

QUT Digital Repository:  
<http://eprints.qut.edu.au/>



Mayze, Brett R. and Bradley, Lisa M. (2008) *Safety culture : a multilevel assessment tool for the construction industry*. In: Third International Conference of the Cooperative Research Centre (CRC) for Construction Innovation – Clients Driving Innovation: Benefiting from Innovation, 12-14 March 2008, Gold Coast, Queensland.

© Copyright 2008 [please consult author]

## **CLIENTS DRIVING INNOVATION: BENEFITING FROM INNOVATION**

### **Full Paper**

## **SAFETY CULTURE: A MULTILEVEL ASSESSMENT TOOL FOR THE CONSTRUCTION INDUSTRY**

### **Brett Mayze**

CRC Construction Innovation, Queensland University of Technology, Australia  
[b.mayze@student.qut.edu.au](mailto:b.mayze@student.qut.edu.au)

### **Lisa Bradley**

Queensland University of Technology, Australia  
[lm.bradley@qut.edu.au](mailto:lm.bradley@qut.edu.au)

## **ABSTRACT**

Traditional approaches to safety improvement often target specific audiences or single organisational levels, yet studies have long recognised the benefits of addressing interventions at multiple levels simultaneously (e.g. Hofmann & Stetzer, 1996). However, there is little empirical research that has actually investigated organisational (or in the current study worksite or project) level effects (Hofmann & Tetric, 2003) and even fewer that have included these in considering multiple levels for improving individual's health and safety (Zohar & Luria, 2005). Furthermore, "safety culture" a concept increasingly being held liable for many workplace incidents and injuries, is derived by interactions across multiple levels of the organisational social system (Kozlowski & Klein, 2000). Accordingly, safety culture remains ill defined, and associated empirical safety research exploring antecedents of safety performance remains an underdeveloped area in the management literature (e.g. Cooper, 2000). Extending a model proposed by Neal and Griffin (2004), and using a sample of one of Australia's largest construction contracting organisations, the current research provides some insight into aspects of safety culture and its effects on individual's engagement in unsafe work practices. Development of the research model, its assessment and the findings from this study hold important implications for the construction industry at a time when lag indicators for reporting OH&S effectiveness are increasingly viewed as restrictive in providing feedback on proactive risk management strategies. Therefore it is the purpose of this paper to investigate the construct of safety culture in the construction industry, by identifying predictors of individual's safety behaviour across multiple levels and considering these in light of actual safety performance. This paper addresses contemporary research and assessment to enable the identification of culturally specific lead indicators for construction organisations to better manage key workplace characteristics demonstrated to be influential on individual's engagement with safe work practices.

**Keywords: Safety Culture, OH&S, Construction Industry, Measurement**

## **SAFETY CULTURE: A MULTILEVEL ASSESSMENT TOOL FOR THE CONSTRUCTION INDUSTRY**

There are inherent risks in the building and construction industry, with contractors, subcontractors and their personnel all needing to actively manage workplace hazards to maximise worker safety and prevent injuries and deaths. The incident rate for fatalities in the Australian construction industry is almost twice the rate of other Australian industries (ASACC, 2007). In addition to fatalities, the incidence of injury in Australian building and construction, while declining, remains about 50% higher than the all industry average (Cole, 2003) with the industry recording the 4<sup>th</sup> highest level of reported non fatal injuries behind mining, manufacturing and transport. However, despite the size of the construction industry, approximately 9% of all employed persons in Australia (ASACC, 2007), and the significance of these safety concerns, organisational behaviour (OB) literature has typically not focused on safety for this industry within Australia or internationally. Occupational health and safety remains one of the least studied phenomena in organisational behaviour, with estimates suggesting it represents less than 1% of the total amount of published research (Campbell, Daft, & Hulin, 1982; Zacharatos, Barling, & Iverson, 2005).

### **A MODEL OF SAFETY PERFORMANCE**

Current research into the measurement of workplace safety often doesn't incorporate the complex relationships that impact on individuals in the workplace. The present paper outlines a model (see Figure 1) that incorporates the individual, the influence of supervisors, and the workplace on a range of important safety outcomes. The proposed model draws on a framework provided by Neal and Griffin (2004) which examined the work environment and individual antecedents of safety outcomes. The model is expanded to incorporate the worksite level and additional antecedents important to safety performance. A brief overview of the components of the model and reason for their inclusion precedes the derivation of the measures used to assess the model. The aim of this study was to test the model's newly developed measures. Initial evidence from this study indicates the measures capture the model and that the model is showing interesting relationships between the variables.

### **ANTECEDENTS OF SAFETY: WORKSITE**

#### **Safety Culture**

The term safety culture is generally used to explain how safety is placed as a priority, which is reflected in decisions and policies and filters down through these into every aspect of operational performance. However, Cooper (2000 p.119) notes that "*a literature search reveals that very few models of organisational safety culture exist,*" Likewise Watson, Scott, Bishop and Turnbeaugh (2005) further suggest that the concept of safety culture is lacking a reliable and valid approach to its theoretical and conceptual definition. While the few existing models of safety culture have often implied influence across multiple organisational levels, the majority have aggregated their findings to a single level of analysis or concentrated on within level measures. Many studies have recognised the potential group effects on individual's health and safety, however, there is little empirical research that has actually investigated cross level affects (Hofmann & Tetrick, 2003).

## ***Safety Culture: A Multilevel Assessment Tool For The Construction Industry***

Mearns and Flin (1999) suggest that safety cultures, like the determinants of safety values and norms, are relatively enduring. Furthermore given the centrality of values and norms to the concept of culture, the present model defines safety culture by safety values and safety norms. However, Ajzen (1991) reported that situational factors that intercede between safety values and safety behaviour are likely to influence the relationship. The most strongly held beliefs cannot be translated into behaviour without an environment or climate that enables the behaviour (Ajzen, 1991). As such safety climate is often considered a distinct yet subordinate of the broader concept of safety culture and presents a sensible starting point for the factors that may potentially contribute or directly relate to a safety focused culture (Guldenmund, 2000; Schneider, 1990; Zohar, 2003).

