*International Review of Business Research Papers*
*Vol. 5 No. 3 April 2009 Pp. 111-141*

# Validity and Reliability of The Safety Climate Measurement in Malaysia

Nor Azimah Chew Abdullah[a], Jeffery T. Spickett[b], Krassi B. Rumchev[c], and Satvinder S. Dhaliwal[d]

*Organizations started giving attention to organizational and management impact on safety performance particularly the function of safety climate. Inconsistency concerning the appropriate elements that should be in safety climate scale has called for an assessment of the safety climate construct. The purpose of this study was to develop a measure of attitudes and perceptions of safety that are related to safety climate in the workplace. The Safety Climate Assessment Scale (SCAS) was administered to 372 employees ranging from physician to support staff. Analysis of data was done using statistical analysis from the SPSS version twelve. Safety experts reviewed the content validity of the safety climate measurement. Construct validity was analyzed by the exploratory factor analysis, and concurrent validity was examined by correlations. Cronbach's alpha was used to measure internal consistency reliability. The results revealed acceptable internal consistency reliability, content validity, construct validity and concurrent validity for the SCAS. The SCAS scores had acceptable overall internal consistency reliability (r = .950). The correlation analysis indicated that scores on the 10 dimension scales of safety climate were moderately dependable.*

Field of Research*:* Managing People and Organization, Managing Change, Safety Climate

## 1. Introduction

Sustaining survival in the competitive environment is a critical agenda in today's world. For several decades, most organizations have focused on quality to maintain their continued existence but in the recent years, the trend has shifted to include occupational health and safety (OHS) as one of the

[a] College of Arts and Sciences, Human and Social Development Building, Universiti Utara Malaysia, Kedah, Malaysia e-mail: norazimah@uum.edu.my
[b] School of Public Health, Curtin University of Technology, Perth, Australia e-mail: J.Spickett@curtin.edu.au
[c] School of Public Health, Curtin University of Technology, Perth, Australia e-mail: K.Rumchev@exchange.curtin.edu.au
[d] School of Public Health, Curtin University of Technology, Perth, Australia e-mail: S.Dhaliwal@curtin.edu.au

determinants of competitiveness through productivity improvement and efficiency (LaMontagne et. al., 2004). Organizations began to give attention to health and safety management due to the following reasons (Hale, Heming, Carthey & Kirwan, 1997):

- Regulatory interest to comply with Occupational Health and Safety Act;
- Reports on major disasters that emphasized on the failings of management to protect the health and safety of their workers;
- Government's requirement for occupational health and safety management systems to assist organizations to meet compliance with the regulations; and
- Increased awareness of corporate responsibility.

Therefore, effective health and safety management and its relation to performance have been considered an important element when managing the interaction between systems and people. Many organizations experienced problems in managing health and safety at work, as the "people" element tends to engage in safe or unsafe behavior according to their interpretation. Accidents were related to some uncontrollable cause with regards to engagement of unsafe behavior while doing some activity. Herbert W. Heinrich, an early pioneer of accident prevention and industrial safety discovered that 88 percent of industrial accidents were originated from human factors (Goetsch, 2005) and in the recent years, safety experts estimated that human factors contributed to 80 – 90% of all industrial accidents (Fleming & Lardner, 1999). The importance of safety management in high reliability industries is extremely critical as major disasters like Chernobyl had exposed that people neglected the correct procedure in doing their job (Fleming & Lardner, 1999). In addition, poor attitude of management towards occupational health and safety has had a major role in poor accident records (Coyle, Sleeman & Adams, 1995). According to Blegen, Pepper and Rosse (2005), numerous studies had associated the following organizational factors to influence worker's injury:

- Supervisor's attitudes, actions, expectations and communications
- Supervisor's tasks
- Senior management and workers involvement in safety issues
- Organization's commitment to safety and willingness to solve safety problems
- Attitude and behavior of workers

As a result of accidents and injuries, organizations started giving attention to organizational and management impact on safety performance particularly the function of safety climate (Nahrgang, Morgeson & Hofmann, 2007). Even numerous studies have indicated that safety climate anticipate safety-related outcomes (Yule, Flin & Murdy, 2007), for example, accidents and injuries

(Huang, Ho, Smith & Chen, 2006), safety performance (Nahrgang, Morgeson & Hofmann, 2007; Shannon & Norman, 2008) and workers' safety behavior (Neal, et al., 2000; Tomas et al., 1999). Previous studies of Barling et al., 2002; Brown and Holmes, 1986; Hofman and Stetzer, 1996; and Lee et al., 1993 on the relationship between positive safety climate and lower accident rates demonstrated that positive safety attitude employees were less possible to be engaged in accidents (cited in Clarke, 2006). Lately, organizations have been applying leading indicators such as safety climate to assess their safety performance (Yule, Flin & Murdy, 2007).

