Centre for Work Health and Safety

Development of industry-specific safety climate scales: Meat processing

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Executive Summary

Objective and Aims

The objective of this project was to develop a set of six industry-specific surveys to measure safety climate (hereafter referred to as 'safety climate scale'). In this report, we concentrate on the safety climate scale developed for the meat-processing industry. In particular, we focus on exploring the aspects of safety climate that are important across the whole cohort of workers, supervisors and managers in this industry. The aims of this project were to:

- Understand and explore the industry-specific nuances of safety climate.
- Demonstrate the utility of industry-specific safety climate over general safety climate scales.
- Establish the validity and reliability of the industry-specific safety climate scale.
- Contribute to the broader research surrounding safety climate.
- Build a practical set of tools that the industry can use to measure safety climate and identify areas for improvement.

Method

To develop the meat-processing safety climate scale, we followed a modified version of the three-phase, nine-step process of scale development outlined by Boateng et al. (2018). This process included: a literature scan of previous industry-specific safety climate research; orientation interviews with industry-experienced work health and safety inspectors; refinement of scale items through an industry focus group; testing and confirmation of scale dimensionality with two international online panels of respondents; psychometric evaluation; and validity checks. Finally, we undertook an industry validation, partnering with a large, Australian meat-processing organisation.

Summary of Findings

Although some safety climate research has focused on the meat-processing industry, most has been conducted in general manufacturing, typically by applying generic safety climate scales. Meat processing is a high-risk industry due to the heavy manual tasks that must be completed. Ergonomic risks are plentiful and must be managed carefully. Further, meat processing is a production-driven industry, often with high-pressure environments and incentives (or punishments) designed to accelerate throughput. Consequently, there is often a preoccupation with 'time' in meat-processing settings and the importance of not losing or wasting it (i.e., a concern that taking people off the line reduces throughput). The time taken to perform cutting tasks must be highly optimised and efficient. Finally, the cultural diversity present in meat-processing settings presents some challenges to the management of safety, particularly as it relates to communication and comprehension of safety requirements.

Meat processing safety climate is best represented by the following factors:

1. Production line setup: the efficiency and quality of production line equipment and its effect on

safety indirectly via increased or decreased production pressure (e.g., product jams or speed of conveyor belts).

2. Safety training: processes designed to ensure a high standard of job and safety capability.
3. Safety priority: management supporting staff to 'stop the line' for safety concerns and not using punishment when safety mistakes occur.
4. Supervisor support: team leaders' practices around supporting workers' competence and skill development, particularly as it relates to safety.

Statistical testing with an industry sample showed that the meat-processing safety climate scale was significantly associated with safety behaviour over and above a generic safety climate scale. This finding highlights the value of measuring an industry-specific version of safety climate.

Conclusions and Practical Implications

The safety climate scale developed in this project captures nuances specific to the meat-processing industry in Australia. It not only provides a more valid way of measuring safety climate in this industry but is also helpful for users in pointing out concrete areas for possible health and safety improvement in their workplaces.

Specific advice for this industry includes the following points:

- Employers are encouraged to measure their organisation's safety climate regularly (every 3-6 months) and interpret the results for each of the four factors that make up meat-processing safety climate separately for clear insights into what can be practically done to improve.
- Where health and hygiene behaviours in relation to COVID-19 are of interest, meat-processing organisations could measure and review their workforce's perceptions of COVID safety climate in addition to 'regular' safety climate.
- With regards to survey implementation, meat-processing organisations should consider providing both online and hardcopy methods to collect data given that computer availability and comfort to use technology may be low in the worker population.
- Meat-processing safety climate perceptions are influenced by the physical design and layout of production machinery, with inefficient or problematic machinery that causes product blockages also informing a reduced sense of safety priority. Manufacturers could consult with workers at the product line design phase and throughout operation as demands, inputs, and processes change to ensure smooth flow.
- Safety competence and training appears to be a major theme within meat-processing safety climate; as workers come from a diverse range of backgrounds, including culturally and linguistically diverse (CALD) backgrounds, it is beneficial for organisations to invest resources in upskilling and providing workers with adequate job and safety knowledge.
- Safety priority can be demonstrated by management when they allow workers to stop the production line without penalty or punishment. In such instances, it is important that management do not signal (explicitly or implicitly) that they are displeased or unhappy with

production halts due to safety concerns.

- Finally, supervisors appear to be important sources of safety climate perception due to their behaviours associated with confidence-building and monitoring of workers' performance. Supervisors in the meat-processing industry should reinterpret and explain safety requirements in simple terms that workers understand, as well as verify the workers' competence before work commences.

Table of Contents

Introduction

Broadly, safety climate refers to the importance of or value placed on safety, as inferred from people's perceptions of safety policies, procedures, and practices within an organisation (Griffin & Curcuruto, 2016). At a more nuanced level, safety climate refers to the shared perceptions of safety priority that develop among workers, both at a work unit or group level (in reference to supervisors and co-workers) and at an organisational level (in reference to management and organisational systems; Zohar, 2010). Safety climate has also been described as a more superficial (and hence, measurable) facet of the deeper organisational culture for safety (Guldenmund, 2007).

