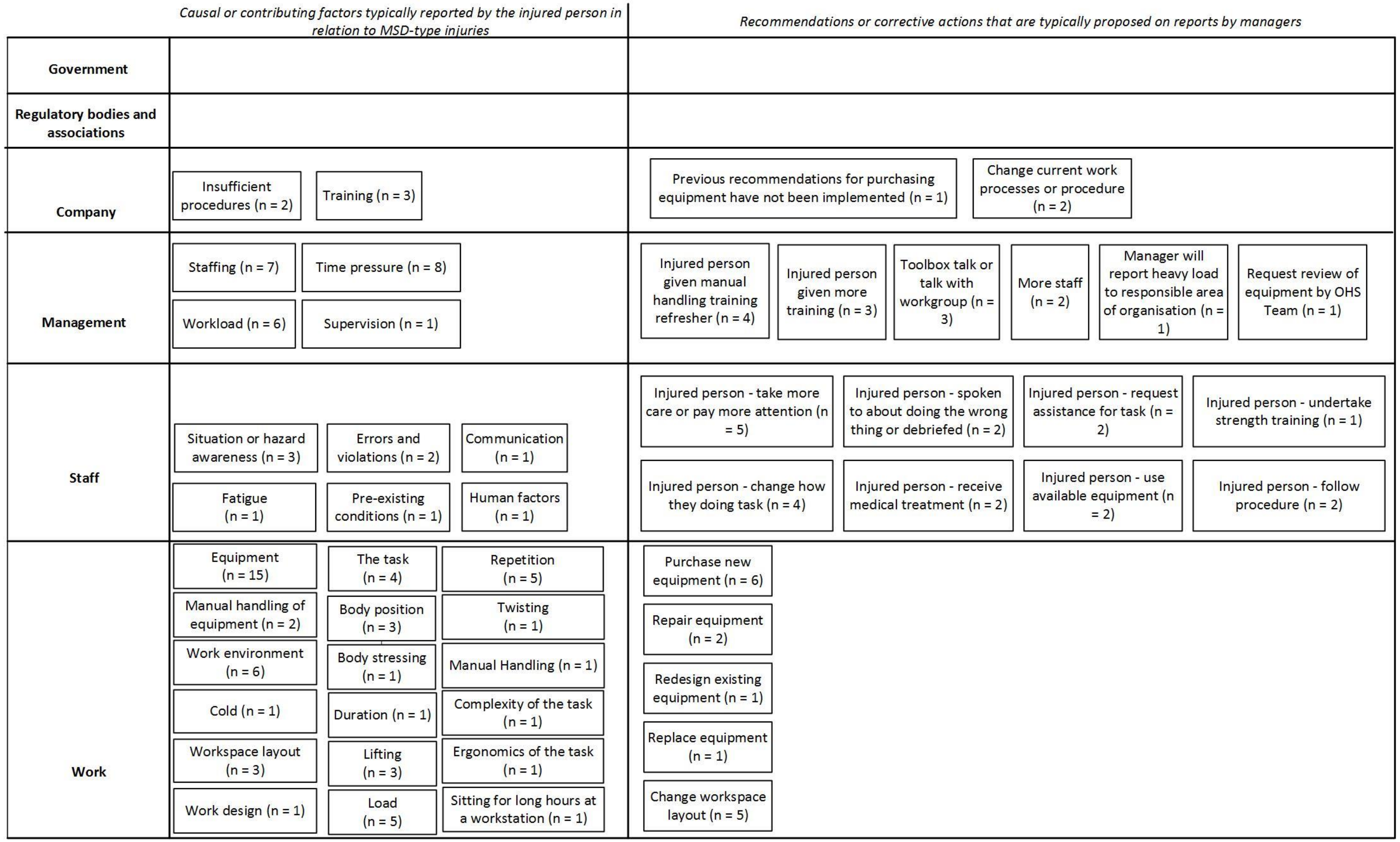

Figure 6 Summary of the types of causal or contributing factors typically reported by injured workers (left hand side of the figure) and the types of recommendations or corrective actions proposed by managers (right hand side of the figure), classified according to Rasmussen's (1) framework. Numbers in brackets represent the number of participants who identified this type of factor or recommendation.

Recommendations proposed on reports by managers. Twenty-five participants reported that managers were required to provide recommendations or corrective actions following a report of an WMSD; their responses are shown on the right hand side of Figure 6. The most common types of recommendations related to equipment (e.g. purchase, repair, replace or redesign equipment; n = 12), actions required by the injured worker (e.g. take more care, change how they doing the task; n = 12), and the provision of more training for the injured worker. In contrast to the causal or contributing factors reported, the majority of recommendations proposed were specific to the actual incident or person injured, rather than considering the broader implications across the work area or organisation. For example, one participant stated that a lot of recommendations related to "Person X did the wrong thing. Person X needs to be spoken to and provided with more training" [HS_4_1].

Analysis. Participants were asked to describe the types of analysis conducted on the incident data; their responses are summarised in Table 22. Two participants stated that their organisation did not undertake any additional analysis due to limitations in retrieving information from the system.

Table 22 Types of analysis conducted on incident data by participants

Types of analysis	N
Trends for incidents characteristics	22
Frequencies of contributing factors	8
Number of LTIs	8
Number of overall incident reports	8
Number of workers compensation claims	6
Number of injuries	4
Number of MTIs	3
Incident rates per work task	1
Number of hazards	1
Number of near misses	1

Participants reported that trend analyses were significantly constrained by data quality issues. As a result, the analyses tended to be limited to relatively simple categories such as injury type, mechanism of injury, body location and work area. This is despite the finding that the incident report forms used by organisations typically collected a lot more detailed information, which would allow more targeted analyses. This suggests that some incident forms could be shorted to only capture the details considered relevant to the injured worker; thus, improving the quality and reliability of the data.

Recommendations proposed by the OHS Team. Participants were asked to provide examples of the recommendations they had proposed following a report of an MSD; these are summarised in Figure 7. The majority considered the broader implications across the work area or organisation (n = 20), rather than focussing on the person injured (n = 4). The most common recommendation was providing training to all staff (n = 8). Some training was specific to the introduction of new

equipment (e.g. incorporating the use of a particular trolley into biannual patient lifting training, EM_1_2); however, typically it focussed on safe lifting practices, e.g. “if we’re having a series of back injuries, then working with our provider… to have them provide us some external support around, “Well, how do we care for our backs?” [Min_1_1]. While it is a strength that recommendations considered the broader implications, training interventions are known to be ineffective in preventing WMSDs.

Another common recommendation was the purchase of new equipment to increase the availability of equipment to all workers or across all tasks (n = 6). For example, “we had a large number of team members going home with knee injuries…we were finding that they weren’t really using the kneel mats. So one particular Area Manager told all their stores to order, as minimum, four of them, and put them under every single shelf….because…a lot of them were just in the cupboard out the back in an area where they couldn’t really get to when they actually needed it. So, it wasn’t easily accessible to them” (Ret_1_1). This example highlights a strength of current practice is addressing the reasons why protective equipment is not being used, rather than focussing on identifying better equipment.

Government	
Regulatory bodies and associations	
Company	Changes to standard operating procedures (n = 5) Provision of training to all staff (n = 8) Provision of training to managers (n = 1)
Management	Change work practices (n = 3) Increase collaboration between staff on tasks (n = 1) Increase compliance with procedures (n = 1) Ergonomic champions to raise awareness of hazards (n = 1) Supervisors to provide more feedback on correct practice (n = 1) Supervisors to increase monitoring of tasks (n = 2) Changes to rostering (n = 1) Introduce task rotation (n = 1)
Staff	Injured person – change work duties (n = 1) Injured person – reduce working hours (n = 1) Injured person – more training Injured person – use checklist to self-assess workstation (n = 1)
Work	Purchase new equipment (n = 6) Automate tasks using equipment (n = 4) Change workstation set up for injured person (n = 2) Changes to equipment design (n = 1) Repair equipment (n = 1) Changes to work area layout (n = 3) Change task design (n = 3) Improve to housekeeping (n = 1)

Figure 7 Summary of the types of recommendations proposed by participants in response to a report, classified according to Rasmussen's Risk Management Framework. Numbers in brackets represent the number of participants who identified this type of recommendation.

Barriers and factors facilitating the implementation of recommendations. Participants were asked about the barriers and factors facilitating implementing recommendations resulting from reports of WMSDs, which are summarised in Figure 8 and classified according to Rasmussen's (1) framework.