### **Safety Climate**

Safety climate represents a combination of what organisational members perceive is happening within the organisation and how they feel about that (Schein, 1992). Safety climate plays an important role in the realisation of desired safety behaviours and performance (Griffin & Neal, 2000; Zohar, 1980). However, climate is an emergent property, characterising groups of individuals. Operationally, it is assessed by aggregating individual perceptions to the required unit of analysis (organisation, work site, team/crew), and using the mean to represent the climate for that entity (Reichers & Schneider, 1990). However, the aggregation of individual perceptions averages out individual and subgroup variation, and has often been used with inconsistent frames of reference across studies. This aggregation of psychological constructs has been posed by Clarke (2006), as a possible explanation of the failure to find a strong influence of safety climate on accident involvement. The various studies into safety climate and culture have seemingly failed to consistently distinguish between measures of safety perceptions (commonly safety climate studies) and measures of safety attitudes (commonly safety culture studies) (Clarke, 2006). Furthermore, Clarke (2006) suggests that there are additional disregarded factors which will influence the effect of attitudes on behaviour, and suggests that including normative safety beliefs will add to the discriminate power of safety attitudes in explaining individual's safety behaviours at work.

### **Safety Performance**

As opposed to self report, accident and injury data have often been employed as a criterion measure (Griffin & Neal, 2000; Mearns, Whitaker, & Flin, 2003; Silva, Lima, & Baptista, 2004; Zohar, 2000) and Clarke (1998) suggests that a reduction in accident and incident rates provides the best measure of a positive safety culture. Yet, accident data as a measure of safety performance has often been criticised (e.g. McKenna & Glendon, 1995) as amongst other shortcomings it doesn't provide a means to evaluate risk exposure and is often insensitive as incidents are so rare (Glendon & Litherland, 2001). More recently, however proactive safety measures such as number of safety audits and inspections conducted, the frequency of communication events; and the percentage of workers receiving OHS training are receiving greater organisational utilisation (NOHSC, 2005). At a worksite level the incorporation of these proactive indices with traditional safety performance measures will be employed to help assess the model.

Accordingly, the current model includes measures of both subjective perceptions of worksite safety practices and worksite behavioural safety norms as well as objective measures of worksite level safety performance.

### **ANTECEDENT OF SAFETY: INDIVIDUAL**

While safety culture implies an organisation-wide influence on individual behaviour, individual behaviour has a reciprocal affect on organisational culture (Schein, 1992). To gain a complete picture of influences on safety outcomes, individual antecedents are also included in the model to provide greater understanding of the dynamics that govern the exchange between the individual employee and the workplace.

#### **Perceived Organisational Support**

Eisenberger, Huntington, Hutchison, and Sowa (1986) suggested that employees form a global belief concerning the extent to which the organisation values their contributions and cares about their well-being. They coined this perceived organisational support (POS). High levels of POS are thought to create obligations within individuals to repay the organisation. The interrelationship between perceived organisational support and safety is illustrated in how perceived safety violations can undermine trust in the employment relationship. There does not appear to be previous research that has explored the link between POS and safety performance.

#### **Personal Safety Values**

It is important to consider both individual values and group values in their influence on safety outcomes. Thygerson (1992) notes that accident prevention is highly correlated to one's sense of values. A person facing a novel situation, such as commencing work on a new job site, or undertaking new tasks associated with a job, will often experience higher unintentional injury rates (Thygerson, 1992). Similarly Crowe (1995) reported that individual safety values are a better predictor than the combination of gender, class standing, and demographic region in determining an individual's safety practices.

#### **Personality**

Factor analyses of the relationships between personality and risk taking suggest that personality profiles can be used to predict risk orientation (Nicholson, Soane, Fenton-O'Creevy, & Willman, 2005). Wagenaar (1992) reports occupational accidents are often characterised by a lack of conscious risk taking. Therefore it would follow that personality should predict both individual safety compliance and participation, however only a handful of studies have examined this relationship. A meta review by Clarke and Robertson (2005), which included a criterion measure of accident data and at least one personality measure from the Five Factor Model of Personality (FFM), concluded that regardless of context individuals low in agreeableness and low in conscientiousness are more liable to be accident-involved. Also that personality measures of conscientiousness, agreeableness and neuroticism were valid and generalisable predictors of accident involvement (Clarke & Robertson, 2005).

#### **Safety Orientation**

Campbell, McCloy, Oppler, & Sager (1993) propose that there are only three determinants of individual performance: knowledge, skill, and motivation. Safety performance, therefore, must be determined by knowledge and skills necessary for particular behaviours and by the motivation of individuals to perform the behaviours (Neal & Griffin, 2004). Personal-safety orientation, a latent variable determined by safety knowledge and safety motivation (Zacharatos et al., 2005), has been found to mediate the relationship between perceptions of safety and safety behaviour (Neal et al., 2000).

### **Safety Behaviour**

It has been suggested that behavioural data are superior to accident statistics as they focus on unsafe behaviour prior to incidents occurring (Reber, Wallin, & Duhon, 1989; Zohar & Luria, 2003). Individual safety behaviours relevant to the workplace can be conceptualised in the same way as other work behaviours that constitute work performance. In this way, safety behaviour in the workplace can be divided in two major components: task behaviour and contextual behaviour (Borman & Motowidlo, 1993; Griffin & Neal, 2000).

Task or safety compliance behaviour, describes the core safety activities that need to be carried out by individuals to maintain workplace safety (Neal & Griffin, 2002; Simard & Marchand, 1994; Williams, Turner, & Parker, 2000). These behaviours may include, for example, wearing personal protective equipment and ensuring and adhering to current and accurate work statement methods.

In contrast, contextual or safety initiative, refers to behaviours in which workers are not simply working within safety standards, but go beyond compliance and act proactively to improve safety in their environment. (Simard & Marchand, 1994; Williams et al., 2000) Neal & Griffin (2002) define safety initiative behaviours as participating in voluntary safety activities or innovation for safety improvement.

Supplementing the previous worksite level measures the individual antecedents discussed (perceived organisational support, personal safety values, personality, individual safety orientation and safety behaviour) have also been identified as important in the organisational safety literature and are integral to the model.

## **METHOD**

The survey was developed to assess individual's own attitudes, values, and behaviours related to workplace safety and their perceptions about safety related worksite group norms and practices. To investigate the relationships between these variables the survey instrument needed to clearly delineate between belief based constructs. Such a survey was not directly available from the literature, and the development of appropriately distinct measures was the primary aim of this study.