Studies have shown that when a safety climate is positive in level and strong in terms of its consistency across workers (measured by the similarity of survey responses within a group), safety behaviours are typically more frequent and injuries are less likely (Clarke, 2010). A safety climate exerts a positive effect on safety performance through several mechanisms, as explained by Griffin and Curcuruto (2016). Safety climate creates a sense of obligation to reciprocate among workers, in the form of more frequent and effective safety behaviours. There is a sense that the organisation genuinely cares, and so employees feel more engaged and willing to be part of safety programs and initiatives. Another mechanism through which safety climate influences safety performance is through worker motivation. Safety climate contributes to both external (i.e., driven by factors outside the individual) and internal (i.e., driven by the individual's own desire) motivation. Regarding external motivation, safety climate conveys specific behaviour-outcome expectancies—that behaving safely will be met with rewards and recognition from the organisation. For internal motivation, a workplace with a positive safety climate causes workers to experience aspects of self-determination (Scott, Fleming & Kelloway, 2014), namely, social connectedness and belonging (i.e., the organisation cares about staff welfare), competency (i.e., safety training, coaching, and capability-building are valued), and autonomy (i.e., the organisation supports workers who speak up and have input into safety decisions).

In a comprehensive review of safety climate intervention studies, Lee et al. (2019) identified strategies that have proven effective in generating safety climate improvement. These strategies included improved safety leadership and redeveloped organisational structures, such as reporting lines, safety management systems, how work is designed and performed, consideration of human factors, and the conditions in which work is performed. Communication about safety was also identified as a critical feature of effective safety climate interventions. Although much work has been done to develop general safety climate scales that incorporate these features to measure safety climate in any industrial context where safety is a goal or priority (e.g., Beus et al., 2019), more nuanced and specific scales that capture industry-specific contexts tend to perform better (Huang et al., 2013). Indeed, Zohar (2010) argued that industry-specific safety climate scales are required, because this approach improves face validity among participants and adds extra context, improving the functioning of these scales in real-world settings. In other words, industry-specific safety climate

scales not only seem more accurate and valid to the workers completing them, but they also capture additional diagnostic and predictive information that can be used to improve safety performance by organisations.

In the remainder of this report, we provide an overview of existing safety climate research in the manufacturing sector, and particularly the meat-processing industry. We then describe the process used to develop a scale specifically designed to measure safety climate in meat processing, followed by the results of this process, including the safety climate scale.

Safety Climate in Meat Processing

A literature scan, drawing on the most highly cited articles published since 2000 and accessible through the Scopus database, identified several meat processing studies that concentrated on safety climate (i.e., De Boeck et al., 2015; De Boeck et al., 2016; De Boeck et al., 2017; Donovan et al., 2020). The studies by De Boeck et al. focussed on food safety climate in a large meat-processing plant, farm butcheries and butcher shops in Belgium. Although the scales they developed have some themes in common with worker safety climate including: 'management commitment', 'communication', 'resources' (e.g., "In my organization, employees get sufficient time to work in a hygienic and food safe way"), the focus was on food hygiene rather than on worker safety. Donovan et al. (2020) studied safety climate on a poultry meat-processing plant in Australia and used generic safety climate scale measures originally developed by Amick et al. (2000; e.g., "Unsafe working conditions are identified and improved promptly").

In addition to these handful of meat-processing-specific studies, Cavazza and Serpe (2009) included in their study not only the meat-processing industry, but also other types of manufacturing and blue-collar types of work across other industries. Beyond Cavazza and Serpe's (2009), a substantial number of studies have investigated safety climate across different types of food manufacturing industries as well as other types of manufacturing. For example, Milijic et al. (2013) developed a scale to measure safety climate in manufacturing industries in Serbia and included factors such as: 'management support and priorities', 'safety training', and 'safety communication' (e.g., "Co-workers often exchange tips with one another on how to work safely"). Another example is Ma et al. (2009), who investigated safety climate across various types of manufacturing organisations in China, using a scale developed for the Chinese context by Lin et al. (2008). This scale covered factors such as: 'management support', 'safety communication', and 'safety competency', (e.g., "I can deal with safety problems at my workplace").

Lee and Dalal (2016) did a similar study on safety climate in South Korean manufacturing organisations, including some food manufacturing companies, using a Korean translation of Griffin and Neal's (2000) widely used general safety climate scale. This scale covers factors like 'manager values', 'training', and 'safety communications' (e.g., "I receive regular updates on technical aspects of safety"). Another widely used generic survey tool is that of Zohar and Luria (2005). Although this

scale was designed as a generic survey tool, it was first developed for and applied in manufacturing plants. Zohar and Luria's scale distinguishes between organisation-level safety climate (e.g., "Top management in this company reacts quickly to solve the problem when told about safety hazards") and group-level safety climate (e.g., "My direct supervisor refuses to ignore safety rules when work falls behind schedule").

All scales had in common the following safety climate factors: 'management commitment, priorities and support', 'safety training', 'awareness' (or 'competency'), and 'safety communication'. A less commonly included factor is 'perceptions of safety inspections'.

In summary, although there have been many safety-climate studies that have focused on the manufacturing sector, and within that sector on food manufacturing industries more specifically, only a few studies have specifically investigated safety climate in the meat-processing industry. Moreover, meat-processing-focused studies tend to emphasise food safety climate rather than worker safety climate or tend to use a general rather than industry-specific safety climate scale.

The meat-processing industry has several special characteristics, such as a mix of safety objectives that include the safety of the food produced, workers' safety, as well as machine and process safety. Moreover, at least within the Australian context, the industry also employs many workers for whom English is not their native language, or who belong to varied educational and social backgrounds. This points to the need to develop safety climate measures that purposely reflect the specificities and nuances of the meat-processing industry in Australia.

Method

Scale Development Process

To develop the meat-processing safety climate scale, we drew on established best practices from the psychology and general health sciences literatures. Specifically, we followed a modified version of the three-phase, nine-step process of scale development outlined by Boateng et al. (2018).