For the past decades, a great number of studies have been done on safety climate, nevertheless, there is inadequate agreement on relevant attributes to be included in the safety climate concept (Williamson, Feyer, Cairns & Biancotti, 1997) and preference for safety climate attributes depends on practical interest of researchers (Huang et al., 2006). Furthermore, Salminen and Seppala (2005) also noted that most surveys have constructed their own measures to assess safety climate and these have lead to differing outcomes due to the dissimilarity in the instruments. Flin et al. (2000) and Guldenmund (2000) discovered 27 safety climate studies that had a variety of items with different factor structures and dissimilar definition (cited in Shannon & Norman, 2008). Some researchers also replicated various safety climate scales but the results were inconsistent (Flin et al., 2000). Previous safety climate studies demonstrated that management safety commitment and workers' safety involvement were being replicated constantly (Salminen & Seppala, 2005; Williamson, et al., 1997).

In spite of numerous researches on safety climate, Zohar (2008, p. 385), stated that "merely developing more measurement scales and re-testing climate-behavior relationships will hold back scientific progress". For that reason, researchers should focus on the psychometric analyses of the safety climate scales. To date, not many studies tried to verify the correlation between safety climate and the outcome variables or examining the construct, criterion and content validity of the scale (Seo et al., 2004 cited in Havold & Nesset, 2008). Therefore, there is a necessity to develop a more extensive tool and validate the scale comprehensively so that it can explain the safety climate concept. For this reason, the purpose of this study was to develop a measure of attitudes and perceptions of safety that are related to safety climate in the workplaces. The specific aims of this study were: to explore the content and construct validity of the safety climate scale, to examine the internal consistency of the safety climate dimensions, and to investigate the relationship between safety climate and two outcome factors: safety incidents, and safety satisfaction and feedback.

## 2. Literature Review

The terms “culture” and “climate” have been used interchangeably in the literature to reveal employees’ attitudes towards safety (Glendon & Stanton, 2000; HSE, 2002). Argument about features of safety climate still continues, although it has related concept but yet it is distinct and can be viewed as the surface attributes of safety culture which can be distinguished from the workers’ attitudes and perceptions (Flin et al., 2000). Nevertheless, Williamson et al. (1997, p. 15) expressed that “In understanding the safety climate or culture of a workplace, the perceptions and attitudes of the workforce are important factors in assessing safety needs”

HSE (2002) defined safety climate as the attitudes in relation to safety within an organization. Neal and Griffin (2002, p. 69) refers safety climate as “perceptions of policies, procedures, and practices relating to safety in the workplace”. Salminen and Seppala (2005) described safety climate as the workers’ perceptions and views related to management approach towards risks and safety. Consequently, this study expresses safety climate as the perceptions of workers related to safety practices, policies, procedures and safety conduct in the workplace.

Table 1 presents several prior studies on safety climate and the dimensions being measured. Unlike most studies in safety climate, Hsu, Lee, Wu, and Takano (2007) study was comprehensive where they categorized safety climate into four levels: organization, management, team, and individual. They reported that organizational level comprises of safety policy features for instance, top management commitment, reward system, reporting system, and resource allocation while management level included safety planning, control, and support factors like safety training, safety activities, and safety management. Team level contains safety implementation factors, for example, communication, coordination, and cooperation in a work team and individual level consist of safety performance of frontline workers such as safety awareness, safety attitude and safety behavior. Similarly, Cox and Cheyne (2000) study examined three types of assessment to measure safety climate: (1) multiple measurement-organizational attribute approach, (2) perceptual-organizational attribute approach, and (3) perceptual measurement-individual attribute approach. The first approach focused on various organizational attributes like structure, safety policy, systems and processes, and reports and it can be measured through observation and audit. The second type measured organizational perceptions like commitment and the last type examined individual perceptions about their feelings and attitudes towards organizational issues like commitment, responsibility, behavior, etc. Besides, Cheyne, Oliver, Tomas and Cox (2002) conducted a study on employee attitudes towards safety in the manufacturing sector in

UK. The study identified safety standards and goals, and safety management, which include personal involvement, communication, workplace hazards and physical work environment as factors that enhanced safety activities in organization. The study also found a good physical working environment and employee involvement as key factors that contributed to safety activities in organizations. In sum, combination of different types of assessment can ensure the high reliability of the safety climate measurement.

From prior studies, the most notable determinant is management attitude or action toward safety. Marsh et al. (1995) findings stated that management commitment has a high impact on all aspects of intervention. Management commitment to safety indicates the extent to which top management demonstrates positive and supportive safety attitudes (Hsu et al., 2007). Safety commitment has been described as a person recognition and participation in safety activities, which are demonstrate by an attempt to enhance safety in the workplace and comply with the safety goals (Cooper, 1995). Prior study like Smith et al. (1978) noted that employees' perception of management's action to safety had resulted in accident reduction (cited in Yule, Flin & Murdy, 2007). In addition, Hong Kong Occupational Safety and Health Council (1998) conducted a study of safety climate in the hotel industry in Hong Kong. The findings indicated that most senior managers had a positive response towards all aspects of safety climate. Supervisory and front-line staffs were particularly positive towards factors like risk taking behavior, obstacles to safe behavior, contributory influences and reporting of accidents. Despite the fact that employee participation and involvement are crucial, the accountability and responsibility in the health and safety must come from senior management as obliged by the Occupational Health and Safety Act (Vassie & Lucas, 2001).