### **Participants**

Surveys were distributed on three construction sites across Australia. From the 188 surveys distributed, the overall response rate for the study was 55%. Most of the respondents were male (92 males, 5 females), and were 17 to 64 years old (mean age 38.5 years). The education levels varied with 27% of respondents having completed up to year 10, 15% completing up to year 12, 30% had completed a trade and 16% had completed a certificate, the remaining respondents had completed a variety of other qualifications. Average role tenure was 12.3 years, organisation tenure was 4 years, and construction industry tenure was 13.6 years. The respondents were predominantly subcontractors (60%), while 40% were direct employees of the organisation.

### **Measures**

The worker survey assessed the following components;

## ***Safety Culture: A Multilevel Assessment Tool For The Construction Industry***

Behavioural norms of safety compliance and behavioural norms of safety initiative - measured used three items each adapted and extended from the safety norms of co-workers scale by Watson et al. (2005) ( $\alpha = .76$ ).

Worksite safety perceptions – including communication and planning (5 items), safety training (4 items), systems and procedures (3 items) from Neal, Griffin and Hart (2000) with alpha coefficients of .93, and a fourth dimension of work pressures from Seo (2005) with an alpha coefficient of .88.

Perceived organisational support - assessed using the eight -item measure of the Survey of Perceived Organisational Support that has a Cronbach's alpha of .90 (Eisenberger, Cummings, Armeli, & Lynch, 1997).

Personal safety values - measured seven items based on work by Crowe (1995) and Maierhofer & Griffin (2002).

Personal attitudes towards risk and behavioural control - attitudes towards risk were assessed using four items adapted from Dedobbeleer and Beland (1991) and Watson, Scott, Bishop and Turnbeaugh (2005). While attitudes towards behavioural control were assessed using four items adapted from Dedobbeleer and Beland (1991) and Williamson, Feyer, Cairns & Biancotti (1997). These were developed using subject matter experts for wording and practical relevance in accordance with the theory of planned behaviour using the framework provided by Ajzen (2002).

Personality - specifically agreeableness, conscientiousness, and neuroticism were assessed using Saucier's (1994) Mini-Markers. Each of the personality variables were assessed using eight items. The Mini-Marker has been used widely in a range of settings and has demonstrated strong correlations with the NEO-Five-Factor Inventory (Mooradian & Nezlek, 1996)

Safety orientation – was assessed by the two measures of safety knowledge and safety motivation. Safety knowledge assessed the extent to which employees felt knowledgeable about safety and was assessed with four items from Neal et al. (2000). Safety motivation assesses effort and interest in personal safety at work and was measured using four items (Neal et al., 2000).

Safety behaviour - was assessed using measures of safety compliance and safety initiative as described by Neal et al. (2000). Seven items from both Neal et al. (2000) and Williams et al. (2000) were combined to measure safety compliance with some items adapted for the construction setting. Safety initiative was measured with eight items from Turner and Parker (2004).

Safety performance - incident, injury and safety data were collated for the worksites being surveyed and presented as six different indices, as described in Table 1.

### **Procedure**

Batches of surveys were sent to safety managers on each worksite. These managers handed out the surveys personally during team meetings and canvassed site personnel to participate. Safety managers were available for survey related questions, though the questionnaires were self explanatory. Upon completion individual surveys were sealed in a reply paid return envelope that was provided and either returned them to the Safety Manager or placed directly into the mail.

## **RESULTS**

### **Survey Participation**

The overall response rate for the study was 55%, however the response rates varied across worksites with 50% response from worksite 1 (N=20), 49% from worksite 2: (N=52), and 78% from worksite 3 (N=32).

### **Scales Scores**

Inspection of the means, standard deviation, skewness and kurtosis scores reveals some potential ceiling effects in some measures. These are expected values in the population and the impact of these are likely to be lower with a larger sample size (Tabachnick & Fidell, 1996 p.73)

The previously developed measures all had alpha coefficients that were similar to previous findings and all demonstrated acceptable internal consistency of the items. For the newly developed items all except one measure also produced good internal consistency (see Table 2). Attitudes towards risk control had an alpha coefficient of .59 indicating that the items weren't assessing the same construct. A correlation matrix for the measures is also displayed in Table 3 showing the inter-correlations between the variables. Inspection of the correlations reveals some of the measures are strongly correlated.

### **Factor Analysis**

An exploratory factor analysis was undertaken to establish if the attitude, behaviour, norm and value measures were distinguishable from each other in assessing differing aspects of safety. The factor analysis results are encouraging with a small sample (see Table 4).

The first factor had all seven safety value items loading on it, along with three cross loaded safety initiate behaviour items. Factors two and three captured the safety compliance behaviour and safety initiative behaviours measures respectively. Factor four encapsulated both the safety norm items for initiative and compliance. The two types of norms loaded onto the same factor and despite being strongly correlated ( $r=.649, p<.01$ ) in subsequent regression results they produce a pattern of results consistent with the predicted model. The items for attitudes towards worksite risk loaded on their own factor, factor five, while factor six captured the majority of the attitude to risk control items, though one item cross loaded on the attitude to worksite risk factor. Factor seven has an interesting array of items loading on it, with two of these providing unique loadings and the other three all cross loaded.

### **Mediated Regression**

A mediated regression was performed for each of the outcome measures (self-report safety compliance behaviour and self-reported safety initiative behaviour). Norms, attitudes, values, and personality were entered into the regression in the first step, followed by the mediators of safety knowledge and safety motivation on the second.

The results for the regression of the independent variables onto safety compliance behaviour mediated by safety knowledge and safety motivation appear in Table . The value of personal safety responsibility and the personality trait of conscientiousness were fully mediated by safety orientation (safety knowledge and safety motivation).

## ***Safety Culture: A Multilevel Assessment Tool For The Construction Industry***

Safety compliance norms were direct predictors of safety compliance behaviour. The model predicted 70% of the variance in safety compliance behaviours ( $F=15.95$ ,  $p<.05$ ,  $df =98$ ).