The steps followed during scale development were as follows:

1. Literature scan of the domain-specific safety climate research.
2. Orientation interviews conducted with SafeWork NSW inspectors (domain subject-matter experts).
3. Formal identification and definition of content domain.
4. Further refinement of content domain through industry focus groups.
5. Item generation.
6. Review of scale items.
7. Recruitment and testing of scale dimensionality with an online panel of respondents (exploratory factor analysis phase).
8. Item reduction and refinement.
9. Recruitment and confirmation of scale dimensionality with an online panel of respondents

(confirmatory factor analysis phase).

10. Psychometric evaluation.
11. Validity checks (construct, criterion, and discriminant).

To develop the specific items for the safety climate scale, we conducted a combination of interviews and focus groups with subject matter experts. Existing networks of well-connected subject matter experts (ranging from consultants to regulators and academics) for the meat-processing industry were consulted and briefed on the project requirements, and a snowball methodology was used to identify participants. Specifically, we interviewed five SafeWork NSW industry-experienced inspectors in addition to conducting a focus group with 10 industry representatives. Workers, supervisors and managers were eligible for the focus group if they had been employed for at least six months or more in the target industry, had operational 'hands-on' roles, and were comfortable participating in a virtual focus group environment.

The draft scale items were constructed following the focus groups and interviews by a team of tertiary qualified researchers. The senior researchers on the team and the Centre for WHS reviewed the items, making edits and refinements to ensure the items performed effectively, had face validity and would be easy for respondents to interpret.

Once the draft item pool was developed, the scale was subjected to testing with two online panels. The first was recruited for the purpose of an Exploratory Factor Analysis (EFA), which determines how the items 'hang together' or to what extent they collectively measure the same construct (safety climate). A second sample provided a more rigorous test through a process of Confirmatory Factor Analysis (CFA).

The final step was to 'road test' the safety climate scale with real-world industry participants. The objectives of performing this industry validation included the following:

- Confirm the psychometric performance of the safety climate scale, including incremental association of safety climate with safety behaviour over and above a generic safety climate scale.
- Evaluate the practical utility of the scale and obtain feedback from participating organisations.
- Inform any final tweaks or adjustments to the safety climate scale items.

Detailed Analytical Strategy

Our process to refine and finalise the meat processing safety climate scale adopted a two-phase approach. First, we conducted EFAs to identify the emergent factor structure and eliminate any poorly performing items (i.e., low factor loadings, cross loadings). Multiple EFAs were conducted, removing one item at a time, and re-examining the factor structure until a 'clean' solution was found.

Next, we conducted a CFA using the second research sample. A CFA for scale development

proceeds with the following steps. First, we tested a series of nested models starting with a single factor (i.e., a congeneric model) and up to the expected number of factors in the scale. Then we examined discriminant validity by including a divergent measure (a personality factor—'conscientiousness'). Including the personality measure in the survey enabled us to determine the validity of each of the measures separately by observing whether they were measuring two distinct constructs. Third, we assessed model fit and examined criterion validity by conducting path analysis (e.g., examining the relationship with safety performance). The last step included an analysis of the relationships between personality measures, safety performance and safety climate.

We also conducted additional analyses to demonstrate the utility of the meat-processing safety climate scale, namely, through hierarchical multiple regression and measuring the change in total variance explained by the model over and above a generic safety climate scale (Hahn & Murphy, 2008).

Sampling of Interview and Focus Group Participants

The selection of participants followed a purposive sampling approach focused on obtaining a sample with diverse experiences of safety climate in the industry. The selection was consistent with best research practices (Creswell & Plano Clark, 2011). Our methodology also followed best practices in scale development; namely, a combination of deductive (theory and literature-driven) and inductive (data-driven) methods (Hinkin, 1995; Morgado et al., 2017). In general, qualitative data saturation is typically achieved between 6-12 participants (Guest et al., 2006). Other academic published research on safety climate scales reported to have used between 8-20 subject matter experts to review items (e.g., Jafari et al., 2017). Our study used actual workers to generate the scale items that were then combined with expert review and feedback, resulting in a more rigorous process.

All levels of organisation (workers, supervisors and managers) were invited to participate in the focus group to ensure that the items applied equally to them. Example questions covered during these investigations included:

What does senior management say or do that tells you how much they care about safety?
What does your supervisor do that tells you how much they care about safety?
What priorities or tensions do you experience at work that affect how much safety is prioritised?

We also asked questions about how their organisation was seen to manage COVID-19 to develop a specific measure that captures this important contemporary health and safety concern. Interview data were thematically analysed and specific safety climate scale considerations, draft items, and contextual information (e.g., language) summarised to inform scale development.

A strength of our scale development process is the integration and synthesis of both academic and industry data sources. These steps ensured that not only did the safety climate scale accurately represent the nature of the safety climate construct, but it was contextualised to the meat-processing industry context, increasing face validity for respondents.

The outcomes of this process included an initial pool of 59 draft scale items and seven factors. These draft items were later refined down to a total of 15 high-performing items across four factors (13 were initially developed and two extra items were added at a later stage).

Sampling for Scale Validation

The online panel Prolific, comprising of a combination of Australian (10%), US (30%), and UK (40%) workers, was employed for the validation samples. The remainder (20%) were from European English-speaking countries. This approach was taken because Australia does not yet possess a cost-effective crowd sourced survey sampling platform. We did not consider nationality to be an important factor for initial validation since the analysis relies on simply understanding and interpreting the item content rather than focusing on actual safety practices in the industry. Similarly, differences in practice and attitudes between Australian participants and those participant workers from other countries were not important for the psychometric analyses we conducted. Our focus was on assessing the performance of the items, such as construct and criterion validity, rather than creating benchmarks or other geographically comparative information. Finally, the international sample provides a conservative test of the psychometric performance of the scale because the items were originally written for the Australian context. This means that if the scale performs well internationally, then theoretically, its suitability for Australian workers would be even greater.