Supervision illustrates an attempt showed by supervisors in coaching and supervising workers' safety (Hsu et al., 2007). Empirical studies revealed that supervisors play a vital role in ensuring safety in the workplace (Yule, Flin & Murdy, 2007). From past research, they found that employees complied with safety rules and procedures when they perceived that the action of their supervisor was fair. In contrast, Brown et al. (2000) discovered that supervisors who demanded more of their workers demonstrated negative influence on safety climate (cited in Yule, Flin & Murdy, 2007). Furthermore, they found that supervisors who delegated job task motivated employees to acknowledge their safety accountability.

Table 1: Dimensions of safety climate in previous studies

| Studies | Climate Dimensions |
|---|---|
| Brown & Holmes (1986) | management concern, management activity, risk perception |
| Budworth (1997) | management commitment, supervisor support, safety systems, safety attitudes, safety reps |
| Cheyne et al. (2002) | communication, individual responsibility, safety standards and goals, personal involvement, workplace hazards, physical work environment |
| Cooper (1995) | management commitment, management actions, personal safety commitment, perceived risk levels, effects of work pace, belief about accident causation, effects of job induced stress, safety communication, emergency procedures, safety training, and role of safety representatives |
| Cox & Cheyne (2000) | management commitment, priority of safety, communication, safety rules, supportive environment, involvement in safety, personal priorities and need for safety, personal appreciation of risk, work environment |
| Cox & Cox (1991) | Personal skepticism, individual responsibility, work environment, safety arrangements, personal immunity |
| Dedobbeleer & Beland (1991) | management commitment, worker involvement |
| Salminen & Seppala (2005) | organizational responsibility, workers' concern about safety, workers' indifference in regards to safety, and the level of safety actions |
| Hsu et al. (2007) | organizational level: top management commitment, reward system, reporting system, and resource allocation; management level: safety training, safety activities, safety management; team level: communication, coordination, cooperation in a work team; individual level: safety performance such as safety awareness, safety attitude and safety behavior |
| Huang et al. (2006) | management commitment, return-to-work policies, post-injury administration, safety training |
| Williamson et al. (1997) | personal motivation for safe behavior, positive safety practice, risk justification, fatalism/optimism |
| Zohar (1980) | importance of safety training programs, management attitudes toward safety, effects of safe conduct on promotion, level of risk at workplace, effects of required work pace on safety, status of safety officer, effects of safe conduct on social status, status of safety committee |

Besides management commitment, safety training and safety policy are also essential determinants to enhance safety performance. Lin and Mills (2001) found that clear policy statements and safety training played an important role in reducing accident rate. Safety training is defined as knowledge of safety given to employees in order for them to work safely and with no danger to their wellbeing (Law, Chan & Pun, 2006). Earlier studies discovered the link between safety training and increased safety performance (Huang et al., 2006). Consequently, effective training facilitates workers to have a sense of belonging and thus, is more accountable for safety in their workplace.

Hsu et al., (2007) findings regarding Taiwanese and Japanese safety leadership denoted that Taiwanese leadership style was "Top-Down Directive" where top management communicated safety policies and involved in safety activities and their supervisors supervised safety issues carefully by performing the management by walking around concept. They also reported that Japanese safety leadership was more focused on "Bottom-Up Participative" where top management promoted employees' participation in any safety activities and less willing to use disciplinary measures against employees' unsafe actions.

Havold and Nesset (2008) explained communication as "the extent to which organization provided an effective information exchange regarding internal safety matters" (p. 4). In other words, communication is the style, frequency and methods of interaction between management and workforce of an organization about safety and risk at work. Open communication describe how safety information is distributed between groups in an organization (Hsu et al., 2007). Therefore, the purpose of communication is to convey safety goals and essential health and safety information to employees so that they are familiar with their organization direction and encourage them to be more involve in any safety activities. Clarke (2006) discovered from previous studies like Hofmann and Morgeson, 1999, Mearns et al., 2003, and Parker et al., 2001 that effective communication has been seen as a vital tool in safe working implementation. In addition, a company's objective and communication of the objective to all workers is the crucial aspect of effective health and safety management as lack of communication may hinder employee involvement (Vassie & Lucas, 2001). Findings of Mearns et al. (1998) also revealed that safety communication decreases safety risk and thus, improves safety in the workplace (cited in HSE, 2005).

Reporting system is the basis to discover the limitation and vulnerability of safety management prior to accident (von Thaden et al., 2003). In other words, reporting system indicates front-line workers willingness to give details of safety issues and problems in workplace. Besides, HSE (2005) stated that employees must be given feedback concerning the action taken to their reporting. Clarke (1998) described that incident reporting can be perceived as an indicator of workers' perceptions about managers' commitment to safety.

Her study revealed that workers who perceived negatively about managers' commitment to safety can trigger employees' unsafe act.