The second mediated regression examined the dependent variable of safety initiative behaviour (see

**Table 6**). Again the value of personal safety responsibility and the personality trait of conscientiousness were mediated by safety orientation (safety knowledge and safety motivation). Neuroticism (which was negatively associated with the mediators) was also fully mediated in its relationship with safety initiative behaviour. Safety training had a direct negative relationship with safety initiative behaviour, indicating greater safety training was associated in less frequent participation in safety initiative behaviour. Attitudes to risk control and safety initiative norms also had a direct, but positive link to safety initiative behaviour.

### **Worksite Safety Information**

Worksite safety data were also collected from safety records held in the organisation for six months prior to the survey completion (see Table ). When the three worksites are compared, the site with the lowest total reportable injury frequency rate, total near miss frequency rate, least work pressure and that reported fewer workplace hazards, also rated the most positively perceived safety systems and procedures, communication and planning, and the highest levels of support from the organisation, personal safety responsibility values, and safety motivation.

### **Worksite Comparisons**

The ANOVAs in Table 8 tested for significant differences between worksites for the measures tested in the study. Results indicate that perceived organisational support, work pressures, and safety initiative norms were significantly different between the three worksites. Table 9 provides the worksite means for these measures.

## **DISCUSSION**

The sample size for this study was not sufficient to conduct a full test of the research model. However the main aim of the study was to assess the reliability and test the newly developed items and those modified for the construction industry. This was achieved and the ability of the attitude, value and normative measures to predict the behavioural measures in this small sample provides a guide to the predictive validity of the measures.

Though the sample size was not sufficient to conduct a confirmatory factor analysis, the factor loadings from an exploratory factor analysis suggest that the items are distinguishable and present to the respondents in a manner consistent with their inclusion on their respective scales. A few exceptions can be noted with some cross loadings and appropriate adjustments to be made to augment some measures. The safety initiative behaviour measure had the highest number of cross loaded items, all of which loaded on the value measure. This suggests that these items may not sufficiently allow respondents to discriminate how important the initiative behaviour is versus how often it is performed. Also the cross loading of attitudes towards risk control leads to the conclusion that there may be two points of references being used in responding to the items, self and other. Additional items need to be developed that are more focused to improve these measures in future research.

Both the compliance and initiative norms loaded on the same factor, suggesting that these tap into the same measure (social norms in this case) indicating that these measures don't discriminate between compliance and initiative. This result maybe attributable to the small sample size, previously discussed as a concern in conducting this factor analysis, although it is curious. It could be that some of the items identified as initiative are considered compliant practices within the subject organisation. However, further analysis demonstrated that the measure of safety initiative norms significantly differed across the three sample worksites, and that regression analysis found that compliance norm predicted compliance behaviour (see Table 5) whereas initiative norm predicted initiative behaviour (see

**Table 6).**

Furthermore, closer inspection of the items that loaded on factor seven suggest that these measured behaviours or practices that are considered organisationally desirable or carry some expectation of observance rather than behaviours that are considered conforming or innovative.

The development of the measures displayed sound reliability (see Table 2), with high levels of internal consistency. The alpha coefficients ranged from 0.80 to 0.92. Exceptions to these results were for the measures of neuroticism (0.70), safety compliance norms (0.77) and attitudes towards risk control (0.59). Apart from neuroticism these other two measures require refinement. The measures also had good discriminant validity as shown in the factor analysis (see Table 4), and predictive validity (see Table 5 and

**Table 6).** New measures were also tested for face and content validity with safety managers. Based on these findings adjustments to the measures for future studies should include the addition of items to the existing scales for, safety initiative behaviour, attitudes to workplace risk, and the compliance and initiative norms. The findings suggest the proposed measures differentiate between belief based constructs, to allow independent assessment of respondent's values, attitudes, perceptions, and norms. Furthermore the measures assessed explained a significant portion of the variance in individual's safety behaviours and observation suggest on first impressions that they also proportionally trend with actual site safety performance.

### **Conclusion**

Enabling organisations in the construction industry to proactively intervene and prevent an accident rather than simply reacting to safety statistics after the event, represents a major advance in risk management practices. Results suggest that the refinement of the measures used to assess the research model in the current study will enable organisations to identify their own specific levers to most effectively drive their unique safety culture.



