MULTI-LEVEL SAFETY CLIMATES: AN INVESTIGATION INTO THE HEALTH AND SAFETY OF WORKGROUPS IN ROAD CONSTRUCTION

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ABSTRACT

In construction projects, occupational health and safety (OHS) competes with traditional bottom line issues, such as costs and time, and is sometimes overlooked in the interests of competing pressures. Even when formal policies stating organizational commitment to OHS and comprehensive OHS procedures have been developed, unsafe work practices continue to occur. Research indicates that safety climate mediates the relationship between management practices and OHS performance, suggesting that workers observe management behaviour, develop shared perceptions of the relative importance of OHS and behave accordingly. However, in complex and highly decentralised environments, this simplistic theory is complicated by the fact that work is undertaken in semi-autonomous teams who may have little opportunity to observe the activities of management. Construction operations are decentralised with work conducted on sites remote from the corporate office, in which OHS policies and procedures are made. This geographical dispersion is likely to increase the impact of group-level safety climate relative to that of the organisation. It is possible that a strong organization-wide OHS climate does not even develop in this context because workers’ interactions with co-workers and their immediate supervisors are more important determinants of their safety attitudes. A safety climate survey was undertaken in a large regional area of one state-based road authority, in Australia. Nineteen workgroups participated in the survey.

Keywords: Safety, Climate, Workgroups, Supervisor, Multi-level

1. INTRODUCTION

Construction is one of Australia’s highest risk industries (NOHSC, 2005). In 2002 – 2003 people working in the construction industry were more than twice as likely to be killed at work as the average worker in all Australian industries. Further, 2005 figures indicate that construction is Australia’s third most dangerous industry, surpassed only by transport and storage, and agriculture (Fraser, 2007). The incidence of compensated claims for the industry is almost three times the national average for all industries (NOHSC, 2005).
This paper describes the first stages of a research project investigating group and organizational level climates within construction organizations (two private sector contracting organizations and one public sector road administration agency). For the purposes of this paper, data from two organizations, one of which was used to conduct a pilot study, is analysed to determine whether group-level safety climate is a valid concept in Australian industry. This analysis is achieved by exploring whether workgroups within a single organization demonstrate their own unique safety climates (as distinct from the organizational safety climate) and to what extent there is variation between the workgroup climates existing within a single organization.

2. SAFETY CLIMATE
The Concept of Safety Climate

Organizational climate has been identified as a set of coherent perceptions and expectations employees have about their work environment. In particular, climate perceptions are formed based on a variety of cues present in the work environment concerning reward-outcome contingencies, which are widely believed to shape workers’ behaviour (Dedobbeleer and Beland, 1991). Safety climate is a subset of organizational climate and has been measured in various industrial sectors, including construction (Dedobbeleer and Beland, 1991, Gillen et al, 2002), manufacturing (Brown and Holmes, 1986, Zohar 1980; Griffin and Neal 2000), road administration (Niskanen, 1994), wood processing (Varonen and Mattila, 2000) and airport ground handling (Diaz and Cabrera, 1997). For a review of safety climate literature, see Flin et al. (2000).

Much of the research has demonstrated a link between safety climate and safety outcomes (Zohar 1980; Diaz and Cabrera 1997; Varonen and Mattila 2000). These studies suggest that safety climate can predict incident occurrence, and also be used to discriminate between organizations with good or bad safety performance. Safety climate has also been found to mediate the transfer of knowledge learned in safety training into behaviour in the workplace (Smith-Crowe et al. 2003).

Multi-level safety climates

Most safety climate studies have focused on workers’ perceptions of organizational level issues, for example the status of specialist safety staff, resources allocated to safety, top management commitment and the quantity and usefulness of safety training. However, modern organizations are large and complex and thus the notion of a single uniform safety climate seems overly simplistic (Lingard, Blismas & Wakefield, 2005).