Performance of an organization is critical to ensure success and survival in the marketplace. According to National Occupational Health and Safety Commission (2002), evaluation of OHS performance enables an organization to discover OHS problem and take preventive action. Most companies assess their safety system using measures like accident rates and audits (Carder & Ragan, 2003). According to them, using accident rates to measure safety performance create problem when there is no data to facilitate performance improvement due to no accidents to investigate. Furthermore, incident that causes no injury like near miss cannot be used to measure safety performance, as it is not a recordable accident although it can present serious threat in future. As for audits, previous research reported negative correlation between audit and accident rates (Carder & Ragan, 2003). In addition, perception survey can be used to assess the effectiveness of safety system as management is liable to determine their principles through their safety performance (Petersen, 2000). Besides, the involvement of management and workers showed positive results in enhancing safety performance (Lin & Mills, 2001).

Enhancing safety performance is important to the success of health and safety management at work. To determine safety improvement in organizations, Donald and Young (1996) conducted an intervention-based study on the attitude of employees in a UK power generation company. Findings of the safety performance indicated improvements in accident rates, absenteeism and general attitude towards safety. In term of manpower, organizations need to hire the right person for the right job as to ensure minimization of workplace hazards. The study of Hassan, Nor Azimah & Chandrakantan (2005) found that hiring practices is one aspect that requires serious attention by the companies as employees should be hired based on good safety records from previous experience in other companies. Management should seek information about the employee's prior safety performance during the selection process. Companies in particular sectors should pool their resources to set up certification bodies to train and certify employees in occupational safety and health. These external bodies can then set industry wide safety and health standards, norms, and values that are accepted by industry players. Employees can attain these standards and obtain certification through safety training or any other means. Organizations can then use these certifications as criterion for selection and promotion of employees in specific operational areas.

# 3. Methodology

## 3.1 Sample

The questionnaire was distributed to 969 employees from three state hospitals in the northern region of Malaysia. This study focused only on public hospitals as the hospitals provide basic healthcare needs to public and must maintain patient safety practices; hospital employees are involved in numerous health and safety issues associated with healthcare facilities; and public hospital is one of the top ten public services organizations that have the highest accident rates compare to other public services sector (SOCSO, 2008). Sample was chosen using stratified proportional random sampling according to occupational group: doctor, nurse, medical officer, management officer, medical support staff and management support staff.

Responses were acquired from 418 employees that gave a response rate of 43.1%. A further 46 responses were excluded from the survey as they comprised more than 10% outliers. Furthermore, respondents answered less than one entire section and every item with the same rating scale. Only a total of 372 usable returns and represented a response rate of 38.4% from the initial sample. Currently, most studies tend to have lower response rates (Newell et al., 2004 cited in Havold & Nesset, 2008). According to researchers from Malaysia, response rate of between 15 – 25 percent is what most researchers in Malaysia received (Rozhan, Rohayu & Rasidah, 2001).

There were about 79.8% female and 20.2% male comprising all three ethnic groups of Malaysian, namely Malay (85.8%), Chinese (8.3%), Indian (3.5%) and other (2.4%). Majority of respondents (39.2%) were diploma holder. Job positions of the respondents were physician, radiographer, paramedic, pharmacist, respiratory therapist, nurse, and supporting staff. 44.6% of the respondents worked as nurse. About 36% employees have worked for 1 – 5 years.

## 3.2 Instruments

Survey approach was employed as it is the most common techniques to evaluate safety-critical factors and participants remain anonymous (Kho, Carbone, Lucas, & Cook, 2005; von Thaden et al., 2003). The questionnaire was adapted from the Safety Climate Assessment tool developed by Flin, Mearns, & Burns (2004) from University of Aberdeen. The scale was modified slightly by replacing the original term “patient safety” with “health and safety”. The questionnaire was intended to identify perceptions on the implications of safety climate dimensions towards their OHS performance in the public hospital in Malaysia. From Fishbein and Ajzen (1975) book on Belief, Attitude, Intention and Behaviour: An Introduction to Theory and Research, Page-

Bucci (2003, p. 2) noted that “Attitude is an important concept that is often used to understand and predict people's reaction to an object or change and how behaviour can be influenced”.

Back-translation and decentering methods were used in this survey. We used two bilinguals: translating from the source (English) to the target language (Bahasa Malaysia), and translating back from the target to the source (Brislin, 1970). Table 2 shows the original dimensions, which were groups into the following subsections: communication, work duties, safety satisfaction, management commitment, errors and incidents, role of supervisors, training and competence, safety rules, reporting, and supervisor’s leadership style. Besides demographic of personnel, the questionnaire consisted of the above listed dimensions. The items were accompanied by a 5-point Likert rating scale.

The original scale as in Table 2 was pilot test to 52 respondents from a district hospital in the northern region of Malaysia. Content validity was also examined to ensure that each item really explains the meanings comprise in the concept (Hair et al., 1998). Ten safety experts: seven practitioners from various industries and three academicians from the public university evaluated the items and its suitability in each dimensions. Negatively-worded items were reverse-scored to achieve a higher score that give positive answer. Individual scale scoring was computed by summing the item scores and dividing by the total number of items. Table 3 shows the final version of the instrument after modification based on feedback from the safety experts and the pilot study, which groups the components into the following twelve sections: communication, safety responsibility, work duties, safety satisfaction, management commitment, health and safety goals, errors and incidents, role of supervisors, training and competence, safety rules, reporting, and supervisor’s leadership style.