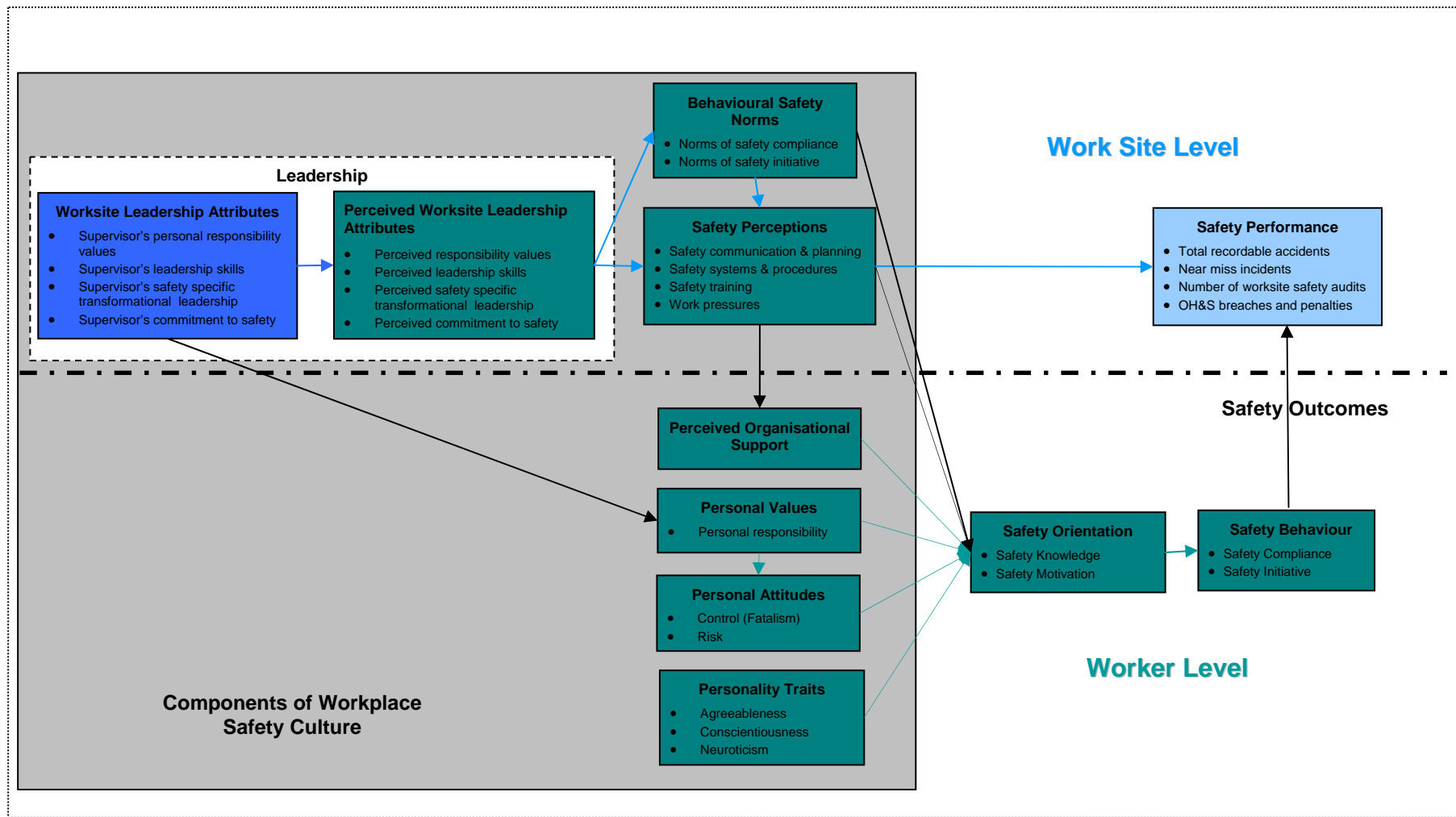


Figure 1. Multilevel model of safety in the construction industry.

## ***Safety Culture: A Multilevel Assessment Tool For The Construction Industry***

Table 1 Incident, Injury and Safety Indices

---

1. Total Recordable Incident Frequency Rate (TRIFR) - The number of total recorded unsafe incidents on site. This figure includes personal injury and incidents (e.g. lost time injuries, fatalities, medical treatment injuries, alternate work injuries, first aid injuries, etc) property damage and environmental events, presented per one million (1,000,000) hours worked on site.
  2. Total Near Miss Frequency Rate (TNMFR) - The number of recorded near misses per one million (1,000,000) hours worked on site.
  3. Frequency of Communications Events - the number of hours worked between each work site communication event (such as tool box talks, pre-starts, etc) over the six months prior to the survey.
  4. Frequency of Worksite Inspections - the number of hours worked between each work site safety inspection over the six months prior to the survey.
  5. Audits Conducted - The total number of worksite safety audits conducted on site over the six months prior to the survey.
  6. Hazards Reported - the total number of worksite safety hazards reported and recorded on site over the six months prior to the survey.
-

**Safety Culture: A Multilevel Assessment Tool For The Construction Industry**

Table 2 Mean, Standard Deviation, Skewness, Kurtosis and Alpha Coefficient Scores for Variables

Variable	Mean	Standard Deviation	Skewness	Kurtosis	Alpha Coefficient
Perceived Organisational Support	3.32	0.68	-0.06	-0.06	.81
Perceived Communication and Planning	3.80	0.74	-0.21	-0.57	.84
Perceived Safety Training	3.54	0.87	-0.11	-0.66	.86
Perceived Safety Systems and Procedures	3.39	0.83	-0.21	-0.13	.84
Perceived Work Pressure	3.20	0.97	0.13	-0.75	.90
Safety Orientation – Safety Knowledge	4.25	0.56	-0.74	1.03	.80
Safety Orientation – Safety Motivation	4.58	0.62	-2.53	10.43	.88
Safety Behaviour – Safety Compliance	4.29	0.65	-1.30	4.04	.92
Safety Behaviour – Safety Initiative	3.84	0.70	-0.30	0.81	.90
Personality Trait - Agreeableness	3.85	0.83	-0.91	1.32	.88
Personality Trait - Conscientiousness	4.11	0.70	-0.96	1.42	.84
Personality Trait – Neuroticism	3.89	0.94	1.97	9.90	.70
Safety Compliance Norm	3.82	0.78	-0.57	0.21	.77
Safety Initiative Norm	3.73	0.78	-0.23	-0.48	.82
Value of Personal Safety Responsibility	4.53	0.53	-1.03	0.36	.90
Attitudes Towards Worksite Risk	3.13	0.99	0.12	-0.46	.81
Attitudes Towards Risk Control	3.10	0.66	-0.35	0.22	.59

**Table 3 Correlations between Variables**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Safety Compliance Norm																
2 Safety Initiative Norm	.649**															
3 Communication & Planning	.366**	.503**														
4 Safety Systems & Procedures	.418**	.608**	.684**													
5 Safety Training	.318**	.515**	.683**	.646**												
6 Work Pressures	.211*	.343**	.316**	.288**	.410**											
7 Perceived Organisational Support	.224*	.293**	.672**	.553**	.548**	.240*										
8 Value of Personal Safety Responsibility	.380**	.347**	.308**	.272**	.328**	.232*	.251*									
9 Attitudes to Risk Control	.146	.217*	.054	.163	.144	.020	-.031	-.136								
10 Attitudes to Worksite Risk	.138	.131	.088	.045	.117	.553**	.108	.273**	-.142							
11 Agreeableness	.324**	.338**	.370**	.372**	.317**	.236*	.244*	.288**	-.071	.142						
12 Conscientiousness	.062	.136	.179	.149	.212*	.128	.237*	.211*	-.037	.075	.503**					
13 Neuroticism	.196	.206*	.090	.036	.131	.057	.036	.139	.061	.150	.557**	.473**				
14 Safety Knowledge	.317**	.279**	.156	.314**	.271**	.125	.225*	.444**	.084	.013	.365**	.490**	.133			
15 Safety Motivation	.230*	.249*	.252*	.252*	.253*	.122	.239*	.418**	.034	.039	.425**	.444**	.369**	.563**		
16 Safety Compliance Behaviour	.414**	.415**	.361**	.431**	.342**	.289**	.338**	.454**	.042	.149	.495**	.429**	.230*	.611**	.775**	
17 Safety Initiative Behaviour	.436**	.501**	.361**	.429**	.272**	.254*	.253*	.330**	.278**	.054	.339**	.352**	.081	.555**	.484**	.668**