The barriers at the "Company" level of the framework could also be interpreted as the systemic factors contributing to WMSD-causation. For example, the issues relating to funding were often identified as an on-going problem by participants, as budgeting did not allow for the elimination of all risks. For example, one participant stated "the realities of the world are that, yes, we want to [eliminate risk], but we can't always. So, we just accept a higher level of risk." [Health_3_1_1]. Similarly, in relation to the lack of workload allocation for implementing recommendations, participants reported their organisations were continually reducing the number of staff. For example, one participant reported "there was a maintenance issue with some trolleys, so it seemed quite straight forward to …recommend that maintenance is kept up to date, but it turns out that their funding for maintenance personnel at that particular site had recently been reduced quite significantly. So they had no one on site for maintenance, so they had to call them in from another town, and they only visited infrequently." Both of these factors are not only barriers to implementing recommendations, they also contribute to the on-going risk of injury.

At the "Staff" level, the most frequently identified factor was that it was difficult to change accepted work practices, especially if the change was perceived as adding additional workload (n = 13). For example, "sometimes you will get a bit of resistance, particularly with older workers who, if you try and introduce a new process where there might be some additional paperwork required, they will resist that because they see it as an extra part, an extra bit of work they need to do to get the same job done." [Min_1_2]. Similarly, one participant reported that staff would be unlikely to use new equipment "if they think it takes longer or if they have to go and [get the device]…there's not enough of them or they're not where they think they should be." [HS_2_1]. However, a few participants qualified these statements by saying that they often considered these barriers when they were developing recommendations, and attempted to overcome them during the design phase by consulting staff.

Overall, the facilitating factors mirror the barriers identified by participants, as the majority address systemic factors that likely contribute to a reduction in the risk of injury. For example: monitoring of recommendations built into scheduled audits; a separate budget for implementing changes; reporting system sending automatic reminders to those responsible for implementation. Participants reported that building monitoring into scheduled audits also provided an opportunity to evaluate the potential effectiveness of changes resulting from recommendations, and make adjustments.

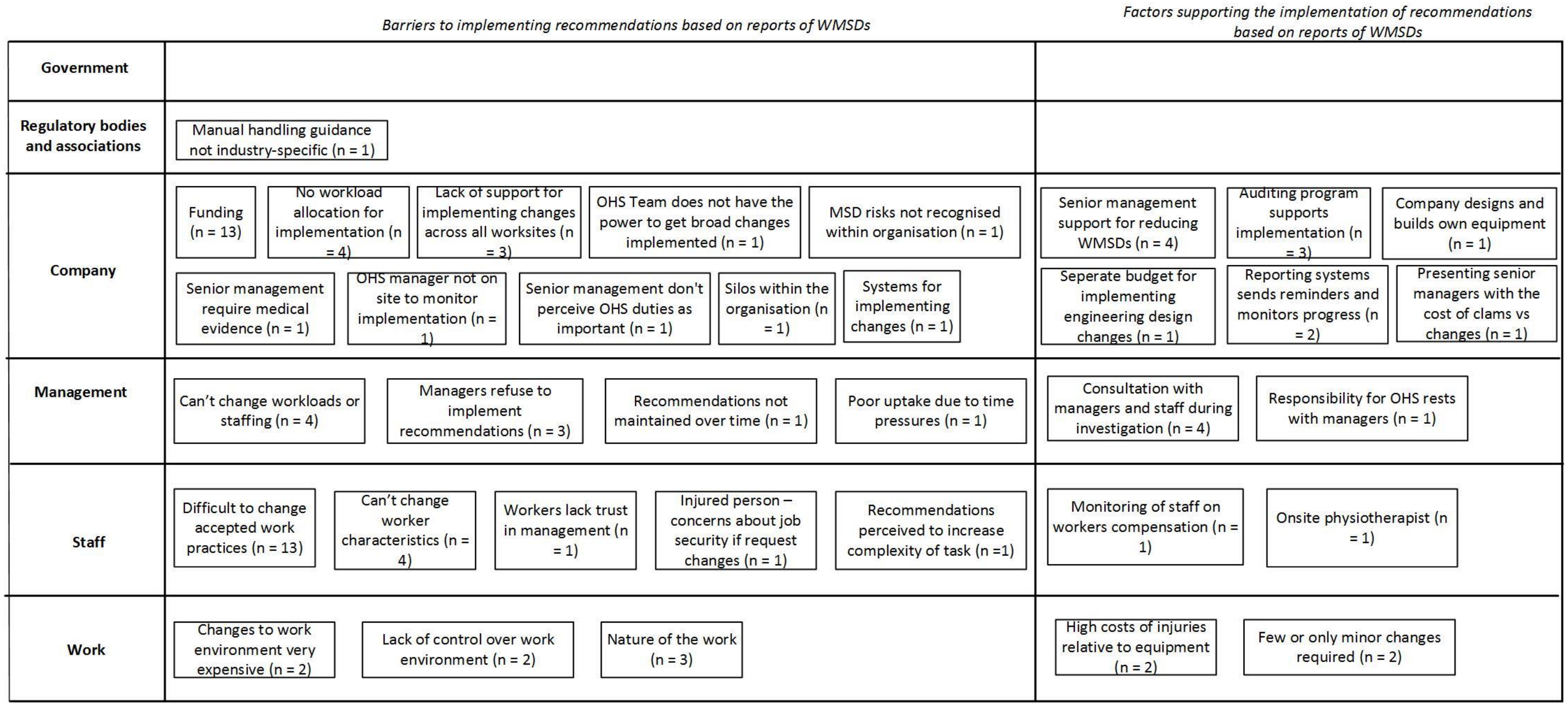

Figure 8 Summary of the barriers (left hand side) and supporting factors (right hand side) influencing the implementation of recommendations based on reports of WMSDs, classified according to Rasmussen's (1) framework. Numbers in brackets represent the number of participants who identified this type of factor.

Follow-up and evaluation. Participants were asked to describe how their organisation evaluated the impact or effectiveness of recommendations resulting from reports; the responses are summarised in Table 23. Overall, the results indicated that few organisations have a formal process for evaluating the effectiveness of safety changes; this represents a key gap in the learning cycle.

Table 23 Evaluation of recommendations resulting from incident reports

Types of evaluation	N
No evaluation	17
Monitoring safety performance	
Analysis of incident data (e.g. no. of injuries, LTIs, MTIs)	10
Cost of return to work and work cover premiums	3
Safety culture surveys	1
Evaluating specific changes	
Talking to injured worker	6
Auditing processes	4
Formal change management and evaluation process	1
Formal process for gathering feedback from employees on changes to procedures	1

Participants also identified a number of barriers to evaluating the impact or effectiveness of recommendations, including: lack of computer-based systems for monitoring implementation (n = 10); lack of time and resources (n = 5); lack of knowledge on how to evaluate changes (n = 3); high staff turnover (n = 1); large number of incidents (n = 1); and risk management plans are not typically updated with changes (n = 1).

The investigation process

Selection. Participants were asked how incidents are selected for further investigation. Eleven participants stated that organisational policy was to investigate "all reports"; however, this typically involved a brief review or investigation by a direct supervisor or manager. In the majority of organisations, the OHS team would initiate an investigation based on the severity of the incident (n = 23). Severity was defined in terms of the outcome (e.g. LTIs or injury-causing; n = 11) or a risk rating based on the outcome and potential for future harm (n = 13). Participants described a number of additional criteria they used, including: trends or clusters of similar incidents (n = 11); legal risk to the organisation (e.g. potential WorkCover claim) (n = 8); on request from a manager (n = 5); the incident seemed suspicious or out of the ordinary (n = 3); and lack of information about the incident (n = 2). Overall, the selection criteria implies that in many organisations incidents associated with WMSDs rarely trigger an investigation by an OHS Team member, as the majority would not be considered severe enough.

However, some participants addressed reports of 'less severe WMSDs' through investigations triggered by trends or clusters of incidents (n = 14). Participants

reported that they looked for trends based on clusters of incidents relating to a particular task (e.g. bariatric patient handling), piece of equipment (e.g. trolleys), or work area. For example, one participant stated, “a couple of years ago there was a big spike [in injuries] of rolling patients [in a particular hospital]... so then we went and did a whole area assessment. What came out was quite a few different recommendations of equipment, tasks, workload, and fatigue.” [HS_5_1]. Participants stated that one advantage of this approach, over one that focuses on the injured worker, is that it allows them to better justify the allocation of resources for recommendations to senior levels of management, e.g. “we’re just trying to look at trends and patterns, and to see what’s actually happening and where we can intervene, basically, to use our resources, in the best manner” [HS_5_2]. Another advantage was that as participants typically received a large number of reports and had limited resources for investigations, this approach allowed them to conduct deeper investigations into more significant issues.