Zohar (2000) proposed two levels of safety climate; (i) that arising from the formal organization-wide policies and procedures established by top management; and (ii) that arising from the safety practices associated with the implementation of company policies and procedures within workgroups. Zohar tested this proposition in a manufacturing context and confirmed that workgroup members develop a shared set of perceptions of
supervisory safety practices, and discriminate between perceptions of the organization’s safety climate and the workgroup safety climate. Thus, workgroups within the same organization can have significantly different group safety climates, providing a good theoretical explanation for why some organizational sub-units consistently perform better in terms of safety than others (despite having very similar risk exposures).

Zohar’s results support a multi-level safety climate model, in which workers are influenced by their perceptions of expected behaviours at both an organizational and workgroup level. Zohar (2000) also reports that workgroup safety climate scores predict the safety performance of workgroups in the months following the climate assessment, i.e. those workgroups with more positive safety climates experience fewer incidents. In particular, Zohar suggests that group-level safety climate relate to patterns of supervisory safety practices, or ways in which organization level policies are implemented within each workgroup or sub-unit. This finding has significant implications for safety management because it suggests that the role played by supervisors in defining the workgroup safety climate is likely to be just as important as, if not more so, than the actions of top management in defining safety policy or of safety professionals in developing safety procedures.

Construction work is highly decentralized with productive work undertaken at sites remote from the corporate office. This geographical dispersion is likely to increase the behavioural influence of group climates relative to organizational climates (Patterson et al. 1996). Construction work is typically performed by semi-autonomous, often contracted, work crews, engaged on a temporary basis to complete a package of work. This situation presents a management challenge with regard to creating a shared understanding of the importance of safety within organizations (Lingard & Rowlinson, 1994). Construction work is also largely non-routine, necessitating the exercise of supervisory discretion in the interpretation of formal safety policies/procedures. In this context, the role of supervisors in shaping subordinates’ safety behaviour is likely to be considerably greater than in work contexts with routine production processes.

Thus, it is useful, in the construction context, to test whether group-level safety climates develop within construction organizations and, if so, what impact group-level climates have on safety performance.

3. RESEARCH METHODS
Participants

Data collected from two organizations is reported in this paper. First, a pilot study was undertaken at a national logistics company to determine the reliability and validity of a questionnaire survey for measuring group and organizational safety climates. Four hundred and thirty-eight completed questionnaires were returned and analysed.

Second, data were collected from the employees within a regional construction and maintenance works district of a large, state-based road administration authority. Four
work centres' make up the works district. A standard work centre consists of a number of work crews. Each work crew has a Team Leader, reporting to a Works Supervisor. It is not unusual for a Works Supervisor to oversee multiple work crews. An example of a typical work centre is shown in Figure 1.

Due to the geographical area covered by the works district, work is highly decentralized with construction and maintenance work undertaken at sites remote from the work centres’, or satellite corporate offices, of the road administration organization.

Figure 1: Typical Work Centre Organisational Chart

Questionnaires were administered during work hours. A member of the research team visited worksites, distributing and collecting the surveys in person. Prospective respondents were advised that completion of the questionnaire was voluntary and confidentiality and anonymity were assured. Workers not available or on site during the survey administration were invited to completed the questionnaire at a later date. Completed surveys were put in self-sealed envelopes and returned directly to the research team, via the site Safety Coordinator.

Data collection

A questionnaire was developed to measure group and organizational safety climate perceptions of Australian construction industry workers. Whilst previous research has identified commonly measured safety dimensions, such as risk, competence, etc (Flin et al, 2000), an examination of previously established safety climate instruments revealed variability in dimensions measured and the actual items used to measure each dimension. The Australian questionnaire comprised of 85 items (questions) drawn from a number of previously used surveys.
The questionnaire consisted of three parts. Part 1 of the questionnaire was made up of 39 items designed to measure the organizational safety climate and consisted of statements such as “The organization really cares about the health and safety of people who work here”, “Management provides enough safety education programs” and “Management officially encourage open communication but in reality most people know not to 'upset the apple cart' or 'rock the boat’” (reverse scored). Completion of Part 1 was requested of both workers and their supervisors.