In return for participating in academic research surveys, participants receive a sizeable reward—typically in the vicinity of $15 AUD per hour. Consequently, Prolific participants are highly engaged and provide quality data. Indeed, researchers have shown that Prolific users are generally more diverse, more engaged, and provide better-quality survey responses than popular alternatives such as MTURK (Peer et al., 2017).

For the industry validation phase, the organisation's management received a hardcopy of the industry-specific scale along with some collateral material including an information sheet to be distributed to employees. We used the Qualtrics platform for the survey delivery. Managers forwarded the information sheet about the project stating what the project was about, a brief introduction to the concept of 'safety climate', an overview of what the survey measures, the requirements of their involvement (including time requirements and a statement on how the project will protect their privacy, as well as contact details for the research team should the need to raise concerns about the survey arise, along with a references to the approval by the Human Research Ethics Committee of Queensland, #2019/22).

Participants

Scale Validation Study 1 – Online Panel

For the first sample in this study, we recruited 150 manufacturing workers from the Prolific user population. Participants were paid a fee of 1.23 GBP (approximately $19 AUD per hour) in exchange for completing the 5-min survey with the draft safety climate items. To 'clean' the data, we removed

cases from the sample where there was no variation across all survey items (e.g., the participant 'strongly agreed' with all items on the survey) and where the duration of participation was below 60 seconds. Further checks were made by including an 'attention' item in the survey where participants had to follow a specific instruction. After data cleaning, a total of 136 participants remained in the dataset. One-hundred eighteen (87%) respondents were employed in the manufacturing industry on a full-time basis, 12 (9%) were part-time, and six (4%) were on a casual or short-term contract. The average tenure of respondents in the industry was 7.1 years (SD=8.1 years).

Scale Validation Study 2 – Online Panel

For the second validation sample, we recruited 250 manufacturing workers, again from the Prolific platform. After data cleaning, 244 cases remained in the dataset. Within this sample, 218 (89%) were employed full-time, 20 (8%) were employed part-time, and 6 (3%) were employed casually or on a contract basis. The average industry tenure was 8.2 years (SD=7.6 years).

Scale Validation Study 3 – Industry Sample

A large meat-processing organisation (employing approximately 3,000 people) based in Australia (with operations across QLD, SA, NSW, and VIC) participated in a further validation of the safety climate scale, including some specific questions to capture COVID-19 safety climate. The organisation participated in exchange for a free survey administration service, written feedback, and a verbal debrief session on the findings. A random selection of 106 workers across meat-processing plants from four different meat-processing sites of the organisation participated in the survey. Participants ranged uniformly in years of tenure, with approximately 20% of the sample corresponding to each year bracket. The sample was slightly more represented by employees with 10 or more years' experience (27, 27%). A total of 61% of the sample were workers, and 35% were frontline supervisors. Males comprised 63% of the sample. A total of 39% of the sample were born overseas.

Results and Interpretation

Scale Development

Exploratory Factor Analysis

Using the first research sample, a series of EFAs were conducted to explore the emergent factor structure of the industry-specific safety climate scale. The method used was Principal Axis Factoring with Promax rotation, as recommended by foundational psychology texts (Field, 2009). Pairwise deletion of cases with missing data was used, and item-factor loadings below 0.50 were suppressed to assist in interpretation. Factors were retained through a process of examining visual 'scree plots' and where factors had eigenvalues of 1.0 or above. Table 1 shows the results from our final EFA using the industry-specific safety climate items (note that two extra items were added to the scale at a later stage to improve the scale).

An example of popular generic safety climate scale is shown below as a comparison against our items, which are more nuanced and specific to the meat-processing industry context (Hahn & Murphy, 2008).

Generic safety climate scale items:

1. New employees learn quickly that they are expected to follow good health and safety practices.
2. Employees are told when they do not follow good health and safety practices.
3. Workers and management work together to ensure the safest possible conditions.
4. There are no major shortcuts taken when worker health and safety are at stake.
5. The health and safety of workers is a high priority with management where I work.
6. I feel free to report safety problems where I work.

The generic items listed above were compared with the industry-specific items we developed during this research. The industry-specific items performed significantly better in terms of their ability to measure the association with safety behaviour.

The first factor, we termed 'production line setup', which included some training and development items (later separated into another distinct factor for the CFA). The second factor was 'safety priority', which includes empowering workers to stop production, and also remaining open to improvements in terms of safety as well as general workflow and efficiency. The final factor, we labelled 'supervisor support' and includes practices relevant to safety communication and ensuring workers are confident to perform their jobs before commencing.

For the CFA, we included additional items based on focus group results and separated the 'production line setup' and 'training' items into separate factors. These items were included based on research team discussions following the EFA results.

The additional items were:

- Management are always looking for ways to improve production safety
- Supervisors take an active interest in building up workers' production skills

Table 1. Final Exploratory Factor Analysis results for the meat-processing safety climate scale.

	Factor		
	1	2	3
At this organisation, our production facilities are designed so product flows smoothly.	0.827		
At this organisation, production machinery has adequate guarding and safety barriers installed.	0.791		
At this organisation, production processes are clearly documented and communicated.	0.762		
At this organisation, workers have easy access to production and machinery safety documentation and information.	0.749		
At this organisation, safety instructions are explained so everyone can understand them	0.689		
At this organisation, workers are supported to learn the correct production techniques (e.g., cutting, lifting).	0.645		
At this organisation, workers are supported to learn safe ways of handling production machines and equipment.	0.631		
Management allows workers to stop the production line at any time without penalty.		0.794	
Management considers how work process changes may put pressure on other production lines.		0.681	
Management are open to new ways of doing production work so safety is improved.		0.603	
Supervisors make sure workers are confident to operate production machinery before the job starts.			0.834
Supervisors pass on safety information to workers on the floor.			0.613
When communicating about safety matters, supervisors ensure everyone has understood the message.			0.566

Reliability Analysis

Reliability refers to the ability of a group of related items to consistently measure a target construct, such as safety climate. Values of internal consistency range from 0.0 (meaning the items are essentially measuring different constructs) to 1.0 (meaning the items are highly correlated and measuring the same construct). Overall, the meat-processing safety climate scale reliability Alpha was 0.93, while dimension-level reliabilities ranged between 0.73 to 0.89. The minimum cut-off for reliability values is 0.60, although, values of 0.70 and above are recommended.