Supporting this approach, participants in organisations with a requirement for an OHS team member to investigate “all reports”, raised questions over their usefulness as “the more investigations you’ve got to do, then the thinner they’ll get… because you’ve got to get them done. Tick, tick, tick, tick, tick, tick. Move onto the next one.” [Con_1_1].

Goals of investigation. Participants were asked to describe the reasons or justifications that they give to staff for conducting an investigation, these are summarised in Table 24. While it is evident that the majority of investigations involve a “learning” goal, they often also include goals related to compliance and protecting the organisation from litigation, which may unintentionally undermine learning. Supporting this claim, a number of participants reported that, despite their best efforts, staff members often perceived that investigations are undertaken to assign blame (n = 13). These participants reported that staff would often confuse the role of the OHS team and external investigators (e.g. WorkSafe inspectors, insurers), and that the term “investigation” implies that punitive actions will be taken. Staff members’ experiences with the WorkCover system further reinforced these views because “…as a worker you’re constantly having to prove that you’re injured and that you’re still injured… it messes with your head.” [HS_1_1]. All of these factors potentially work to undermine the quality and comprehensiveness of the information that can be obtained during investigations to support prevention and review of risk controls.

Table 24 Reasons given to staff for conducting an investigation

Theme	N
Prevent future incidents and review risk controls	28
Comply with company procedures	7
Improve outcomes for the injured person	5
Gather evidence	3
Gather evidence for common law claim	1
Determine whether the person had complied with procedures	1
Stop upper levels of management asking questions about the incident	1

Scope of investigation: information collected. Participants were asked to describe the information that they tried to collect during an investigation into a WMSD; their responses are summarised in Table 25. The data collection tools and techniques used are summarised in the *organisational resources* section of this chapter.

Table 25 Questions used during investigation into WMSDs, classified according to key themes. Numbers in brackets indicate the number of participants who made this response.

Theme	Question	N
"What happened"	Who, what, when, where, why	11
	Were there were previous similar incidents?	4
Recommendations	Recommendations from workgroup	1
General questions about contributing factors	What factors contributed in the work environment and organisation?	13
	What were the causes?	3
	What is the primary or root cause?	1
Specific questions about equipment	Equipment use, serviceability, suitability, availability	10
Specific questions about the environment	Design of work area	3
	Weather conditions	2
	Signage	1
Specific questions about the task	How is the task performed?	4
	Task planning and risk management	3
	Patient behaviour	2
Specific questions about the injured person	Training history	8
	Compliance with task procedures	7
	Compliance with safe practice, manual handling training	6
	Pre-existing injuries	6
	How is the task performed?	4
	What other tasks is the person required to do?	3
	Activities outside of work contributing to injury	2
	Are injuries still persisting?	2
	Is the injury due to work activities?	2
	Age of injured person	1
	Why were decisions were made at the time?	1
Specific questions about the workgroup	Identify all the people involved	4
	Communication within the team	3

	What is the culture within the work unit?	2
	Who is responsible and accountable?	1
Specific questions about the company	Funding issues	1
Specific questions about the industry	Identify others in the industry with similar issues	1

Three distinct approaches to investigations into WMSDs are evident from responses shown in Table 25. The first approach treats WMSDs similarly to any other incident, collecting general information about "what happened", the contributing factors, and gradually focussing on specific causes. These participants tended to use investigation templates, unstructured interviews, and witness statements. For example, one participant stated they start by going "…out there, find out what [happened], I usually talk to the worker first…what are their concerns, what's happened, what do they think are the issues." [HS_5_2].

The second approach focuses on specific risk factors for WMSDs, such as task performance, equipment, the work environment, and the job role of the injured worker. Along with unstructured interviews, these participants tended to use risk assessments, observations of the task, work station assessments and rosters.

The third approach primarily focuses on compliance with procedures, manual handling practices and training. For example, one participant stated they started with the question: "what should the worker have done? …How should it have been done?" [HS_3_1]. These participants tended to use unstructured interviews, written statements, training logs and procedures.

While all participants stated that the goal of investigation is "prevention", these different approaches to investigation have consequences for the types of recommendations that will be subsequently identified. The first and second approach may uncover issues that impact across the organisation or workgroup, while the third is primarily focussed on the injured worker.

One surprising finding was that, although the majority of participants reported that the primary goal of investigations was "prevention and review of risk controls", few appeared to explicitly review risk controls. Rather, the majority of participants tended to use a "blank slate" approach when reviewing tasks associated with injuries by conducting a new risk assessment of the task without referring to any previous assessments.

Three participants described approaches for explicitly reviewing the risk controls in place for a task. One approach involved trying to identify why the risk controls had failed for a particular task (n = 2). For example, in trying to determine why a staff member had sustained an injury while moving a bariatric patient, a participant reported they might ask the following questions: "what's the safe weight limit of the ceiling hoist that we've got? And where can I get an appropriate commode chair, where can I get a bariatric bed? Which ones are appropriate for this 250 kilogram patient?" [HS_1_1]. This approach often resulted in recommendations involving multiple small changes to the work environment, which were intended to improve the success of the current controls. For example, in response to an incident involving a patient hoist not working, the following changes were recommended: signs

reminding staff to charge batteries for hoists, SOPs laminated and attached to the hoist, and a training session for the workgroup on how to use a hoist. This approach is essentially aimed at optimising current risk controls, which obviously has advantages for organisations where funding is a significant barrier to introducing more costly changes.

Another approach involved actively reviewing the risk assessments that had been undertaken (n = 1). The participant described how the risk assessment for a particular task, “was huge, 6, 7 pages long with everything from housekeeping, and loss of reputation from on-boarding subcontractors inaccurately and a whole range of stuff” [Min_1_1]. The recommendation was to “adjust the risk assessment processes to…ensure it was aligned with task planning, considering the high risk scenarios.”

Potentially, these approaches may be useful in combating the view in other organisations that “all controls are in place” (Edu_2_1) and “nothing more can be done” [Trans_1_1].

Scope of investigation: Types of contributing factors considered during investigations. Participants were asked to describe the types of contributing factors considered during investigations into WMSDs; their responses are summarised on the left hand side of Figure 9, classified according to Rasmussen’s (1) framework. The most commonly considered types of factors were “equipment” (n = 25), “injured person – training” (n = 17) and task performance (n = 13). Participants then split into two groups, either focussing on factors associated with the injured person, or factors at the “Management” and “Company” levels of the framework. This implies two different approaches to investigating WMSDs: one that is based on how the person performs the particular task, and one that is based on how the task is performed within the organisational context. Participants expressing the latter view also tended to report that they initiated investigations based on clusters of incidents; this is a key strength of current practice in some organisations.