Parts 2 and 3 of the questionnaire (46 items) were designed to measure perceptions of the safety attitudes and behaviour of respondents’ supervisors and co-workers. These parts of the questionnaire were only administered to non-supervisory workers. The combination of the two parts permitted an analysis of the existence of group safety climates with each organization. Part 2 (About Your Supervisor) utilised a scale previously developed and validated by Zohar (2000), measuring supervisory attitudes and behaviours towards safety. Example items are “Whenever pressure builds up, my supervisor wants us to work faster, rather than by the safe work procedures” (reverse scored), and “My immediate supervisor often talks to me about health and safety.” Part 3 focused on safety expectations and behaviour of co-workers (About Your Team). A scale developed by Burt, Sepie, & McFadden (2006), to measure considerate and responsible employee (CARE) behaviour was included in Part 3. The CARE scale measures the extent to which workers perceive that their co-workers actively look out for the safety of other workers in their work group. Example items are “Workers should avoid creating hazards for co-workers,” and “Workers should assist each other with tasks to ensure safety.”

All items contained within the survey were measured on a five point scale ranging from 5 (strongly agree) to 1 (strongly disagree).

Data analysis

The data collected was analysed using various statistical procedures. As organizational and group-level safety climates are multi-dimensional the structure of the data was first explored using a principal components factor analysis followed by a varimax rotation. Items were deemed to load on a given factor where their loading was 0.50 or greater (Hair et al, 1995). To determine if all the items falling into a single factor measured the same underlying construct, Cronbach’s alpha was performed. Factors with an alpha >0.70 were considered internally consistent. One way analysis of variance (ANOVA) was used to test for homogeneity in the safety climate perceptions of workers in different workgroups within the organization. If workgroup safety climate is a valid concept, it would be expected that perceptions of the organizational climate would be consistent between workers within single workgroups but that perceptions of group level climate factors would differ significantly between workgroups. Finally, to determine the level of agreement between members of a single workgroup enabling the measurement of the cohesiveness of team safety attitudes, a procedure developed by James et al (1984). If \( f_{rg(j)} \geq 0.70 \), then group consensus was deemed to exist about a particular aspect of workplace safety.
4. RESULTS

The Sample Group

To ensure that there was a sufficient number of respondents per workgroup to provide a reliable ‘view’ of the workgroups’ safety climate, teams with less than 3 members were excluded from the workgroup safety climate analysis.

The pilot study provided a total of 423 completed surveys, breaking down into 396 surveys from non-supervisory employees and 27 surveys for supervisors. Missing data did not present any issues with aggregate amounts per question being <3%. All worker surveys were used in the factor analysis. Twenty-seven worker surveys failed to record their workgroup. These surveys were eliminated from any further analysis. The case-to-variable ratio of 5:1, met the minimum requirement for principal components analysis suggested by Gorsuch (1983).

There were 101 completed surveys received from the road administration agency. Of these, 30 respondents were supervisors, while the remaining 71 were workers, representative of 22 separate crews. The mean workgroup size was 4, with a standard deviation of 1.32. Seven workgroups were eliminated from the analysis because they had fewer than three members, leaving a total of 15 workgroups. Table 1 shows the number of members within a group. A review was conducted of missing data, indicating that there was less than 3% missing. Any missing values identified were replaced with the calculated mean. A case-to-variable ratio of less than 1:1 was achieved, necessitating the data to be pooled with the pilot study data for meaningful principal components factor analysis.

<table>
<thead>
<tr>
<th>Crew Numbers</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Workgroup 1</td>
<td>4</td>
</tr>
<tr>
<td>Workgroup 2</td>
<td>2</td>
</tr>
<tr>
<td>Workgroup 3</td>
<td>4</td>
</tr>
<tr>
<td>Workgroup 4</td>
<td>4</td>
</tr>
<tr>
<td>Workgroup 5</td>
<td>4</td>
</tr>
<tr>
<td>Workgroup 6</td>
<td>7</td>
</tr>
<tr>
<td>Workgroup 7</td>
<td>1</td>
</tr>
<tr>
<td>Workgroup 8</td>
<td>4</td>
</tr>
<tr>
<td>Workgroup 9</td>
<td>4</td>
</tr>
<tr>
<td>Workgroup 10</td>
<td>4</td>
</tr>
<tr>
<td>Workgroup 11</td>
<td>5</td>
</tr>
<tr>
<td>Workgroup 12</td>
<td>3</td>
</tr>
<tr>
<td>Workgroup 13</td>
<td>4</td>
</tr>
<tr>
<td>Workgroup 14</td>
<td>4</td>
</tr>
<tr>
<td>Workgroup 15</td>
<td>4</td>
</tr>
<tr>
<td>Workgroup 16</td>
<td>6</td>
</tr>
<tr>
<td>Workgroup 17</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 1: The road construction agency’s crew numbers
Factor Analysis