## 3.3 Analysis

Analysis of data was done using statistical analysis from the SPSS version twelve. Significance was set at a two-tail with an alpha level of 0.05. The internal consistency for all instruments was analyzed using Cronbach’s alpha. To assess validity of the instrument, factor analysis like content validity, concurrent validity, and construct validity have been utilized. A priori of analyzing exploratory factor analysis and not pursuing confirmatory factor analysis was decided for this study.

Table 2: Factors and total number of items included in the original instrument

| Factor | Description | Number of item | Rating scale |
|---|---|---|---|
| Safety communication | Perception about safety communication including openness in communication | 7 | 1 = strongly disagree to 5 = strongly agree |
| Training & competence | Attitudes to acquire knowledge and skills about risks in job | 6 | 1 = strongly disagree to 5 = strongly agree |
| Health & Safety reporting | Attitudes and perception relating to feedback about incidents | 8 | 1 = strongly disagree to 5 = strongly agree |
| Work duties | Perceptions of individual job duties relating to safety issues | 9 | 1 = strongly disagree to 5 = strongly agree |
| Safety satisfaction | Attitudes and perceptions relating to aspects of safety measures in the workplace | 17 | 1 = highly dissatisfied to 5 = highly satisfied |
| Management safety commitment | Perceptions of management commitment to safety issues | 13 | 1 = strongly disagree to 5 = strongly agree |
| Errors and incidents | Attitudes and perceptions about errors and incidents in the workplace | 14 | 1 = strongly disagree to 5 = strongly agree |
| Role of supervisor in safety and health | Perceptions of supervisor's role in ensuring safety in the workplace | 28 | 1 = strongly disagree to 5 = strongly agree |
| Safety rules | Perceptions of rules about safety in the workplace | 3 | 1 = strongly disagree to 5 = strongly agree |
| Supervisor's leadership style | Perceptions of leadership style in ensuring safety in the workplace | 14 | 1 = not at all to 5 = frequently |
| TOTAL | | 119 | |

# 4. Findings and Discussion

## 4.1 Pilot Test And Safety Expert Feedback

The 119 Likert-type items as in Table 2 were subjected to a small pilot study and safety expert evaluation. From the feedback, items were removed when they were reflected as inappropriate, redundant, and confusing or consist of extremely low item-total correlations. Some items were perceived clear and relevant but it needs modification as some items in certain dimensions were rather too long. Safety expert reviewed whether the items measure the full theme implied by their label. Accordingly, further items were refined to eliminate related items across categories and 25 items were deleted from the initial group of 119 items. As a result, the final version was 94 items. Table 3 illustrates summary of feedback from safety experts and pilot study regarding items in the safety climate dimension and it revealed that the role of supervisor dimension had the most deleted items, i. e. 14.3 percent (17 items). Overall total items being eliminated from specific factors were 21.0 percent (25 items) and 10 items (8.4 percent) were relocated to another factors to ensure the items are with appropriate theme.

## 4.2 Exploratory factor analysis (EFA)

This study utilized exploratory factor analysis to examine the factorial validity of the Bahasa Malaysia constructs. The 94 items were submitted to an exploratory factor analysis with principle axis factoring extraction and varimax rotation. A priori criterion was set according to number of factors extracted, i.e. 12 factors. This technique is practical when a study tries to test a theory or replicate another study (Hair et al., 1998). To consider factor analysis, the sample must be 100 or greater or a minimum of five-to-one ratio between case and variable (Hair et al., 1998, Tabachnick & Fidell, 2007). The minimum level of factor loadings must be more than ± .30, loadings of ± .40 is significant and loadings of ± .50 or greater are most significant (Hair et al., 1998). However, sample size plays a major role in determining significant factor loadings. Loadings of .30 is considered significant for a sample sizes of 350 or greater (Hair et al., 1998). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy for this survey was greater than .60 and the Bartlett's test of sphericity was significant. The anti-image correlation matrix demonstrated that all measures of sampling adequacy (MSA) were above the acceptable level of .50. Therefore, it was appropriate to factor analyzed the data.

Table 3: Summary of feedback from safety experts and pilot study regarding items in the safety climate dimension

| Factor | Total items in original scale | % of items deleted from the factor | % of items relocate to another factor | % of items taken from another factor | Total items in revised scale |
|---|---|---|---|---|---|
| Safety communication | 7 | - | 0.8 (1) | 0.8 (1) | 7 |
| Training & competence | 6 | - | 1.7 (2) | - | 4 |
| Health & safety reporting | 8 | 2.5 (3) | - | - | 5 |
| Work duties | 9 | 0.8 (1) | - | - | 8 |
| Safety satisfaction | 17 | - | - | - | 17 |
| Management safety commitment | 13 | 3.4 (4) | 1.7 (2) | - | 7 |
| Errors and incidents | 14 | - | - | - | 14 |
| Role of supervisor in safety and health | 28 | 13.5 (16) | 0.8 (1) | - | 11 |
| Safety rules | 3 | - | - | - | 3 |
| Supervisor's leadership style | 14 | 0.8 (1) | 3.4 (4) | 0.8 (1) | 10 |
| Health & safety goals | - | - | - | 4.2 (5) | 5 |
| Safety responsibility | - | - | - | 2.6 (3) | 3 |
| TOTAL | 119 | 21.0 (25) | 8.4 (10) | 8.4 (10) | 94 |