Confirmatory Factor Analysis

A CFA was conducted with all items loaded onto a single congeneric safety climate factor. The fit for this single factor model was unacceptable ($\chi^2(90)=322.37$, $p<.01$; RMSEA=0.10, 90%CI=0.09 to

0.12, p<.01; CFI=0.87, TLI=0.85; SRMR=0.06). Therefore, the safety climate scale is best represented by more than one factor, supporting our EFA results.

A second CFA was then run using the factors identified during the EFA process, with separate 'Resourcing' and 'Safety Priority' dimensions. The results of this second CFA showed excellent fit statistics ($\chi^2(86)=184.12$, p<.01; RMSEA=0.07, 90%CI=0.05 to 0.08, p=0.06; CFI=0.95; TLI=0.93; SRMR=0.04). Figure 1 shows a visual representation of the CFA results, with standardised factor loadings shown.

Regarding low factor loadings, in particular, SC_8 (noting that values of 0.30 and above are acceptable), there may be opportunities to tweak item wording to improve performance. For SC_8, the item referred to perceptions of management accepting stop work decisions by workers, whereas the other items reflected management's willingness to improve safety and make additional safety investments. SC_8 expands the content domain of the 'Safety priority' factor to include stop work support from management.

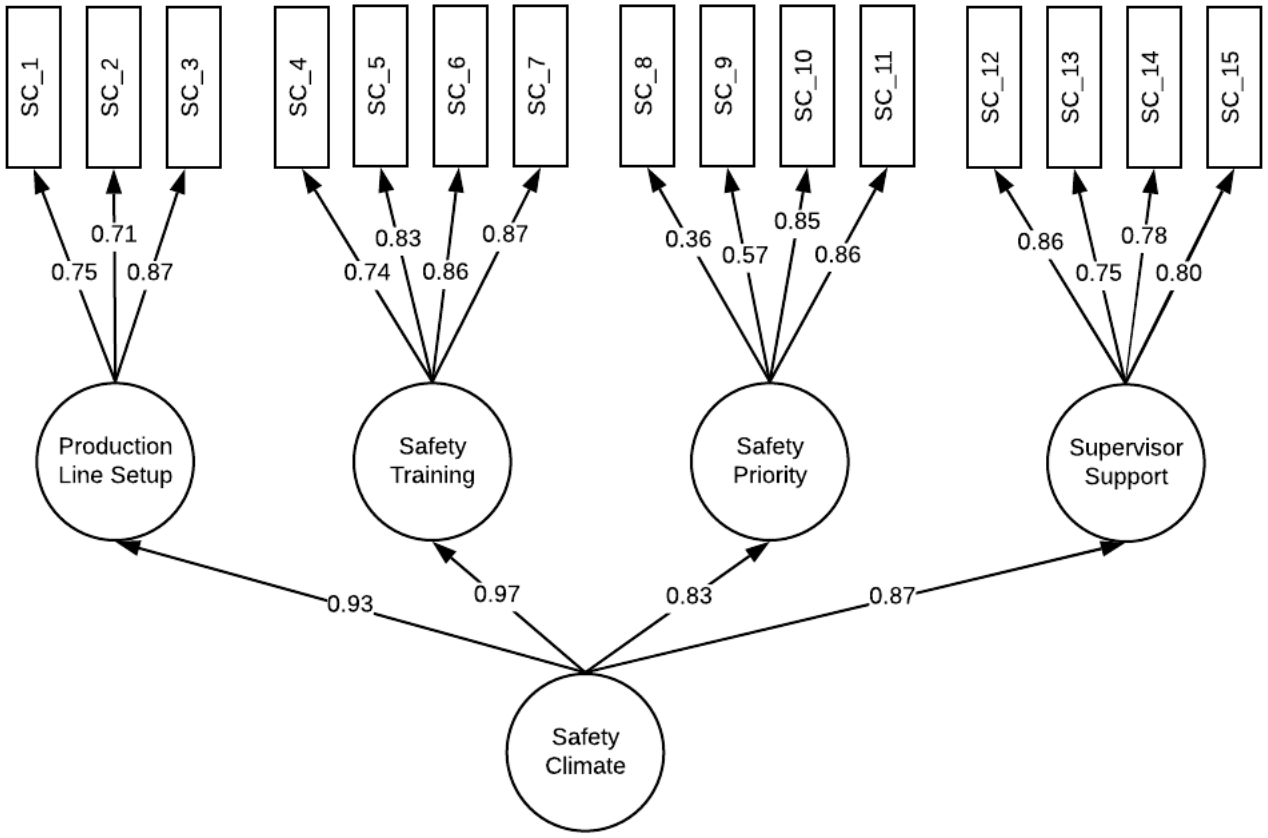

Figure 1. Confirmatory Factor Analysis results for the meat-processing safety climate scale, linking 15 items into four key factors, fully standardised coefficients shown.

Additional Validity Checks

Discriminant Validity

To determine discriminant validity, a CFA was conducted that included the meat-processing safety climate items and five items from a conscientiousness personality scale (Hogan & Foster, 2013).