\*\*  $p < .01$ , \*  $p < .05$

## **Safety Culture: A Multilevel Assessment Tool For The Construction Industry**

Table 4 Factor Loadings for Items

	Factor						
	1	2	3	4	5	6	7
Safety compliance norm 1	.268	.074	.143	.400	-.178	.379	-.451
Safety compliance norm 2	.104	.238	.138	.787	-.072	.115	-.118
Safety compliance norm 3	.249	.235	.070	.726	-.032	.158	-.051
Safety initiative norm 1	.058	.072	.268	.765	-.097	.131	.134
Safety initiative norm 2	.216	.088	.184	.828	-.006	-.077	.051
Safety initiative norm 3	.088	.205	.144	.745	-.042	-.051	.111
Safety compliance behaviour 1	.061	.820	.036	.022	.036	.103	-.127
Safety compliance behaviour 2	-.097	.804	.142	.070	-.059	-.028	.047
Safety compliance behaviour 3	.146	.658	.157	.109	-.234	.045	.070
Safety compliance behaviour 4	.259	.774	.093	.098	-.024	-.070	-.045
Safety compliance behaviour 5	.214	.767	.078	.246	-.136	-.105	-.011
Safety compliance behaviour 6	.294	.725	-.004	.203	-.040	-.031	.072
Safety compliance behaviour 7	.280	.732	-.096	.292	-.159	-.095	.111
Attitudes to worksite risk 1	.048	-.081	-.112	-.186	.832	.150	-.141
Attitudes to worksite risk 2	-.081	-.042	-.150	.000	.531	.358	.483
Attitudes to worksite risk 3	-.030	-.187	.050	-.002	.846	-.002	.054
Attitudes to worksite risk 4	-.246	-.186	.163	.004	.765	.035	.155
Attitudes towards risk control 1	-.146	-.031	.211	.146	.105	.688	.081
Attitudes towards risk control 2	.215	-.089	.088	.092	.108	.708	.118
Attitudes towards risk control 3	.183	.158	.228	-.168	.442	.423	-.204
Attitudes towards risk control 4	.006	-.170	.110	-.072	.141	.368	.461
Value of personal responsibility 1	.744	.248	.273	.096	-.002	.045	-.084
Value of personal responsibility 2	.822	.166	.298	.073	-.013	-.036	.002
Value of personal responsibility 3	.818	.093	.304	.117	-.054	.000	.004
Value of personal responsibility 4	.788	.153	.356	.159	-.105	-.089	.060
Value of personal responsibility 5	.572	.235	.105	.337	-.039	.059	.500
Value of personal responsibility 6	.733	.280	.015	.093	-.045	.174	.111
Value of personal responsibility 7	.715	.080	.296	.273	-.028	.120	-.131
Safety initiative behaviour 1	.144	.250	.376	.225	-.187	.047	.542
Safety initiative behaviour 2	.407	.123	.447	.319	.067	.227	.327
Safety initiative behaviour 3	.437	.136	.444	.324	-.112	.270	.339
Safety initiative behaviour 4	.475	.122	.680	.155	-.076	-.057	.116
Safety initiative behaviour 5	.177	.027	.800	.152	.036	.208	-.019
Safety initiative behaviour 6	.239	.050	.788	.209	.122	.134	-.019
Safety initiative behaviour 7	.275	.126	.734	.201	-.046	.218	.052
Safety initiative behaviour 8	.281	.058	.703	.102	.058	-.027	.068
Percentage of variance explained by factor	15.08	13.09	11.66	11.37	7.68	5.52	4.66

## **Safety Culture: A Multilevel Assessment Tool For The Construction Industry**

Table 5 Regression of IVs onto Self-Reported Safety Compliance Behaviour Mediated by Safety Knowledge and Safety Motivation

	Step 1	Step 2
	<i>Beta</i>	<i>Beta</i>
Step 1		
Safety Compliance Norm	.175	.161*
Safety Initiative Norm	-.031	-.004
Communication & Planning	-.062	-.014
Safety Training	-.077	-.071
Safety Systems & Procedures	.186	.103
Work Pressures	.100	.076
Perceived Organisational Support	.106	.065
Value of Personal Safety Responsibility	.222*	-.047
Agreeableness	.182	.075
Conscientiousness	.220*	-.001
Neuroticism	.081	.033
Attitudes to Worksite Risk	-.041	.064
Attitudes to Risk Control	.070	.008
Step 2		
Safety Knowledge		.182*
Safety Motivation		.597*
Adjusted $R^2$	.385	.696
$F$	5.727**	15.95**
$df$	98	98

\*  $p < .05$ , \*\*  $p < .01$

**Safety Culture: A Multilevel Assessment Tool For The Construction Industry**

Table 6 Regression of IVs onto Self-Reported Safety Initiative Behaviour Mediated by Safety Knowledge and Safety Motivation

	Step 1	Step 2
	<i>Beta</i>	<i>Beta</i>
Step 1		
Safety Compliance Norm	.118	.093
Safety Initiative Norm	.230	.242*
Communication & Planning	.139	.202
Safety Training	-.250*	-.259*
Safety Systems & Procedures	.137	.069
Work Pressures	.129	.114
Perceived Organisational Support	-.025	-.045
Value of Personal Safety Responsibility	.199*	.029
Agreeableness	.107	.039
Conscientiousness	.339**	.177
Neuroticism	-.224*	-.198
Attitudes to Worksite Risk	-.080	-.017
Attitudes to Risk Control	.258**	.217**
Step 2		
Safety Knowledge		.231*
Safety Motivation		.237*
Adjusted $R^2$	.403	.484
$F$	6.10	7.13
$Df$	98	98

\*  $p < .05$ , \*\*  $p < .01$

**Safety Culture: A Multilevel Assessment Tool For The Construction Industry**

Table 7 Worksite safety information.