The factors developed from the exploratory factor analysis were not the same with the original set of dimensions. Table 4 shows the factor analysis for the items in the dependent variables; where the rotated solution demonstrated two factors which together explained 36.52%: (1) safety satisfaction and feedback (21 items, α = .91 ), and (2) safety incidents (7 items, α = .76). The results suggested that four items from the safety incidents dimension were factored into the safety satisfaction dimension, thus the new factor was renamed as safety satisfaction and feedback. Further three items from safety incidents dimension were eliminated from the scale as the factor loadings were lower than .30 (SI4 = .142, SI5 = .244, SI7 = .028). The KMO measure of sampling adequacy for the dependent variables was .867 and the Bartlett's Test of Sphericity was significant ($\chi^2$ = 4936.02, p < 0.000).

30 safety climate items for the independent variables were factor analyzed and six factors were extracted which explained 44.55% of the variance: (1) health and safety goals (5 items, α = .88 ), (2) training and competence (4 items, α = .79), (3) safety rules and reporting (7 items, α = .78), (4) openness in communication (4 items, α = .68), (5) transition in communication (4 items, α = .63), and (6) work duties (6 items, α = .66). From Table 5, the results

suggested that one item from work duties dimension and two items from safety rule dimension were factored into the safety reporting scale, thus the new factor was renamed as safety rules and reporting. The factor measuring safety communication was split into two factors: openness in communication, and transition in communication. Openness in safety communication retained four items while transition of safety communication retains three items and one item from safety reporting was factored into this construct. Further one item from safety rules dimension and one item from the work duties dimension were eliminated from the instrument as the factor loadings were lower than .30 (R2 = -.279, WD5 = .282). The KMO measure of sampling adequacy for the independent variables was .858 and the Bartlett's Test of Sphericity was significant ($\chi^2$ = 4343.65, p < 0.000).

Factor analysis for the mediator variables as in Table 6 revealed four factors, which accounted for 51.56% of the variance: (1) supervisor's leadership style (10 items, α = .94), (2) role of supervisor (8 items, α = .91), (3) management commitment (6 items, α = .71), and (4) safety responsibility (6 items, α = .71). Among the items loading on the management commitment were two items from role of supervisor dimension. The items factored on this dimension give the impression that support and involvement from management toward safety activities in the workplace are crucial. Lack of commitment from management is linked with higher industrial accident rates (Cooper, 1995). The safety responsibility factor revealed three items from management commitment loaded into this factor. Thus, this factor was labeled as safety responsibility that emphasized the responsibility of management and workers toward safety activities in the workplace. Further one item from role of supervisor were removed from the instrument as the factor loadings were lower than .30 (RS6 = .290). The KMO measure of sampling adequacy for the mediator variables was .933 and the Bartlett's Test of Sphericity was significant ($\chi^2$ = 6745.93, p < 0.000).

Table 4: Factor analysis for the items in the dependent variables (N = 372)

| Item Code | Item | Factor Loading |
|---|---|---|
| | Factor 1: Safety Satisfaction & Feedback | |
| SS9 | How satisfied are you with the following aspects of the safety system? Department/unit/ward safety induction | .774 |
| SS12 | How satisfied are you with the following aspects of the safety system? Department/unit/ward Health and Safety Committee | .766 |
| SS11 | How satisfied are you with the following aspects of the safety system? Hospital Health and Safety Committee | .738 |
| SS10 | How satisfied are you with the following aspects of the safety system? Safety audits/inspections | .733 |
| SS8 | How satisfied are you with the following aspects of the safety system? Hospital safety induction | .695 |
| SS16 | How satisfied are you with the following aspects of the safety system? Occurrence/incidence reporting system | .681 |
| SS17 | How satisfied are you with the following aspects of the safety system? Investigation and follow-up measures after injuries and accidents have taken place | .667 |
| SS6 | How satisfied are you with the following aspects of the safety system? Security guard presence | .641 |
| SS5 | How satisfied are you with the following aspects of the safety system? Police presence | .616 |
| SS7 | How satisfied are you with the following aspects of the safety system? Controlled entry to department/unit/ ward | .581 |
| SS13 | How satisfied are you with the following aspects of the safety system? Workplace design | .524 |
| SS14 | How satisfied are you with the following aspects of the safety system? Housekeeping/cleaning | .514 |
| SS2 | How satisfied are you with the following aspects of the safety system? Uniforms and aprons | .476 |
| SS1 | How satisfied are you with the following aspects of the safety system? Disposable personal protective equipments (e.g. gloves, masks) | .472 |
| SS15 | How satisfied are you with the following aspects of the safety system? Competency of co-workers | .458 |
| SS3 | How satisfied are you with the following aspects of the safety system? Lead coats (for x-ray) | .455 |
| SS4 | How satisfied are you with the following aspects of the safety system? Personal alarms | .405 |
| SI2 | In this department/unit/ward, we discuss ways to prevent errors/mistakes from happening again | .539 |
| SI3 | We are given feedback about changes put into place based on event/incident reports | .519 |
| SI6 | Mistakes have led to positive changes here | .440 |
| SI1 | We are informed about errors/mistakes that happen in this department/unit/ ward | .401 |
| Percentage of variance explained | | 26.16 |
| Cronbach's Alpha | | .912 |