Following a principal components factor analysis (with Varimax rotation), any items that either double-loaded (indicating conceptual overlap) or that failed to load with other items (i.e. splintered) were removed from the dataset.

In the pilot study (N=423) a forced two factor model of organisational safety climate explained 47% of the variance. Based on the common theme of the questions the 2 factors were named Management Commitment and Priority of Safety. Twenty statements loaded on the Management Commitment factor and reflected perceptions about the level of proactive management involvement, managers’ safety related communication and enforcement of safety programmes. A total of nine statements made up Priority of Safety and referred to the degree to which employees perceived pressure to complete work and the prioritization of safety against other outcomes. The item loadings for the questions contained in Part 2 of the questionnaire (N=396) for the logistics organization confirmed the Zohar’s two-dimensional model of group climate. The two factors, Supervisor Action and Supervisor Expectation, explained 54.6% of the variance. Supervisor Action, relates to supervisory reactions to subordinates’ safety conduct (i.e. positive or negative feedback) and the manner in which they follow through with their feedback by either emphasizing, or diminishing the importance of safety. Supervisory Expectation refers to workers’ perceptions of their supervisors’ safety-related expectations. Part three of the questionnaire required a forced two factor model, explaining 36% variance. Sixteen questions from Burt et al.’s (2006) CARE scale loaded on the first factor, which was renamed Co-workers’ Ideal Safety. This factor contains items relating to co-workers’ behaviours which, if performed, would increase workgroup safety. Ten items loaded on the second factor which was named Co-workers’ Actual Safety. Items loading on this factor described employees’ perceptions of the actual (as opposed to ideal) safety behaviours and attitudes of co-workers within their workgroups. Cronbach’s Alphas for all six factors, resulted in reliability scores > 0.8 (See Table 3), and these factors were deemed to have acceptable internal consistency reliability.

Data collected from the road administration agency was subjected to the same factor analysis process as that of the logistics organization. However, the emerging factor structure was not easily interpretable. The splintering of factors was possibly due to the lower sample size and subject-to-item ratio in the road administration organization (See Lingard & Rowlinson, 2006). In order to analyse the data, the factor structure derived from the pilot study with the logistics company was assumed. Cronbach’s alpha tests were conducted to determine the internal reliability of factors assuming the factor structure derived from the logistics company. The internal reliability scores, as seen in Table 3 resulted in $\alpha=0.8$ for five of the six factors. An insufficient score of $\alpha<0.8$ for Supervisor Action led to further examination of the road administration organisation’s data. A review of a parallel analysis and the scree plot for the items contained in Part 2 of the questionnaire showed a single component (as opposed to a two-dimensional supervisory model. Thus, Supervisor Expectation and Supervisor Action were combined yielding a single factor reliability score, of $\alpha=0.853$. Therefore final factor structure for the road administration agency resulted in five principal components, Management
Commitment, Priority of Safety, Co-workers’ Actual Safety, Co-workers’ Ideal Safety and Supervisory Actions, the result of the amalgamation of Supervisor Expectation and Action.