	Total Reportable Injury Frequency Rate	Total Near Miss Frequency Rate	Frequency of Communications Events	Frequency of Worksite Inspections	Audits Conducted	Hazards Reported
Worksite 1	62.6	20.9	231.5	5324.9	3	62
Worksite 2	191.2	233.2	93.9	152.4	28	154
Worksite 3	73.6	73.6	135.2	1181.7	13	76

## **Safety Culture: A Multilevel Assessment Tool For The Construction Industry**

Table 8 ANOVAs for worksite comparisons

		ANOVA				
		Sum of Squares	df	Mean Square	F	Sig.
Perceived Organisational Support	Between Groups	3.87	2	1.93	4.49	0.01*
	Within Groups	41.82	97	0.43		
	Total	45.69	99			
Communication & Planning	Between Groups	2.46	2	1.23	2.28	0.11
	Within Groups	52.90	98	0.54		
	Total	55.36	100			
Safety Training	Between Groups	1.35	2	0.67	0.89	0.41
	Within Groups	73.99	98	0.76		
	Total	75.34	100			
Safety Systems & Procedures	Between Groups	1.69	2	0.84	1.21	0.30
	Within Groups	68.01	98	0.69		
	Total	69.69	100			
Work Pressures	Between Groups	5.58	2	2.79	3.12	0.04*
	Within Groups	87.58	98	0.89		
	Total	93.15	100			
Safety Compliance Norm	Between Groups	1.57	2	0.78	1.31	0.27
	Within Groups	58.77	98	0.60		
	Total	60.34	100			
Safety Initiative Norm	Between Groups	4.85	2	2.42	4.27	0.02*
	Within Groups	55.60	98	0.57		
	Total	60.45	100			
Values personal responsibility	Between Groups	0.15	2	0.07	0.22	0.80
	Within Groups	32.15	98	0.33		
	Total	32.30	100			
Attitudes to Worksite Risk	Between Groups	3.80	2	1.90	1.96	0.15
	Within Groups	94.88	98	0.97		
	Total	98.68	100			
Attitudes to Risk Control	Between Groups	0.93	2	0.46	1.06	0.35
	Within Groups	42.94	98	0.44		
	Total	43.87	100			
Safety Knowledge	Between Groups	0.24	2	0.12	0.38	0.68
	Within Groups	30.99	98	0.32		
	Total	31.24	100			
Safety Motivation	Between Groups	0.07	2	0.03	0.08	0.92
	Within Groups	38.09	98	0.39		
	Total	38.15	100			
Safety Compliance	Between Groups	0.07	2	0.03	0.08	0.92
	Within Groups	42.47	98	0.43		
	Total	42.54	100			
Safety Initiative	Between Groups	1.33	2	0.67	1.36	0.26
	Within Groups	48.00	98	0.49		
	Total	49.33	100			

Examination of the mean values for each of the self-report measures for the statistically significant group differences are listed in Table 9.

## ***Safety Culture: A Multilevel Assessment Tool For The Construction Industry***

Table 9 Mean worker self-reports aggregated by worksite.

	Perceived organisational support	Work pressures	Safety initiative norm
Worksite 1	3.71	2.84	3.75
Worksite 2	3.19	3.14	3.90
Worksite 3	3.32	3.05	3.38

## **REFERENCES**

- Ajzen, I. (1991). *The theory of planned behavior*. *Organizational Behavior and Human Decision Processes*, 50(2), 179-211.
- Ajzen, I. (2002). *Constructing a TpB Questionnaire: Conceptual and Methodological Considerations*. Retrieved September, 2002, from <http://www.people.umass.edu/ajzen/pdf/tpb.measurement.pdf>
- ASACC, (2007). *Priority Industry Information Sheet: Construction [Electronic Version]*. *Statistical Data and Reports*. Retrieved 11/10/07 from <http://www.ascc.gov.au/ascc/AboutUs/Publications/StatReports/>.
- Borman, W. C., & Motowidlo, S. J. (1993). *Expanding the criterion domain to include elements of contextual performance*. In N. Schmitt, W. C. Borman & Associates (Eds.), *Personnel selection in organizations* (pp. 71-98). San Francisco: Jossey-Bass.
- Campbell, J. P., Daft, R. L., & Hulin, C. L. (1982). *What to study: generating and developing research questions*. Thousand Oaks, CA: Sage.
- Campbell, J. P., McCloy, R. A., Oppler, S. H., & Sager, C. E. (1993). *A Theory of Performance*. In N. Schmitt & W. C. Borman (Eds.), *Personnel selection in organizations* (pp. 35-69). San Francisco: Jossey-Bass.
- Clarke, S. (1998). *Safety culture on the UK railway network*. *Work and Stress*, 12(3), 285-292.
- Clarke, S. (2006). *Contrasting perceptual, attitudinal and dispositional approaches to accident involvement in the workplace*. *Safety Science*, 44(6), 537-550.
- Clarke, S., & Robertson, I. T. (2005). *A meta-analytic review of the Big Five personality factors and accident involvement in occupational and non-occupational settings*. *Journal of Occupational & Organizational Psychology*, 78(3), 355-376.
- Cole, T. R. H. (2003). *Final report of the Royal Commission into the Building and Construction Industry*. from <http://www.royalcombcj.gov.au/hearings/reports.asp>
- Cooper, M. D. (2000). *Towards a model of safety culture*. *Safety Science*, 36(2), 111-136.
- Crowe, J. W. (1995). *Safety values and safe practices among college students*. *Journal of Safety Research*, 26(3), 187-195.
- Dedobbeleer, N., & Beland, F. (1991). *A safety climate measure for construction sites*. *Journal of Safety Research*, 22, 97 - 103.
- Eisenberger, R., Cummings, J., Armeli, S., & Lynch, P. (1997). *Perceived Organizational Support, Discretionary Treatment, and Job Satisfaction*. *Journal of Applied Psychology*, 82(5), 812-820.