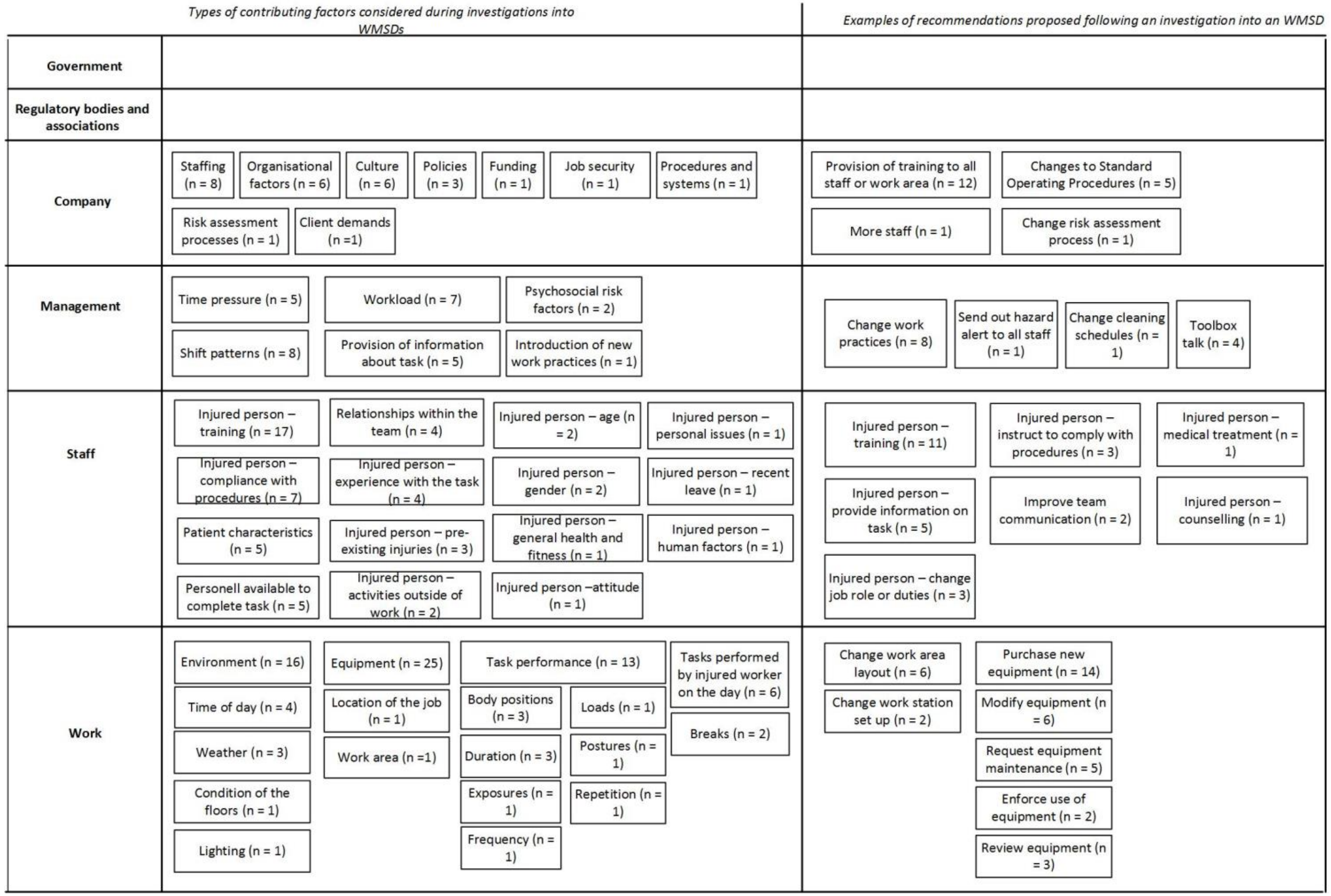

Figure 9 Summary of the types of contributing factors considered during investigations into WMSDs (left hand side), and example of recommendations proposed following an investigation into an WMSD (right hand side) , classified according to Rasmussen's (1) framework. Numbers in brackets represent the number of participants who identified this type of factor or recommendation.

Analysis. Participants were asked to describe the types of analysis that was undertaken on the data collected during investigations, and how they developed recommendations. The majority of participants stated they would start by producing a written report including a description of the incident and contributing factors (n = 22). In addition, four participants described how they developed a model or diagram of contributing factors. Three participants described linear models (e.g. PEEPO chart from ICAM and fishbone diagram), which are both based on Reason's Swiss Cheese model. One participant described using diagrams linking contributing factors, similar to the Accimap technique. Some participants stated that they did not undertake any further analysis, attaching the data collected during the investigation to the initial incident report (n = 10).

A number of participants raised concerns about the lack of analysis following an investigation (n = 6). Some of these concerns related to lacking a method for translating investigation findings into recommendations, e.g. "from those interviews we generally have a really good impression of what everyone thought was happening at that time. Then there is sort of a blank spot and then there is that person who writes his recommendations." [Edu_2_2]. Other concerns were that the systems did not allow them to aggregate data across investigations to identify trends, or determine whether corrective actions for similar occurrences had been implemented.

Developing recommendations. Describing the development of recommendations, the majority of participants stated that they developed an "action plan" (n = 23). In some organisations this involved a consultation phase (n = 15), while other participants simply stated they would devise recommendations based on "what was found" [HS_1_3]. Different types of consultation were described, including: informal discussions with the injured person and their manager; meetings with the key people responsible for implementing the actions; and formal focus groups. The type of consultation typically depended on the scope of investigation (i.e. focussed on the individual or broader), the costs of the change required and the size of the organisation. The consultation phase was seen as beneficial as it provided an opportunity for stakeholders to review the investigation findings, have input into the analysis, and identify barriers to implementing recommendations.

One participant described how they would produce a number of recommendations, with advantages and disadvantages listed for each, as well as a risk matrix describing the extent to which each option was likely to control the risk [HS_1_1]. This information was used then used by managers to support business cases for funding new risk control measures. The participant stated that the risk matrix provided evidence that [upper levels of management] "can't ignore because they'd actually be negligent if they did. So therefore they have to find the money" [HS_1_1]. This practice is potentially highly beneficial for overcoming many of the barriers to implementation that were identified by participants.

Examples of recommendations. Participants were asked to provide examples of recommendations they had proposed following an investigations into an WMSD; they are summarised on the right hand side of Figure 9, classified according to Rasmussen's (1) framework. Interestingly, few participants gave examples of recommendations designed to address the contributing factors they investigated at the "Company" and "Management" levels of framework; a number of participants

commented on the difficulties associated with recommending broad changes across the organisation (n = 23).

Participants who provided examples of recommendations classified at the “Management” and “Company” levels of the framework tended to describe approaches to designing recommendations based on analysing clusters of incidents as well as senior management involvement in the development of recommendations. For example, one participant described how investigations were reviewed multiple times by senior managers: “Well, if this incident occurred, these are the contributory factors they’ve identified, however we’ve had 7 similar incidents. These are the contributory factors in those… then that often leads to returning to the investigation for further work, and then coming back with… corrective actions [which senior managers review and develop further corrective actions] from an organisational perspective” [Min_1_1]. A similar approach was described in three organisations. In all these organisations the participant had frequent verbal contact with senior management regarding safety management performance built into their role. In other organisation, the OHS team primarily communicated through business cases or monthly reports.

Barriers and factors supporting the implementation of recommendations. Participants were asked about the barriers and supporting factors impacting implementation of the recommendations resulting from investigations of WMSDs; their responses are summarised in Figure 10, classified according to Rasmussen’s (1) framework. The majority of the barriers and supporting factors mirror those identified in relation to implementing recommendations following incident reports. In addition, a number of barriers to effecting large-scale changes within the organisation were identified by participants.

Figure 10 Summary of the barriers and factors supporting the implementation of recommendations, classified according to Rasmussen's (1) framework. Numbers in brackets represent the number of participants who identified this barrier or supporting factor.

	Barriers to implementation of recommendations	*Factors supporting the implementation of recommendations*
Government	Government funding (n = 3) Uncertainty of government funding and jobs (n = 1)	
Regulatory bodies and associations	Lack of industry-specific advice from WHS regulator (n = 1) Standards on equipment (n = 1)	Unions (n = 1)
Company	Lack of funding (n = 9) Lengthy approval process for purchases (n = 2) Senior management - unwilling to spend money on old facilities that will be superseded (n = 2) Senior management - unwilling to change the number of staff (n = 3) Broader changes require buy-in across the organisation(n = 2) No system for determining whether change has been implemented across the organisation (n = 1) Long term changes hard to implement (n = 3) Senior management - unwilling to change (n = 2) Senior management - uncertainty about validity of investigation findings (n =3) Senior management - prioritises changes (n = 3) Job insecurity (n = 1) New procedures may not be relevant across all sites (n = 1) Senior management - lack of accountability or responsibility for implementation (n = 2)	Automated system for sending reminders to person responsible (n = 1) Supportive culture for reducing injuries (n = 1)
Management	Managers decide whether they want to implement changes (n = 6) Staff workloads (n = 3) Managers do not fund purchase of new equipment (n = 1) Difficult to communicate changes across all shifts (n = 1)	Consultation with staff to develop recommendations (n = 1) Managers responsible for making sure changes are implemented (n = 1) OHS Manager writes business case (n = 1)
Staff	Difficult to change accepted practices (n = 3) Safety precautions not take seriously (n = 2) Lack of co-operation between different work groups in the organisation (n = 1)	Workers previous experience with safety precautions (n = 1) Recommendations aimed at individual behaviour are easy to implement (n = 1)
Work	Equipment is very expensive (n = 1) Maintenance requests take a long time (n = 1)	

Follow-up and evaluation. Participants were asked to describe how their organisation evaluated the impact or effectiveness of recommendations resulting from investigations; their responses are summarised in Table 26. The findings indicate that the evaluation of changes is a key gap in current practices.