First, a CFA with all items loading onto a single factor was conducted. The model had very poor fit statistics, which indicated that loading the personality items with the safety climate items was inappropriate ($\chi^2(170)=642.07$, $p<.01$; RMSEA=0.11, 90%CI=0.10 to 0.12, $p<.01$; CFI=0.79; TLI=0.76; SRMR=0.09).

Next, another CFA with the safety climate items differentiated from the conscientiousness items was conducted. This model showed significantly better fit, with CFI and TLI value changes exceeding 0.10 as recommended to demonstrate a change in model fit (Byrne, 2010; $\chi^2(169)=437.32$, $p<.01$; RMSEA=0.08, 90%CI=0.07 to 0.09; CFI=0.88; TLI=0.86; SRMR=0.07).

Criterion Validity

To check criterion validity, a series of bivariate correlations were calculated between all variables included in the CFA. As shown by Table 2, meat-processing safety climate was significantly related to a similar construct—'management safety commitment'. It was also related to the safety performance variables 'safety compliance' and 'safety proactivity', and at levels equal to or higher than general work performance (i.e., 'proficiency', 'adaptivity' and 'proactivity'). Finally, the safety climate scale did not predict an unrelated stable trait—'emotional regulation'.

Table 2. Bivariate correlations between study variables.

	SC*	2	3	4	5	6	7	8
(1) Management safety commitment	0.80							
	0.00							
(2) Conscientiousness	0.35	0.31						
	0.00	*0.00*						
(3) Safety compliance	0.43	0.45	0.41					
	0.00	*0.00*	*0.00*					
(4) Safety proactivity	0.29	0.31	0.37	0.51				
	0.00	*0.00*	*0.00*	*0.00*				
(5) Emotional regulation	0.00	-0.01	0.01	-0.03	0.07			
	0.99	*0.91*	*0.83*	*0.59*	*0.30*			
(6) Work performance – Proficiency	0.42	0.37	0.47	0.50	0.30	-0.11		
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.08*		
(7) Work performance – Adaptivity	0.35	0.34	0.49	0.35	0.32	-0.02	0.48	
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.80*	*0.00*	
(8) Work performance – Proactivity	0.24	0.23	0.37	0.28	0.40	0.12	0.31	0.56
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.06*	*0.00*	*0.00*

Note: SC refers to the meat-processing safety climate scale, with all items aggregated to an overall score. P-values are shown in italics underneath each bivariate correlation.

Incremental Validity

To assess the incremental validity of the meat-processing safety climate scale, a short-form generic safety climate scale was included in the survey and assessed in terms of the association with safety behaviour variables ('safety compliance' and 'safety proactivity'; see Appendix). A series of hierarchical multiple regression analyses were undertaken with the short-form safety climate scale included first, followed by the meat-processing safety climate scale.

At the overall scale level, the meat-processing safety climate scale did not add incremental utility to the measurement of either 'safety compliance' or 'safety proactivity'. However, when we added each factor separately, we found that 'supervisor support' (R^2_{change}=0.02, p<.05) explained significant variation in the outcome over and above the generic safety climate scale. For 'safety proactivity,' none of the factors significantly increased the model's utility.

Industry Validation

In this instance, management in the meat-processing organisation under study reported satisfaction with the process, including the practical utility, support and information provided during the process. No changes to the safety climate scale were implemented following review by the organisation's management. Having a high degree of involvement and regular communication with the organisation's management warranted the seamless implementation of the survey. To facilitate uptake by the workforce across the different meat-processing sites, a hardcopy version of the survey was used.

> *As far as the safety climate survey goes - it was relevant to our industry and the questions asked were great in capturing those important topic areas which shape our business. Undertaking a sample of surveys across our business allowed us to get a clear indication of where we sit within the safety climate scale and identify key target areas for improvement.*
> *- Manager at Meat Processing Organisation*

Initial discussions with the organisation in preparation for implementation identified the diverse cultural and linguistic character of its workforce. At the organisation's request, two demographic questions around gender and country of birth were therefore added.

Criterion Validity

To check criterion validity, a series of bivariate correlations were calculated between all variables included in the industry sample survey. As shown by Table 3, meat-processing safety climate in the industry sample was significantly related to the safety performance variables 'safety compliance' and 'safety proactivity'. It was also significantly related to 'COVID safety climate' (i.e., perceptions of how effectively the company's management has handled the pandemic, including topics such as resourcing, communication, and COVID-specific safety practices, see Appendix), 'engagement' and 'deep', rather than 'surface' compliance' (e.g., going through the motions of complying). Further, COVID safety climate's association with pandemic health and hygiene outcomes was stronger than

that of 'regular' safety climate and 'surface' compliance with COVID-19 requirements was positively related to 'Emotional exhaustion'.

Table 3. Bivariate correlations between study variables.

	SC*	2	3	4	5	6	7
(2) Safety compliance	0.48						
	0.00						
(3) Safety proactivity	0.53	0.58					
	0.00	*0.00*					
(4) COVID safety climate	0.70	0.34	0.38				
	0.00	*0.00*	*0.00*				
(5) COVID deep compliance	0.37	0.42	0.34	0.46			
	0.00	*0.00*	*0.00*	*0.00*			
(6) COVID surface compliance	0.02	0.08	-0.08	-0.05	-0.08		
	0.86	*0.41*	*0.42*	*0.66*	*0.41*		
(7) Engagement	0.35	0.36	0.33	0.42	0.41	0.08	
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.45*	
(8) Emotional exhaustion	-0.62	-0.45	-0.45	-0.49	-0.37	0.18	-0.43
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	0.07	*0.00*

Note: SC refers to the meat-processing safety climate scale, with all items aggregated to an overall score. P-values are shown in italics underneath each bivariate correlation.