<table>
<thead>
<tr>
<th>Factor 1: Management Commitment</th>
<th>Logistics Organisation α</th>
<th>Road Administration Organisation α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 2: Priority of Safety</td>
<td>0.941</td>
<td>0.897</td>
</tr>
<tr>
<td>Factor 3: Supervisor Expectation</td>
<td>0.941</td>
<td>0.897</td>
</tr>
<tr>
<td>Factor 4: Supervisor Action</td>
<td>0.830</td>
<td>0.669*</td>
</tr>
<tr>
<td>Factor 5: Co-workers’ Actual Safety</td>
<td>0.851</td>
<td>0.819</td>
</tr>
<tr>
<td>Factor 6: Co-workers’ Ideal Safety</td>
<td>0.918</td>
<td>0.870</td>
</tr>
<tr>
<td>New Single Factor: Supervisory Action (Road administration Organisation only)</td>
<td></td>
<td>0.853</td>
</tr>
</tbody>
</table>

* Cronbach’s Alpha score less than the accepted score of > 0.80

Table 3: Cronbach’s Alpha scores for factors

Within group consensus

To determine the level of agreement between members of the same workgroup, indicating team cohesiveness in their perceptions of safety, the r_{w(g)} statistic was calculated using a formula developed by James et al (1984). Within-group agreement is deemed sufficient if r_{w(g)} ≥ 70. Assuming a uniform null distribution, the results of the road administration agency’s data indicate a high level of within-group homogeneity, meaning that members within the same workgroup agreed and had a consistent view about safety issues being raised. The Co-workers’ Actual Safety and Co-workers’ Ideal Safety factors yielded a median score of 0.95 and 0.98 respectively. Supervisory Actions also revealed a high within group homogeneity, with a median score of 0.97.

Between group differences

In order to compare the attitudes and perceptions of members of different workgroups, a one-way analysis of variance (ANOVA) was conducted. The mean score for each factor was identified, i.e. Co-workers’ Actual Safety, Co-workers’ Ideal Safety, Supervisory Actions, Management Commitment and Priority of Safety. If the significance value in the ANOVA table is ≤ 0.05 a significant difference between groups is deemed to exist.

There was a statistically significant difference between workgroups at the p<0.05 level for Co-workers’ Actual Safety (F(14, 49) = 3.19, p = 0.001). The effect size, calculated using eta squared was 0.47. The results for Co-workers’ Ideal Safety, (F(14, 49) = 1.12, p = 0.369) indicated no significant differences between groups. Workgroups showed
statistically significant variance in perceptions of *Supervisory Actions* (F(14, 49) = 2.105, p = 0.028), with an eta squared score of 0.38. These results indicate that those surveyed have a consistent view about co-workers’ attitudes and behaviours, that, if performed would increase safety. However, members of different workgroups’ opinions differed in their assessments of co-workers’ actual safety behaviour and supervisory actions.

Organisation-level safety perceptions were assessed at a workgroup level and also the perceptions of supervisors and non-supervisory workers were compared. A one way analysis of variance indicated that, at a workgroup level, there is no statistical significance in the way workgroups consider *Management Commitment*, (F(14, 50) = 1.78, p =0.07). However, members of different workgroups viewed the priority the organisation placed on safety (*Priority of Safety*) significantly differently (F(14,50) = 2.44, p = 0.01), with an eta square score of 0.41.

An independent-samples t-test was conducted to compare the *Management Commitment* and *Priority of Safety* mean scores for non-supervisory workers and supervisors. There was no significant difference between supervisors and non-supervisory workers perceptions of either of the organizational safety climate factors.

**Bi-variate correlation analysis**

In order to determine the nature and strength of linkages between variables measured, bi-variate correlation analysis were conducted. The relationship between *Co-workers’ Actual Safety*, *Co-worker’s Ideal Safety* and *Supervisory Actions* was explored using Pearson product-moment correlation coefficients. The results of this analysis are presented in Table 4.