Table 26 Evaluation of recommendations resulting from investigations

Types of evaluation	N
No evaluation	12
Talking to injured person	6
Monitoring long term safety performance	3

Interestingly, participants from two organisations indicated that they were currently undergoing an evaluation of their investigation system. This involved reviewing the quality of investigation findings and recommendations. One organisations had developed specific standards that were required to be met for the identification of contributing factors and recommendations, and were using these to evaluate a sample of historical investigation reports. Both organisations required managers to undertake investigations; the aim of the reviews was to standardise the quality of these investigations. These processes are likely to significantly enhance learning, and have been identified by Lindberg et al., (13) as a key aspect of best practice.

Discussion

The aim of the study described in this chapter was to examine the strengths and weaknesses in current practice concerning incident reporting and investigation WMSDs. Within the wider program of research, the findings will inform the development of the new incident reporting and investigation framework. The key findings are discussed below in relation to the main barriers to learning and strengths identified in current practice.

What are the current barriers to learning?

Overall, the findings suggest that the organisational resources supporting current practices are not optimal. In particular, the findings show that reporting and investigation practices are either not underpinned by a model of accident causation, or if they are, they tend to be underpinned by older models such as Reason's Swiss Cheese model. In addition, incident reporting forms often only give the opportunity to identify one contributory factor; this is inconsistent with the now widely accepted notion that incidents, and WMSDs in particular, are underpinned by multiple interacting contributory factors. As a result, recommendations derived from reporting and investigation tend to focus on equipment, the injured worker, or improved training programs. This 'fix the broken component' approach is widely acknowledged to be a flawed approach to safety management, and WMSD prevention, as it overlooks important contributory factors across the organisation (25). These findings suggest that a key issue preventing learning from incidents is that reporting and investigation practice is constrained by an older view on how and why incidents occur. As a result, there are limitations around what is learned about incidents, and the countermeasures produced are likely to have only a minimal impact on reducing WMSDs. The implication for future approaches is that all aspects of the reporting

and investigation process should be underpinned by an appropriate model of accident causation.

A second important issue relates to the lack of consistency around reporting and investigation practice. The lack of clarity around the terms used (e.g. definitions of near miss) is an important finding. In addition, the majority of participants reported a lack of clarity around what types of WMSDs to report. The analysis also revealed significant variability across the tools used and the practices adopted, both across different organisations and within organisations. For example, participants reported using a wide range of data collection methods even within the same organisation. Ensuring consistency and clarity around reporting investigation systems, processes, and methods is recommended as a key factor to support learning from incidents.

A third, related, barrier to learning relates to issues associated with training and the expertise of those involved in reporting and investigation. The majority of participants identified a lack of, or inadequate, training in reporting and investigation as a key barrier. In addition, issues were identified around manager skill sets, misperceived capabilities around investigation, and a lack of opportunity to reflect or receive feedback following reporting and investigation. An implication moving forward is that improved training systems around reporting and investigation are required, and that opportunities for refresher training and reflection following investigations should be provided.

A fourth key finding related to issues associated with software used to support incident reporting and investigation. Participants reported that often the design of the software intended to collect data about incidents presented significant barriers to learning from incidents. Specifically, the majority of tools focus on the storage of data, while ignoring the subsequent phases of the learning cycle. The redesign of software tools or the selection of software tools should explicitly take into account the capabilities required to support learning from incidents.

A final key finding relates to the lack of systems for evaluating the effectiveness of changes. Most organisations had no formal system for monitoring or evaluation. In addition, participants identified a number of barriers to monitoring and evaluation. The key issues were a lack of computer-based systems for monitoring and a lack of knowledge on how to evaluate changes. The development of systems for monitoring and evaluating recommendations once implemented represents a critical avenue for future research, as the literature is lacking guidance in this area.

What are the strengths of current practices?

Whilst key issues were identified, some notable practices were also identified that are likely to significantly enhance opportunities for learning. These practices tended to be a result of individual skills and experience, rather than organisational resources.

A key strength identified across multiple organisations was the use of clusters of incidents to trigger investigations into a particular task, piece of equipment, or work area. This involved undertaking an analysis of incident data to identify trends, and allocating resources for a deep investigation. The resulting investigations tended to involve a more collaborative approach, involving multiple people from the work area, and result in the identification of multiple, interacting recommendations. The key advantage of this approach, over one based on investigating individual reports, is that limited resources can be channelled into deeper investigations and the implementation of recommendations that are likely to have a broader impact within

the organisation. However, it should be noted that this approach is only possible in organisations where the data collection and storage tools support this type of analysis.

A second key strength was approaches to investigation based on explicitly reviewing risk controls. This involved examining the reasons why the current risk controls associated with a task had failed, and identifying mechanisms for eliminating these factors. The advantage of this approach is that it often resulted in the identification of a number of low cost mechanisms for changing the conditions in the work environment, rather than just relying on retraining or informing individuals to implement safe working practices.

A third key strength was the identification of a number of mechanisms used to enhance the implementation of recommendations. The presentation of recommendations to senior managers was identified as a particularly critical aspect of ensuring that recommendations were implemented. Some participants achieved this through the presentation of cost-benefit analyses, or by providing an assessment of the extent to which recommendations would reduce the risk of future injuries. The documentation and formalisation of these practices also represents an avenue for future research, as many organisations involved in the study would benefit from implementing these approaches.

Finally, a notable strength was organisations evaluating their own investigation system by reviewing the quality of investigation findings and recommendations. This is an important step of the learning cycle and provides a useful process for improving reporting and investigation processes.

Conclusions

In conclusion, in many organisations the available resources do not adequately support the practices required to effectively learn from WMSDs. Incident reporting systems are designed around data storage requirements, rather than analysis and decision making. Many investigation systems rely on the experience and expertise of the investigator, which in many cases is limited. Nevertheless, participants identified many practices that they had developed to overcome these challenges. Overall, the findings from the study have a number of important implications for proposed framework, which is presented in the following chapter.

Chapter 4: Summary of the framework

This chapter presents the framework for learning from reports and investigations into WMSDs, which is based on the findings from chapters 1, 2 and 3. Organisations can use the framework to evaluate their own incident reporting and investigation systems, and identify opportunities to enhance them.

This chapter is divided into the following sections: *organisational resources* and *the stages of the learning cycle* (i.e. reporting and data collection, analysis, designing recommendations, decision-making, follow-up and evaluation). In each section, the elements and processes required to optimize learning from incidents are described in terms of the characteristics of best practice, facilitators and barriers. “Characteristics of best practice” describes the conditions that are required to optimize learning from incidents; these are based on the literature presented in chapters 1 and 2. The facilitators and barriers describe the factors that influence whether the potential for learning propagates throughout the organisation, these are based on the findings described in chapter 3.

Organisational resources

Organisational resources describe the components of the reporting and investigation system that are required to support learning from incidents. A summary of the organisational resources required to optimise learning, along with facilitators and barriers are described in Table 27.

Table 27 Summary of the organisational resources required to learn from incidents, facilitators and barriers.

Resources	Characteristics of best practice resources	Facilitators	Barriers
Accident Causation Model	A systemic model of accident causation (e.g. Rasmussen’s framework) underpins all aspects of the reporting and investigation process.	The model is integrated into all organisational documents (e.g. policies, procedures, training)	Use of accident analysis methods that are inconsistent with this model (e.g. five whys, taproot). Limited knowledge and understanding of accident causation within the organisation.
Taxonomy of contributing factors	A domain-specific taxonomy is used to support the application of the accident causation model, and guide data collection and analysis. It is suggested that organisations	The taxonomy is integrated into all reporting and investigation resources and practices.	Categories are overlapping or unclear to workers.

	use Figure 11 and Figure 12 as a starting point for developing their own taxonomy. Additional sources of data for taxonomy development are described in Chapter 1.		
Policies and procedures	Contain a clear definition of *what* should be reported and investigated regarding WMSDs.	Includes examples of the types of WMSDs that should be reported.	Lack of clarity in defining WMSDs and all contributing factors
	Define who is responsible and involved in each stage of the learning cycle.	Senior management have specific responsibilities regarding their role in the reporting and investigation system.	Persons identified as responsible lack the skills to conduct investigations. Persons identified as responsible lack the power to implement recommendations.
	Include the three core principles of the systems approach: • Safety is a shared responsibility of everyone working within the system; • Adverse events and near misses are caused by multiple, interacting, contributing factors, not just a single bad decision or action; • The factors contributing to accidents or report of WMSD do not necessarily have to be failures, errors or violations.		