| Item Code | Item | Factor Loading |
|---|---|---|
| | Factor 2: Safety Incidents | |
| SI8 | In the last month, how many incidents did you see that inadvertently harmed staff? | .738 |
| SI9 | In the last month, how many errors or near misses did you see that could have harmed staff? | .729 |
| SI10a | During the last year how many times have you been injured or felt unwell as a result of the following problems at work? Moving and handling | .703 |
| SI10b | During the last year how many times have you been injured or felt unwell as a result of the following problems at work? Needlestick and sharps injuries | .674 |
| SI10c | During the last year how many times have you been injured or felt unwell as a result of the following problems at work? Slips, trips or falls | .672 |
| SI10e | During the last year how many times have you been injured or felt unwell as a result of the following problems at work? Work related stress | .457 |
| SI10d | During the last year how many times have you been injured or felt unwell as a result of the following problems at work? Exposure to dangerous substances (including radiation) | .369 |
| | Percentage of variance explained | 10.36 |
| | Cronbach's Alpha | .769 |

Table 5: Factor analysis for the items in the independent variables (N = 372)

| Item Code | Item | Factor Loading |
|---|---|---|
| | Factor 1: Health & Safety Goals | |
| SG2 | Top management discusses in specific terms who is responsible for achieving performance targets in health and safety | .840 |
| SG4 | Top management articulates a compelling vision of the future for health and safety | .821 |
| SG3 | Top management emphasizes the importance of having a collective sense of mission for health and safety | .773 |
| SG1 | Top management have set out a clear vision for health and safety in this hospital | .687 |
| SG5 | Top management makes clear what one can expect to receive when performance goals for health and safety are achieve | .523 |
| | Percentage of variance explained | 11.14 |
| | Cronbach's Alpha | .886 |
| | | |
| | Factor 2: Training and Competence | |
| TC1 | I understand the health and safety requirements for my job | .713 |
| TC2 | I understand the health and safety risks in my job | .694 |
| TC4 | I am always certain what to do to ensure high standards of health and safety in my work | .652 |
| TC3 | My training has covered the health and safety risks I face in my job | .590 |
| | Percentage of variance explained | 9.50 |
| | Cronbach's Alpha | .798 |
| | | |
| | Factor 3: Safety Rules and Reporting | |
| R3 | The rules always describe the safest way of working | .549 |
| SRT3 | I think that reporting health and safety incidents makes a difference to safety here | .529 |
| SRT1 | All health and safety incidents are reported here | .489 |
| SRT4 | People are willing to report health and safety incidents here | .482 |
| SRT2 | I am encouraged to report health and safety incidents | .438 |
| R1 | The written safety rules and instructions are easy for people to understand and implement | .434 |
| WD1 | Health and safety issues are never sacrificed to get more work done | .341 |
| | Percentage of variance explained | 7.20 |
| | Cronbach's Alpha | .782 |

| Item Code | Item | Factor Loading |
|---|---|---|
| | Factor 4: Openness in Safety Communication | |
| SC2 | Staff will freely speak up if they see something that may negatively affect health and safety at work | .690 |
| SC3 | Staff have the freedom to question the decisions or actions about health and safety of those with more authority | .651 |
| SC1 | Health and safety issues that may affect me are well communicated | .431 |
| SC4 | Staff are afraid to ask questions about health and safety when something that does not seem right has happened | .429 |
| | Percentage of variance explained | 6.11 |
| | Cronbach's Alpha | .685 |
| | | |
| | Factor 5: Transition in Safety Communication | |
| SC6 | Important health and safety information is often lost during shift changes | .699 |
| SC5 | Problems often occur in the exchange of information about health and safety across hospital departments / units | .525 |
| SC7 | I receive no communication about health and safety in any form from top management | .519 |
| SRT5 | I think it is a waste of time reporting health and safety errors/near misses because nothing gets done about it | .357 |
| | Percentage of variance explained | 5.34 |
| | Cronbach's Alpha | .634 |
| | | |
| | Factor 6: Work Duties | |
| WD4 | We work in "crisis mode" when trying to do too much, too quickly | .702 |
| WD3 | Staff work longer hours than what is considered to be best for their health and safety | .476 |
| WD2 | We have enough staff to handle the workload | .430 |
| WD8 | There is pressure from other hospital departments / units to get more work done | .427 |
| WD7 | I am satisfied with my current work schedule | .411 |
| WD6 | I am able to take scheduled rest breaks and still get my work done | .399 |
| | Percentage of variance explained | 5.26 |
| | Cronbach's Alpha | .660 |