## **Safety Culture: A Multilevel Assessment Tool For The Construction Industry**

- Eisenberger, R., Huntington, R., Hutchison, S., & Sowa, D. (1986). Perceived organizational support. Journal of Applied Psychology, 71, 500–507.
- Glendon, A. I., & Litherland, D. K. (2001). Safety climate factors, group differences, and safety behaviours in road construction. Safety Science, 39, 157 - 188.
- Griffin, M. A., & Neal, A. (2000). Perceptions of Safety at Work: A Framework for Linking Safety Climate to Safety Performance, Knowledge, and Motivation. Journal of Occupational Health Psychology, 5(3), 347-358.
- Guldenmund, F. W. (2000). The nature of safety culture: a review of theory and research. Safety Science, 34(1-3), 215-257.
- Hofmann, D. A., & Stetzer, A. (1996). A cross-level investigation of factors influencing unsafe behaviors and accidents. Personnel Psychology, 49(2), 307.
- Hofmann, D. A., & Tetrick, L. E. (2003). Health and safety in organizations : a multilevel perspective (1st ed.). San Francisco, CA :: Jossey-Bass,.
- Kozlowski, S. W., & Klein, K. J. (2000). A multilevel approach to theory and research in organizations: Contextual, temporal, and emergent processes. In K. J. Kline & S. W. Kozlowski (Eds.), Multilevel theory, research, and methods in organizations (pp. 3-90). San Francisco: Jossey-Bass.
- Maierhofer, N. I., & Griffin, M. A. (2002). Investigating the link between work values and work behaviours. Paper presented at the International Congress of Applied Psychology, Singapore.
- McKenna, E. F., & Glendon, A. I. (1995). Human safety and risk management. London: Chapman & Hall.
- Mearns, K., Whitaker, S. M., & Flin, R. (2003). Safety climate, safety management practice and safety performance in offshore environments., Safety Science (Vol. 41, pp. 641-680): Elsevier Science.
- Mearns, K. J., & Flin, R. (1999). Assessing the state of organizational safety - Culture or climate? Current Psychology, 18(1), 5-17.
- Mooradian, T. A., & Nezlek, J. B. (1996). Comparing the NEO-FFI and Saucier's Mini-Markers as measures of the Big Five. Personality and Individual Differences, 21(2), 213-215.
- Neal, A., & Griffin, M. A. (2002). Safety climate and safety behaviour. Australian Journal of Management, 27, 67.
- Neal, A., & Griffin, M. A. (2004). Safety climate and safety at work. In J. Barling & M. R. Frone (Eds.), Psychology of workplace safety. (pp. 15-34): American Psychological Association.
- Neal, A., Griffin, M. A., & Hart, P. M. (2000). The impact of organizational climate on safety climate and individual behavior. Safety Science, 34(1-3), 99-109.
- Nicholson, N., Soane, E., Fenton-O'Creevy, M., & Willman, P. (2005). Personality and domain-specific risk taking. Journal of Risk Research, 8(2), 157-176.

## **Safety Culture: A Multilevel Assessment Tool For The Construction Industry**

- NOHSC. (2005). Standards and OHS Legal Obligations. Retrieved 28 November, 2005, from <http://www.nohsc.gov.au/>
- Reber, R. A., Wallin, J. A., & Duhon, D. L. (1989). Safety programs that work. The Personnel Administrator, 34(9), 66.
- Reichers, A., & Schneider, B. (1990). Climate and Culture: An evolution of constructs. In B. Schneider (Ed.), Organizational climate and culture (pp. p 5-39). San Francisco: Jossey-Bass.
- Saucier, G. (1994). Mini-Markers: A brief version of Goldberg's unipolar Big-Five markers. Journal of Personality Assessment, 63(3), 506-516.
- Schein, E. (1992). Organizational culture and leadership (2nd Edition ed.). San Francisco, CA: Jossey-Bass.
- Schneider, B. (1990). Organizational climate and culture. San Francisco: Jossey-Bass.
- Seo, D. C. (2005). An explicative model of unsafe work behavior. Safety Science, 43(3), 187-211.
- Silva, S., Lima, M. L., & Baptista, C. (2004). OSCI: an organisational and safety climate inventory. Safety Science, 42(3), 205-220.
- Simard, M., & Marchand, A. (1994). The behaviour of first-line supervisors in accident prevention and effectiveness in occupational safety. Safety Science, 17(3), 169-185.
- Tabachnick, B. G., & Fidell, L. S. (1996). Using multivariate statistics (3rd ed.). New York, NY: Harper Collins College Publishers.
- Thygeson, A. L. (1992). Safety (2d ed.). Boston: Jones and Bartlett Publishers.
- Turner, N., & Parker, S. K. (2004). The effect of teamwork on safety processes and outcomes. In J. Barling & M. R. Frone (Eds.), The psychology of workplace safety. (pp. 35-62): American Psychological Association.
- Wagenaar, W. (1992). Risk-taking and accident causation. In J. F. Yates (Ed.), Risk-taking behaviour. Chichester: Wiley.
- Watson, G. W., Scott, D., Bishop, J., & Turnbeaugh, T. (2005). Dimensions of interpersonal relationships and safety in the steel industry. Journal of Business & Psychology, 19(3), 303-318.
- Williams, H., Turner, N., & Parker, S. K. (2000). The compensatory role of transformational leadership in promoting safety behaviors. Paper presented at the Academy of Management Annual Meeting, Toronto, Canada.
- Williamson, A. M., Feyer, A.-M., Cairns, D., & Biancotti, D. (1997). The development of a measure of safety climate: The role of safety perceptions and attitudes. Safety Science, 25(1-3), 15-27.
- Zacharatos, A., Barling, J., & Iverson, R. D. (2005). High-performance work systems and occupational safety. Journal of Applied Psychology, 90(1), 77-93.

## **Safety Culture: A Multilevel Assessment Tool For The Construction Industry**

Zohar, D. (1980). *Safety climate in industrial organizations: theoretical and applied implications*. Journal of Applied Psychology, 65, 96-102.

Zohar, D. (2000). *A group-level model of safety climate: Testing the effect of group climate on microaccidents in manufacturing jobs*. Journal of Applied Psychology, 85(4), 587.

Zohar, D. (2003). *Safety climate: Conceptual and measurement issues*. In J. C. Quick & L. E. Tetrick (Eds.), Handbook of occupational health psychology. (pp. 123-142). Washington, D.C.: American Psychological Association.

Zohar, D., & Luria, G. (2003). *The use of supervisory practices as leverage to improve safety behavior: A cross-level intervention model*. Journal of Safety Research, 34(5), 567-577.

Zohar, D., & Luria, G. (2005). *A multilevel model of safety climate: cross-level relationships between organization and group-level climates*. Journal of Applied Psychology, 90(4), 616-628.