Incident report forms	Forms collect the information required to support decisions regarding the depth of the investigation or review	Forms collect information from multiple people (e.g. injured person, manager). Categories define: mechanism and location of injury, task/s involved, work area, and recurring risks for the organisation (e.g. patient handling). Free text boxes collect detailed description of relevant events and work conditions, potential contributing factors and recommendations (from both injured worker and others)	Forms take more than 5-10 minutes to complete. Description of incidents and contributing factors limited by space on form. Categories are confusing, include a high degree of overlap or require medical knowledge to complete. Forms encourage the selection of a single contributing factor.
Data collection tools for the investigation of WMSDs	A broad range of standardised tools are available which target the collection of information about contributing factors at each level of Rasmussen's framework.	Interview questions developed specifically to capture information about the factors influencing the success/failure of risk controls and the conditions of work. Existing risk assessments are reviewed and modified to capture new hazards (rather than relying on a blank slate approach) The same set of data collection tools are used in every investigation into an WMSD.	Unstructured interviews or informal "chats". Templates with broad themes. Checklists of failures (e.g. procedures not followed, lack of supervision). Reliance on a single source of data. Investigators utilise different investigation tools, depending on their preferences.
Software for reporting and investigation	A database is used to store all incident reports and investigation findings, in a format that supports	See Table 19 for features of software tools that facilitate learning from incidents.	See Table 20 for features of software tools that act as barriers to learning from incidents.

	all stages of the learning cycle (e.g. reporting, analysis, recommendations, decision-making and follow-up).		
Training on incident reporting	All staff receive training on incident reporting which focuses on identifying WMSDs and learning from incidents. The training includes: • A description of the types of conditions and injuries to report. • The likely consequences for reporting (e.g. early intervention, prevention) • An explanation of the underpinning accident causation model. • An explanation of the details required for effective reporting (e.g. what makes a good description).	Training provided on an annual basis. Training is specific and relevant to the organisational context. Design of training considers different skills, education level and access to computers.	Training is embedded in other OHS compliance training. Training requires face to face delivery. Training not specific to organisational context. Training focuses on compliance.
Training on investigation practices	All staff required to lead investigations receive formal training with regular refreshers. The training includes: • An explanation of the underpinning accident	Opportunities to reflect on investigation practice with more experienced staff, and receive timely feedback. Evaluation of the quality of investigation reports on a regular	Online training. Examples used in training not specific to organisational context. Training focuses on compliance. Lack of opportunities for feedback

	causation model and learning cycle. • Practice using data collection tools. • Practice applying the accident analysis method and taxonomy. • Organisation-specific case studies.	basis, with timely feedback.	on practice. Training gives investigators false sense of authority.

Government								
Regulatory bodies and associations								
Company								
Management	Functional: Job Design	Interpersonal: Low supervisor support	Interpersonal: Supervisory methods	Interpersonal: Low co-worker support	Temporal: High efforts & low rewards	Temporal: Organisational change	Temporal: Work scheduling	Temporal: Limited breaks
Staff	Demographics: Occupation	Demographics: Gender	Demographics: Marital and family status	General health, prior pain and co-morbidities: Headaches	General health characteristics: High BMI	Health behaviours: Physical activity outside of work	Worker perceptions: Low job security	Worker strain and recovery: Recovery after work
	Demographics: Age	Demographics: Education level	General health characteristics: History of MSDs	General health characteristics: Health problems	Health behaviours: Smoking	Individual psychological factors: Personality variables	Worker perceptions: Lack of opportunities for career development	Worker strain and recovery: High stress or strain
	Demographics: During of employment	Demographics: Ethnicity and country of origin	General health characteristics: Physical capacity	General health characteristics: Sleep issues	Health behaviours: Alcohol consumption	Individual psychological factors: Depressive or emotional symptoms	Worker perceptions: Value workers place on promotion	
Work	Ambient conditions: Cold temperatures	Equipment: Keyboard positioning	Equipment: Telephone rests	Equipment: Extended computer use	Equipment: Screen height	Postures: Awkward postures	Postures: Prolonged standing at work	Task factors: Heavy physical work
	Ambient conditions: overall work environment	Equipment: Extended mouse use	Equipment: Exposure to vibration	Equipment: Extended keyboard use	Equipment: Chair design	Postures: Working with hands above shoulders	Postures: Prolonged work in sedentary/static positions	Task factors: Repetitive and precision work
		Equipment: Desk height	Equipment: Workstation design	Equipment: Mouse positioning		Postures: Neck flexion		

Figure 11 Prototype taxonomy of potential contributing factors based on the literature on the risk factors associated with MSDs. Note that the shading represents the level of evidence associated with each risk factor identified in the review. A shaded box with bold outline indicates strong evidence; a shaded box with bold dashed outline indicates consistent findings from more than one study; a shaded only box indicates limited evidence (i.e. one study); and an unshaded box with a normal outline indicates that evidence varies. The strength of the evidence should be used to prioritise the type of data collected during investigations.

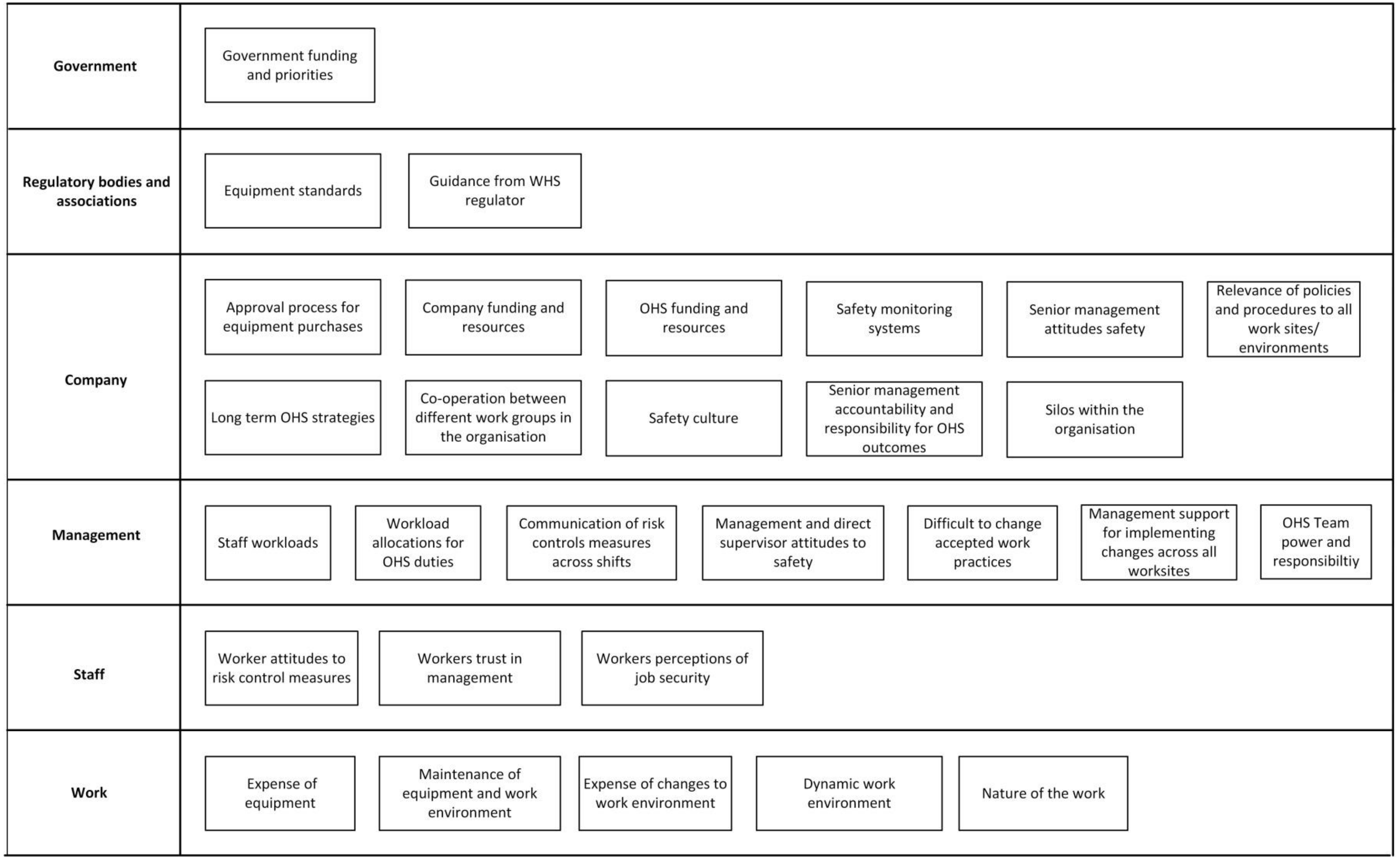

Figure 12 Summary of the barriers influencing the implementation of recommendations identified by interview participants.