<table>
<thead>
<tr>
<th></th>
<th>Number in Crew</th>
<th>MgtCommit</th>
<th>Priority of Safety</th>
<th>Supervisory Action</th>
<th>Co-workers’ Actual Safety</th>
<th>Co-workers’ Ideal Safety</th>
</tr>
</thead>
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<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Sig. (2-tailed)</td>
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<td>.186</td>
<td></td>
<td>1.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
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<td></td>
<td>65</td>
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<tr>
<td>MgtCommit</td>
<td>.887</td>
<td>.426**</td>
<td></td>
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<tr>
<td>Sig. (2-tailed)</td>
<td>1.000</td>
<td>.000</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>N</td>
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<td>99</td>
<td></td>
<td>99</td>
<td>99</td>
<td>99</td>
</tr>
<tr>
<td>Priority of Safety</td>
<td>-.097</td>
<td>-.497**</td>
<td>-.426**</td>
<td>1.000</td>
<td>.471**</td>
<td>.023</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
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<td>.000</td>
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<td>69</td>
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</tr>
<tr>
<td>Supervisory Action</td>
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<td>.409*</td>
<td>.409*</td>
<td>.471**</td>
<td>1</td>
<td>.000</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
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<td>.000</td>
<td>.000</td>
<td>.000</td>
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<td>.000</td>
</tr>
<tr>
<td>N</td>
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</tr>
<tr>
<td>Co-workers’ Actual Safety</td>
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<td>-.310**</td>
<td>-.273</td>
<td>.321**</td>
<td>-.023</td>
<td>1</td>
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<td>Sig. (2-tailed)</td>
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<td>.010</td>
<td>.023</td>
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<td>.854</td>
<td>.000</td>
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</tr>
</tbody>
</table>

*Correlation is significant at the 0.05 level (2-tailed).*

**Correlation is significant at the 0.01 level (2-tailed).**

Table 4: Correlation Matrix
Supervisory Actions showed a strong, positive relationship with all of the other variables, with Management Commitment (r=0.497, p=0.00), Priority of Safety (r=0.426, p=0.00), Co-workers’ Ideal Safety (r=0.321, p=0.007) and Co-workers’ Actual Safety (r=0.471, p=0.00).

Priority of Safety also showed a strong, positive correlations with Management Commitment (r=0.684, p=0.00), Supervisory Action (r=0.426, p=0.00) and Co-workers’ Actual Safety (r=0.409, p=0.00). There was a positive relationship between Priority of Safety and Co-workers’ Ideal Safety (r=0.273, p=0.023) though the relationship was not as strong as the other variables.

Co-workers’ Actual Safety was not significantly correlated with Co-workers’ Ideal Safety

A significant negative relationship was found to exist between Co-workers’ Actual Safety and the number of members within a workgroup (r=-.252, p=.043)

5. DISCUSSION

The results indicate a high level of within-group consensus in relations to Supervisory actions, Co-workers’ Actual and Co-workers’ Ideal safety behaviour, meaning that members within the same workgroup agreed and had similar views about group-level safety issues. This outcome provides some evidence that group-level safety climates exist within the road administration agency. That is, group members develop shared perceptions of supervisors and co-workers’ safety-related behaviour.

The analyses of variance also confirmed that mean scores for group and organizational level safety climate variables differed significantly between workgroups within the agency, providing further evidence for the existence of distinct workgroup safety climates within the organization. At a group-climate level, significant differences were found in the way members of different workgroups perceived supervisory behaviours and actions (Supervisory Actions). This indicates that some supervisors are perceived to place greater emphasis on safety and behave in a more consistent manner when dealing with safety issues than other supervisors within the road administration agency.

There was also significant between-group variance in the way workers perceived the safety behaviours and attitudes of their co-workers within their workgroups (Co-workers’ Actual Safety). The data indicated that some workgroups had greater confidence in their co-workers, demonstrating co-worker concern for safety, whilst other workgroups failed to have the same degree of trust and support between group members. Co-workers’ Ideal Safety related to workers’ attitudes regarding behaviours which, if performed, would increase co-workers’ safety. All workgroups had a consistent view about Co-workers’ Ideal Safety, indicating a shared view within and between workgroups about how co-workers should behave in relation to safety within a work team.
Perceptions of organisation-level safety climate factors were also found to differ between members of different workgroups. In particular between group differences in views about how safety is prioritised by the road administration agency were significant. This suggests the absence of shared understanding of safety, a key component of organizational safety culture, within the organization (Prussia 2003). No differences were found between the perceptions of supervisory compared to non-supervisory personnel, again indicating that group-level variables might be more important determinants of safety perceptions than organizational level variables.