A series of hierarchical regression analyses were run to test for the incremental explanation of safety behaviour over and above the generic safety climate scale. Both analyses showed that the meat-processing-specific safety climate scale added a significant amount of explanatory power over and above general safety climate for compliance (R^2_{change}=0.14, p<.01) and proactivity (R^2_{change}=0.19, p<.01). This result means that the industry-specific safety climate scale still managed to account for variation in safety performance even after general safety climate was accounted for and, overall, was stronger correlate than general safety climate. Within a real-world industry context, the industry-specific safety climate scale performed better with the industry sample than when an online sample was used. The smaller change in meat-processing safety climate performance in the online panel sample as compared to the industry sample could be due to 1) the small tweaks and improvements made to the items in-between these studies, and 2) differences in respondent engagement in the industry sample (i.e., more engaged in the survey process). From these results, it seems that when the safety climate survey is administered within an organisational setting, and possibly also within an Australian context, it performs better than if it is used with a sample of people from multiple organisations and based internationally.

Applicability to Culturally and Linguistically Diverse (CALD) workers

Noting that a total of 39% of the sample respondents were born overseas and the additional demographic variable was requested by the participating organisation, we ran additional analyses to check for differences by CALD status. No significant differences were found on average, which

suggests that the interpretation and applicability of the scale is equivalent across the groups.

Summary of Scale Psychometric Properties

- Overall, the meat-processing safety climate scale reliability Alpha was 0.93; dimension-level reliabilities range between 0.73 to 0.89. These results mean that the items in the scale consistently measure a single topic (safety climate), balancing the breadth of the topic with specific repeated instances of each item to ensure that the influences of response error are minimised.
- The meat-processing safety climate scale demonstrated good CFA model fit, highlighting strong construct validity. A strong CFA result means that the items in the scale are associated with each other and collectively tap into the concept of safety climate in a valid way.
- The scale was related to variables as expected, such as 'safety performance' and 'management safety commitment'. Further, it was not related to a dissimilar construct (personality trait—'emotional regulation'). The first two results show that the scale is associated with similar other topics, which helps to establish its validity. Discriminant validity was shown by differentiating conscientiousness from the safety climate items. The other results show that safety climate is not related to dissimilar topics like personality, again bolstering the validity and integrity of the newly-developed scale.
- Incremental validity over a general safety climate scale was demonstrated for dimensions of the meat-processing safety climate scale, which means that the industry-specific scale was still significantly associated with outcomes like safety performance even after accounting for the effects of a general safety climate scale.
- Overall, within a real-world industry context, the meat-processing safety climate scale performed better than when an online sample was used.

Limitations

One of the limitations of this study was the use of cross-sectional data. Within the scope of the study and timeframe, it was not possible to collect data at two or more time points (e.g., safety climate data at time one, and outcome data at time two). Therefore, further evidence of the safety climate scale's ability to truly predict future incident involvement and safety performance will need to be gathered. Also, the scale was tested in just one industry setting with a limited sample of approximately 100 employees. Ideally, multiple organisations would be used to test the safety climate scale performance to account for differences in context and variations within the meat processing industry.

Conclusions and Practical Implications

The development and implementation of the meat-processing scale served 6 main purposes:

- Understand and explore the industry-specific nuances of safety climate;
- Demonstrate the utility of industry-specific safety climate scale over general safety climate scales;
- Establish the validity and reliability of the industry-specific safety climate scale;
- Contribute to the broader research surrounding safety climate;
- Build a practical tool that the industry can use to measure safety climate and identify areas for improvement.

This project shed light onto the industry-specific nature of safety climate within the meat-processing industry. Safety climate was best represented by four, separate factors: 'Production line setup', 'Safety training', 'Safety priority', and 'Supervisor support'. Together, these factors predicted meat-processing-specific safety performance as expected. Further, our industry validation study showed that the meat-processing safety climate scale explained safety performance over and above the general safety climate scale.

Acknowledging the limitations of a cross-sectional design and the limited organisational sample, we found evidence that the meat processing safety climate scale is valid and largely reliable. As the industry continues to use the scale, further data should be collected to inform future refinements and improvements, and generally add to the evidence base around this scale. Finally, the experiences of the participating organisation and testimonial feedback showed that the scale is practical and a useful source of safety improvement information.

Regarding the use and interpretation of this safety climate scale, several practical recommendations are apparent:

- Employers are encouraged to measure their organisation's safety climate regularly (every 3-6 months) and interpret the results for each of the four factors that make up meat-processing safety climate separately for clear insights into what can be practically done to improve.
- Where health and hygiene behaviours in relation to COVID-19 are of interest, meat-processing organisations could measure and review their workforce's perceptions of 'COVID safety climate' in addition to 'regular' safety climate.
- With regards to survey implementation, meat-processing organisations should consider providing both online and hardcopy methods to collect data given that computer availability and comfort to use technology may be low in the industry's worker population.
- Meat-processing safety climate perceptions are influenced by the physical design and layout of production machinery, with inefficient or problematic machinery that causes product blockages also informing a reduced sense of safety priority. Manufacturers could consult with workers at the product line design phase and throughout operation as demands, inputs, and

processes change to ensure smooth flow.