The learning cycle

Reporting and data collection

The "reporting and data collection" phase of the learning cycle includes the initial report of the incident and the collection of additional data through investigation if required. A summary of the processes required to optimise initial reporting are presented in Table 28, and summary of the processes required to optimise data collection during investigations are presented in

Table 29.

Table 28 Summary of the processes required to learn from incidents in the reporting and data collection phase, facilitators and barriers.

Process	Characteristics of best practice processes	Facilitators	Barriers
What to report	Definition states the minimal requirements for reporting WMSDs: Pain, discomfort or any injury associated with a task or working conditions, regardless of whether treatment is required. Conditions of work that may result in pain, discomfort or injury (i.e. hazards)	What to report is reinforced in all organisational documents, and regularly discussed within the workplace.	Lack of clarity around "reportable" and "notifiable" incidents. Lack of clarity regarding the differences between workers compensation claims and incident reports.
Encouraging early reporting	Workers thresholds for reporting are as low as possible (i.e. many reports are received regarding pain and discomfort not requiring treatment).	All reports result in an appropriate response to the injured person. Provision of early intervention resources (e.g. free treatment). One system for reporting all incidents. Telephone reporting provided for workers with poor access to	Direct supervisor has to approve report. Multiple approvals required to submit a report. Injured person cannot access form offsite. Requirement to report to multiple

		computers. Tablets provided for reporting while offsite. Wellbeing programs that promote early reporting (e.g. work station assessments).	systems. Software tool is slow or difficult to navigate. Requirement to report all incidents resulting in pain and discomfort
Quality of information recorded on reports	All fields on incident reports are completed, with sufficient detail to support prevention activities or the selection of the incident for investigation.	Incident report form requires only minimal amount of information. OHS Team provide immediate feedback on quality of information provided on report. Refresher training on incident reporting offered to areas with poor quality reports.	Repetitive fields or long report forms. Requirement to report to multiple systems. Software tool is slow or difficult to navigate.

Table 29 Summary of the processes required to learn from incidents during the data collection phase of investigations, facilitators and barriers.

Process	Characteristics of best practice processes	Facilitators	Barriers
Selection of incidents for investigation	Incidents selected for investigation should be those from which as much information as possible can be extracted for prevention. For example: • High potential for repetition of incident or exacerbation of injury. • Recurring incidents associated	Information required to support a decision is collected on incident reports. Analyses are undertaken to identify clusters of incidents involving tasks, equipment and work areas. Incident reports and investigation reports are stored in an accessible,	Only investigating injury-causing or serious incidents. Company policies mandating the investigation of all incidents, diluting the quality of investigations and availability of resources. Software tool does not support the

	• with a particular task or work area. • Work areas/tasks which have experienced change (e.g. to staffing, equipment, environment, manager).	searchable format.	identification of clusters of incidents.
Goals of investigation	The goal of investigations is learning, with a focus on the review of risk controls and identifying targets for prevention efforts.	"Investigations" with a learning goal are rebadged using terms such as "review of risk controls" and "review of practice" to overcome fears associated with investigations.	Competing goals: compliance, protecting the organisation from litigation, blame, gathering evidence. Lack of clarity between the difference between investigations undertaken by external agencies to assign blame (e.g. regulator, workers compensation, insurance), and the investigations conducted by the organisation to support learning. Negative experiences with the regulator or work cover system.
Scope of the investigation	Investigations focus on the factors influencing behaviour in the work context, rather than the immediate context of the incident or the injury sustained by a particular worker on a particular task.	The information collected allows for a consideration of contribution factors and relationships between them across all levels of Rasmussen's (1) framework. The investigation starts with the specific details, and then goes "up and out" to examine the factors across the system. The investigation attempts to uncover why the risk controls failed for a	The investigation focuses on the actions of the injured person. The investigation focuses on the "root cause". Evaluating what "should" have been done (e.g. looking for lack of compliance, failures or errors). Investigators hold the view that "all controls are already in place."

		particular task. Actively reviewing risk assessments and project planning materials to uncover gaps in the identification of hazards.	
Data collection procedures	Data collection should: • Involve independent investigators (i.e. not manager of injured person). • Be undertaken as soon as practical after the initial report. • Use a broad range of data sources, such as interviews, documentation, risk assessments. • Involve participants from all organisational levels (e.g. workers, supervisors, senior managers etc.). • Draw on previous relevant investigations or incident reports.	The OHS Team review incident reports on a daily basis; incidents selected for investigation are immediately followed up. The OHS Team are appropriately resourced to conduct investigations in a timely manner. Incident reports and investigations are stored in an accessible, searchable format.	Manager of injured person is responsible for immediate response and investigation of incident. Paper-based incident reporting system delays organisational response to incident. OHS Team lack resources for investigations. Lack of staff workload allocation for involvement in investigations.

Analysis

The “analysis” phase of the learning cycle describes how the data from reports and investigations are analysed in order to identify appropriate recommendations. A summary of the processes required to optimise this phases of the learning cycle are presented in Table 30.

Table 30 Summary of the processes required to analyse incidents to optimise learning, facilitators and barriers.

Process	Characteristics of best practice processes	Facilitators	Barriers
Incident report data	Analysis of categorical data (i.e. trend analysis) supports identification of issues for prevention activities or selection of key issues for further investigation.	Trend analysis focuses on work areas, task types, and risk factors specific to the organisation. Software tool allows categorical data to be easily exported into a format for analysis (e.g. Excel files). Software tool supports searching based on categories to identify appropriate data sets.	Trend analysis focuses on incident rates or severity.
Incident report data	Additional coding of qualitative data: a systems-based accident analysis method and taxonomy are used to analyse the qualitative information about contributing factors contained in incident reports. This information is used to identify recurring issues and trigger investigations.	OHS Team have specific workload allocations to identify "clusters" of incidents. Software tool allows qualitative data to be easily exported into a format for analysis (e.g. Excel files). Software tool supports searching of free text to identify appropriate data sets.	Software tool makes it difficult to access or sort incident reports. Limited qualitative information is collected on the incident report.
Investigation data	Criteria for analysis of investigation data: • Results in a detailed description of the events and circumstances surrounding the incident; • A systems-based accident analysis method and	Training is provided on applying the accident analysis method and taxonomy. A template for investigation analysis and reporting is developed that supports the application of the accident analysis method.	Analysis is sole responsibility of the OHS Team. Person allocated responsibility for analysis lacks skills to undertake it appropriately. Those involved in the investigation assume that they already know the contributing factors, prior to

	taxonomy are used to analyse the data collected from incident reports and investigations. • The Accimap or similar technique is used to graphically represent the findings from investigations. • Results in a written report. • Involves participants from all organisational levels (e.g. workers, supervisors, senior managers etc.) to interpret the analysis and identify contributing factors.		undertaking any analysis. System does not allow investigation team to determine whether recommendations resulting from similar incidents have been implemented in the past.

Recommendations

The “recommendations” phase of the learning cycle describes how the analyses of reports and investigations are translated into recommendations. A summary of the processes required to optimise this phases of the learning cycle are presented in Table 31.

Table 31 Summary of the processes required to design effective recommendations, facilitators and barriers.

Process	Characteristics of best practice processes	Facilitators	Barriers
The design process	There is a formal process for designing recommendations which involves: • Participants from all organisational levels (e.g. workers, supervisors, senior	Producing a number of recommendations, with advantages and disadvantages listed for each, as well as a risk matrix describing the extent to which each option was likely to	Lack of workload allocation to participate in the design process. The OHS Team are perceived as “responsible” for developing recommendations.

	managers etc.); • Identifying multiple recommendations to address the contributing factors, and the relationships between them, identified from the data; • Considering potential interactions between recommendations and existing risk control measures; • Considering potential interactions between new risk control measures; and • Identifying potential barriers to implementation, and propose mitigation strategies.	control the risk. The OHS team have frequent verbal contact with senior manager.	