Strong positive relationships were found to exist between Management Commitment, Priority of Safety, Supervisory Actions and Co-workers Actual Safety. The relationship between Co-workers’ Ideal Safety and Priority of Safety was not as strong as it was with Management Commitment or Supervisory Action, and failed to have any significant relationship with Co-workers Actual Safety. This finding, along with the strong positive relationships found between Supervisory Actions, Priority of Safety and Co-workers’ Actual Safety, indicates a hierarchical link between workers’ perceptions of the importance placed upon safety within the organization, the safety actions of supervisors and safety supportive behaviour between co-workers within workgroups. This supports the work of Simard & Marchand, which indicated that macro-level safety management activities within organizations are indirectly related to workers’ safety behaviour through their impact upon supervisory actions (Simard & Marchand, 1994; 1995; 1997).

A negative relationship was also found between the number of members within a workgroup and the group members’ perception of Co-workers’ Actual Safety behaviour. Thus, as a workgroup increases in size, group members perceive their co-workers to be less supportive of the safety of other members within the group.

Members of different workgroups shared a consistent view about the ideal safety behaviours of co-workers, i.e. what co-workers should do to support the safety of others in their workgroup. The perception of ideal co-worker behaviour in relation to safety is independent of perceptions about the actual safety behaviours demonstrated by co-workers, priorities of the organization and the actions of supervisors. This indicates a consistent opinion of how co-workers should behave in relation to the safety of their workmates.

The results support the notion that group-level safety climates exist within the road construction agency. These findings are similar to Zohar (2000) and Findley et al (2006), who found differences in the safety climates among worker groups. Within the Australian road construction agency, members of different workgroups develop shared within-group perceptions of safety. At the same time, between group differences in perceptions of safety were significant.

The strength and quality (i.e. supportive or unsupportive of safety) of group level climates is reported to influence workgroups’ safety performance through shaping members’ safety behaviour (Zohar 2002a). The existence of variation between workgroup safety climate (driven by supervisor and co-workers’ actual behaviour) can
therefore support or undermine organizational safety management efforts. Strategies to develop supervisors and co-workers’ safety leadership behaviour, to foster strong and supportive group safety climates and promote consistency in the safety climates between workgroups within an organization can contribute to better organizational performance in safety and help to bridge the gap between policy statements and practice (Zohar 2002b, Zohar & Luria 2004).

6. CONCLUSIONS

The results of the research confirm the existence of group-level safety climate within the Australian construction industry. This research offers support that workgroup climates are perceived as distinct from those of the organisation. First, the results have shown that workgroup members develop uniform perceptions concerning safety within their own teams; second, these perceptions vary between workgroups, resulting in significantly different safety climate perceptions between members of different workgroups (i.e. between group variance); and third, the safety climate perceptions displayed at a workgroup level differ from perceptions of the organisational safety climate. The existence of distinct workgroup safety climates provides one theoretical explanation for why some organizational workgroups consistently perform better in OHS than others (despite having very similar risk exposures), and suggests that interventions designed to develop strong and positive group-level safety climates could benefit the Australian construction industry.

7. LIMITATIONS

The research had some limitations. First, the pilot study was conducted within a non-construction (logistics) organization. Owing to the fact that the road administration agency employed a smaller workforce than the logistics company, results of the principal components factor analysis for the construction organization was unstable. The safety climate factor structure produced from the pilot study (logistics organization) was therefore assumed to be valid for the road administration agency. Cronbach’s alphas suggest that the factors generated had acceptable internal consistency reliability; however, there is a need to confirm this factor structure when data are collected from the two private sector construction contracting organizations.

A second limitation relates to a lack of objective safety performance data for the workgroups. This data could not be easily retrieved for fine-grained workgroup level analysis. Thus it was not possible to examine whether group level safety climate variables (such as Supervisory Action and Co-workers' Actual Safety) is significantly related to safety outcomes, such as incidents and injuries.
8. REFERENCES
Bartlett, M., S., (1954), A note on the multiplying factors for various chi square approximations, *Journal of the Royal Statistical Society*, 16 (series B), 296-298