- Safety competence and training appears to be a major theme within meat-processing safety climate; as workers come from a diverse range of backgrounds, including culturally and linguistically diverse backgrounds, it is beneficial for organisations to invest resources in upskilling and providing workers with adequate job and safety knowledge.
- Safety priority can be demonstrated by management when they allow workers to stop the production line without penalty or punishment. In such instances, it is important that management do not signal (explicitly or implicitly) that they are displeased or unhappy with production halts due to safety concerns.
- Finally, supervisors appear to be important sources of safety climate perception due to their behaviours associated with confidence-building and monitoring of workers' performance. Supervisors in the meat-processing industry should reinterpret and explain safety requirements in simple terms that workers understand, as well as verify the workers' competence before work commences.

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Appendix

The Meat-Processing Safety Climate Scale

Production line setup

- At this organisation, our production facilities are designed so product flows smoothly.
- At this organisation, production machinery has adequate guarding and safety barriers installed.
- At this organisation, production processes are clearly documented and communicated.

Safety training

- At this organisation, workers have easy access to production and machinery safety documentation and information.
- At this organisation, safety instructions are explained so everyone can understand them.
- At this organisation, workers are supported to learn the correct production techniques (e.g., cutting, lifting).
- At this organisation, workers are supported to learn safe ways of handling production machines and equipment.

Safety priority

- Management allows workers to stop the production line at any time without penalty.
- Management considers how work process changes may put pressure on other production lines.
- Management are open to new ways of doing production work so safety is improved.
- Management are always looking for ways to improve production safety.

Supervisor support

- Supervisors make sure workers are confident to operate production machinery before the job starts.
- Supervisors pass on safety information to workers on the floor.
- When communicating about safety matters, supervisors ensure everyone has understood the message.
- Supervisors take an active interest in building up workers' production skills.

The Meat-Processing Safety Performance Scale

Safety Compliance

- I report all safety incidents to my supervisor
- I stop the production line if I notice a significant safety risk
- I use the correct cutting and lifting techniques to maintain safety

Safety Proactivity

- I look out for the safety of my co-workers on the production line
- I teach new workers how to operate machines and equipment safely
- I provide feedback on how production line safety can be improved
- I speak up and ask questions if I am unsure or confused about safety matters
- I speak up if I feel too tired or unwell to work safely

COVID-19 Safety Climate Scale

- Senior management is genuinely concerned about protecting workers from COVID-19
- Senior management takes COVID-19 safety requirements (e.g. hand washing, social distancing) into consideration when designing work rosters
- Senior management addresses people's concerns about COVID-19
- During meetings, my supervisor speaks about the risk of COVID-19
- My supervisor reminds people to comply with COVID-19 safety requirements
- My supervisor makes sure employees with COVID-19 symptoms will not show up at work
- At this workplace, people regularly talk about the risk of COVID-19
- At this workplace, people comply with new COVID-19 safety measures
- At this workplace, people come up with new ways of doing work to reduce COVID-19 infection

COVID-19 Compliance Behaviours Scale

- I increase my awareness of how COVID-19 infects people
- I try to understand how COVID-19 safety practices help to reduce the risk of infection
- I follow COVID-19 hygiene and sanitisation procedures very closely
- I make a conscious effort to minimise the risk of infection to myself and others
- I treat COVID-19 safety procedures like a tick and flick exercise
- I put in the minimum effort needed to meet COVID-19 safety requirements
- I act like I am complying with COVID-19 safety requirements
- I follow COVID-19 safety procedures while feeling unconcerned about the risk of infections

Example Recruitment Email

As part of our commitment to building a workplace that fosters excellent health and safety, we are conducting a short survey. The purpose of this survey is to give everyone an opportunity to share their experiences of our workplace, and what makes them feel more or less safe when undertaking work.

In this survey, you will be asked questions about things that we know influence health and safety, with a focus on the culture of this workplace. The survey questions were made using feedback from actual workers from our industry. This is your chance to give us honest and open feedback so we can make further improvements. This survey should only take about 10 minutes to complete.

The main benefit to you is that, by participating, you will allow us to incorporate your views and experiences into our future initiatives and programs. Creating and maintaining a workplace culture which promotes safety is one of our key priorities. In the survey, there is space for you to write some comments and share your views, in addition to rating questions that ask about your experiences and perceptions in the workplace.

Your personal information will never be shared. We are only interested in the grouped and deidentified trends across all people—not the details of what individuals answer on the survey.

Thank you in advance for your time to complete this important survey. We hope you will find the time to participate fully and honestly. You can access the survey using the link below:

INSERT SURVEY LINK HERE

Example Information Flyer

Safety culture survey project

What is this project about?

We are interested in hearing about your unique experiences and views on safety at this workplace. The idea of doing a survey is to provide everyone that works here with a voice about what they see and hear. That way, we will get useful feedback about our workplace culture which will help to drive future improvements in safety.

What is the survey measuring?

The survey is measuring a specific part of the broader culture for safety at this worksite called the 'safety climate'. Safety climate is like the mood of our worksite around safety (i.e., is it valued and prioritised?), whereas culture is more like the personality (i.e., what do people believe about safety?). Safety climate is known as a 'leading safety indicator' because it gives information about where we can focus our energy and attention to improve before accidents happen. The survey asks you about your perceptions of safety policies, practices, and procedures at our workplace. There are no right or wrong answers—just answer what comes to mind immediately. We include a comments box so you can provide some more detailed feedback not captured by the survey questions.

How will my privacy be maintained?

Your privacy is very important because without it, you might feel less comfortable to be open and honest. When the survey responses are submitted, they are grouped together with everyone else's and cannot be identified. This means that we are unable to link what your answer on the survey back to you as an individual. That should help you to feel comfortable in answering how you really see things at this workplace.

When can I complete the survey?

You will be given time during your working day to complete this survey because we feel it is important for everyone to get involved. A link to the online survey will shortly be distributed.

Who can I talk to with questions about this project?

Please get in touch with <INSERT NAME & DETAILS> if you have any questions about this project.