Decision-making

The “decision-making” phase of the learning cycle describes the process of selecting recommendations for implementation. A summary of the processes required to optimise this phases of the learning cycle are presented in Table 32.

Table 32 Summary of the processes required to select effective recommendations for implementation, facilitators and barriers.

Process	Characteristics of best practice processes	Facilitators	Barriers
Addressing injured workers issues	Risk control measures addressing injured workers focus on addressing the factors that influence safe behaviour (e.g. co-worker support, availability of equipment, changes to tasks), rather than retraining or educating the individual worker.	Injured worker is directly involved in the design of recommendations, and has power to select the option that best suits them.	Lack of funding for local changes.
Identifying effective risk control measures	Decisions regarding the implementation of recommendations are made based on whether they: • Target the factors that create hazardous conditions and unsafe acts, rather than focusing on technology or human operators; • Target the redesign of organisational systems; • Apply across the organisation; and • Include plans for long-term maintenance.	OHS Team has frequent verbal contact with senior management regarding safety management performance built into their role.	See Figure 12 for a summary of the barriers. The recommendations selected for implementation consistently address the behaviour of the person involved in the incident, rather than the work conditions. OHS team primarily communicate with senior management through business cases or monthly reports.

Follow-up and evaluation

The "follow-up and evaluation" phase of the learning cycle includes both monitoring implementation and evaluating the result. A summary of the processes required to optimise this phases of the learning cycle are presented in Table 33.

Table 33 Summary of the processes required to effectively follow-up and evaluate the outcomes of incident reports and investigations, facilitators and barriers.

Process	Characteristics of best practice processes	Facilitators	Barriers
Implementing and maintaining recommendations	A formal implementation and evaluation plan is developed, which includes: • Responsibilities for implementation and monitoring changes are assigned to participants from all organisational levels (e.g. workers, supervisors, senior managers etc.); • Consideration and control of the factors that impose constraints on implementation and maintenance of change over time (see Figure 12); and • Specific indicators of successful implementation.	All staff involved in designing recommendations. Monitoring of recommendations built into scheduled audits. Separate budget for implementing changes. Reporting system sending automatic reminders to those responsible for implementation. Presenting senior managers with data on costs vs claims, or business cases.	The people assigned responsibility for implementation do not have the necessary resources and power within the organisational structure.
Disseminating the	Opportunities for disseminating the	Incident reports, investigations and lessons learnt are stored in an	System does not allow access to

lessons learned	lessons learned include: • Lessons learnt are shared across areas of the organisation undertaking similar tasks • Relevant reports and investigations are retrieved when a similar situation is encountered. • Relevant incidents are discussed in the training with new personnel. • Lessons learnt are shared between organisations within the same sector.	accessible, searchable database.	reports and investigations.
Evaluation of risk control measures	There is a formal process for evaluating the implementation and effectiveness of new risk control measures. Evaluation includes monitoring of actual changes (e.g. talking with staff, audits, observations of practice) and safety performance indicators (e.g. safety climate surveys, hazard and injury reporting).	Organisational policies include specific standards for evaluating the outcomes of changes.	Lack of computer-based systems for monitoring implementation. Lack of time and resources. Lack of knowledge on how to evaluate changes. High staff turnover. Large number of incidents. Risk management plans not typically updated with changes.
Evaluation of reporting and investigation process	There is a formal process for monitoring the quality of reporting and investigation.	Organisational policies include specific standards for reports and investigations. Investigators receive feedback on	

	the quality of their reports, and mentoring if required.

Appendix A: Quality of included systematic reviews

The quality of the included systematic reviews was assessed using the following criteria from the AMSTAR tool (49):

1. Was an 'a priori' design provided?
2. Was a comprehensive literature search performed?
3. Was there duplicate study selection and data extraction?
4. Was the status of publication (i.e. grey literature) used as an inclusion criterion?
5. Was a list of studies (included and excluded) provided?
6. Were the characteristics of the included studies provided?
7. Was the scientific quality of the included studies assessed and documented?
8. Was the scientific quality of the included studies used appropriately in formulating conclusions?
9. Were the methods used to combine the findings of studies appropriate?
10. Was the likelihood of publication bias assessed?
11. Was the conflict of interest stated?

Table 34 Summary of methodological quality of included systematic literature reviews (assessed using AMSTAR criteria)

	Criteria												
Study	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Overall Score**	**Quality Ranking**
Ariens et al., (54)	Y	Y	Y	Y	N	Y	Y	Y	N/A	N	N	7/11	M
Ariëns et al., (55)	Y	Y	Y	Y	N	Y	Y	Y	N/A	N	N	7/11	M
Bernal et al., (56)	Y	Y	Y	N	N	Y	Y	Y	Y	N	N	7/11	M
Bongers et al., (57)	Y	Y	Y	Y	N	Y	Y	Y	N/A	N	N	7/11	M
Coenen et al., (58)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	10/11	H
Côté et al., (52)	Y	Y	N	Y	N	Y	Y	Y	N/A	N	N	6/11	M

Crawford et al., (59)	Y	Y	Y	N	N	Y	Y	Y	N/A	N	N	6/11	M
da Costa and Vieira (60)	Y	Y	Y	Y	N	Y	Y	Y	N/A	N	N	7/11	M
Gallagher and Heberger (61)	Y	Y	N	Y	N	N	Y	N	N/A	N	N	4/11	M
Hartvigsen et al., (62)	Y	Y	Y	Y	N	Y	Y	Y	N/A	N	N	7/11	M
Hauke et al., (63)	Y	N	Y	N	N	Y	Y	Y	Y	N	N	6/11	M
Heneweer et al., (64)	Y	N	Y	N	N	Y	Y	N	N/A	N	N	4/11	**L**
Ijmker et al., (65)	Y	Y	Y	Y	N	Y	Y	Y	N/A	N	N	7/11	M
Janwantanakul et al., (66)	Y	N	Y	Y	N	Y	Y	Y	N/A	N	N	6/11	M
Koch et al., (67)	Y	Y	Y	Y	N	Y	Y	Y	N/A	N	N	6/11	M
Kraatz et al., (68)	Y	N	Y	Y	N	Y	Y	Y	Y	N	N	7/11	M
Lang et al., (69)	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	9/11	H
Linton (70)	Y	N	Y	N	N	Y	Y	Y	N/A	N	N	5/11	M
Long et al., (6)	Y	Y	Y	Y	N	Y	Y	Y	N/A	N	N	7/11	M
Mayer et al., (71)	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	8/11	M
National Research Council and Institute of Medicine (50)	Y	Y	Y	Y	N	Y	Y	Y	N/A	N	N	7/11	M
Osborne et al., (72)	Y	Y	Y	N	N	Y	Y	Y	N/A	N	N	6/11	M

Pincus et al., (73)	Y	Y	Y	N	N	Y	Y	Y	Y	N	N	7/11	M
Roffey et al., (74)	Y	Y	Y	Y	N	Y	Y	Y	N/A	N	N	7/11	M
Sherehiy et al., (75)	Y	N	Y	Y	N	N	Y	Y	N/A	N	N	5/11	M
Sobeih et al., (76)	Y	Y	Y	Y	N	Y	Y	Y	N/A	N	N	7/11	M
Taylor et al., (77)	Y	Y	Y	N	N	Y	Y	Y	Y	N	N	7/11	M
Treaster and Burr (78)	Y	N	N	Y	N	Y	N	N/A	N	N	N	3/11	**L**
van Rijn et al., (79)	Y	Y	Y	Y	N	Y	Y	Y	N/A	N	N	7/11	M
Village et al., (80)	Y	N	Y	Y	N	Y	Y	Y	N/A	N	N	6/11	M
Wærsted et al., (81)	Y	N	Y	Y	N	Y	Y	Y	N/A	N	N	6/11	M
Number of Low Quality Reviews								2					
Number of Moderate Quality Reviews								27					
Number of High Quality Reviews								2					
Total Number of Literature Reviews								31					

Y=Yes; N=No; N/A= Not Applicable. L=Low Quality; M=Moderate Quality; H=High Quality.

<u>Quality Ranking:</u>

0-4 – Low; 5-8 – Moderate; 9-11 – High (51)

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