Table 6: Factor analysis for the items in the mediator variables (N = 372)

| Item Code | Item | Factor Loading |
|---|---|---|
| | Factor 1: Supervisor's Leadership Style | |
| LS8 | My supervisor helps me to develop my strengths | .826 |
| LS7 | My supervisor gets me to look at problems from many different angles | .779 |
| LS9 | My supervisor suggests new ways of looking at how to complete assignments | .770 |
| LS3 | My supervisor talks enthusiastically about what needs to be accomplished | .769 |
| LS5 | My supervisor spends time teaching and coaching | .753 |
| LS1 | My supervisor provides me with assistance in exchange for my efforts | .744 |
| LS4 | My supervisor specifies the importance of having a strong sense of purpose | .728 |
| LS6 | My supervisor acts in ways that build my respect | .708 |
| LS10 | My supervisor has a strong sense of justice | .703 |
| LS2 | My supervisor instills pride in me for being associated with him/her | .589 |
| | Percentage of variance explained | 20.93 |
| | Cronbach's Alpha | .945 |
| | | |
| | Factor 2: Role of Supervisor | |
| RS2 | My supervisor is well qualified in health and safety | .712 |
| RS5 | I feel very confident about my supervisor's skills to deal with health and safety issues | .710 |
| RS10 | My supervisor knows about the work that needs to be done | .708 |
| RS8 | My supervisor is known to be successful at the things he/she tries to do | .705 |
| RS4 | My supervisor seriously considers staff suggestions for improving health and safety for workers | .692 |
| RS9 | I trust my supervisor to act on health and safety concerns | .661 |
| RS7 | The actions of my supervisor show that health and safety is a top priority | .610 |
| RS1 | My supervisor says a good word when he/she sees a job done according to established safety procedures | .465 |
| | Percentage of variance explained | 15.47 |
| | Cronbach's Alpha | .913 |

| Item Code | Item | Factor Loading |
|---|---|---|
| | Factor 3: Management Commitment | |
| MC6 | The hospital's procedures are only there to cover the backs of Senior Managers | .697 |
| MC4 | Senior Managers put their budget before safety | .574 |
| MC2 | Senior Managers seem interested in health and safety only after an adverse event happens | .493 |
| MC7 | I trust Senior Managers to act on safety concerns | .466 |
| RS11 | My supervisor overlooks health and safety problems that happen over and over | .459 |
| RS3 | My supervisor seems interested in health and safety only after an adverse event happens | .327 |
| | Percentage of variance explained | 8.26 |
| | Cronbach's Alpha | .714 |
| | | |
| | Factor 4: Safety Responsibility | |
| SR1 | I know the person who represents me in the Health and Safety Committee | .555 |
| SR3 | I am clear about my responsibilities for health and safety | .530 |
| SR2 | I am involved in health and safety initiatives at work such as health and safety committee | .480 |
| MC5 | Senior Managers genuinely care about the health and safety of people at this hospital | .541 |
| MC3 | The actions of Senior Managers show that health and safety is a top priority | .434 |
| MC1 | I know who the Senior Managers are | .422 |
| | Percentage of variance explained | 6.90 |
| | Cronbach's Alpha | .715 |

## 4.3 Internal Reliability

The internal consistency reliability coefficient for all instruments was calculated using Cronbach's alpha. With all 119 items in the original scale, the Cronbach's alpha for the pilot study was 0.948 (n = 52). Table 7 presents the Cronbach's alpha, mean and standard deviation for the summated scale of the revised instrument after factor analysis. The Cronbach's alpha for all the dimensions in the revised scale were in the range of .634 to .945. The overall Cronbach's alpha for the revised scale was .950. A lenient cut-off of 0.60 is common in exploratory research; the generally agreed upon lower limit for alpha is 0.70 (Hair et al., 1998) and many researchers require a cut-off of 0.80 for a "good scale" (Dawson & Trapp, 2004). Thus, the Cronbach's alpha coefficient of the revised instrument was above the acceptable level of .60. The highest mean were contributed by safety rules and reporting (mean = 3.8949, SD = .47573) and training and competence (mean = 3.8829, SD = .54886) while the lowest mean was from safety incidents dimensions (mean = 1.5488, SD = .52642).

## 4.4 Concurrent Validity

Bivariate correlations were used to analyze concurrent validity between safety climate dimensions and two outcome factors. The item-level analysis from Table 8 revealed that some items showed weak or negative relationship with other items in the measurement. Although safety incidents associated negatively and weakly with all dimensions of safety climate and safety satisfaction and feedback, it also substantiated a predictive relationship. For instance, the negative correlation between safety incidents and supervisor's role ($r=-0.119$; $p>0.05$); management commitment ($r = -0.265$; $p>0.01$); safety goals ($r=-0.131$; $p>0.05$); rules and reporting ($r=-0.127$; $p>0.05$); open communication ($r=-0.166$; $p>0.01$); transition communication ($r=-0.308$; $p>0.01$); and work duties ($r=-0.242$; $p>0.01$) indicated that increased safety climate dimensions predicted decreased safety incidents. Besides, positive relationship between safety climate dimensions implicated enhanced safety climate predicted increased safety satisfaction and feedback (refer Table 8). The direction of these associations was consistent with prior studies (Huang et al., 2006; Johnson, 2007). Kline (2005) indicated that the non-significant relationships between safety climate dimensions and safety incidents were due to the consequence of mediating variables (cited in Johnson, 2007), for example supervisor's leadership style. The correlation analysis indicated that scores on the 10 dimension scales of safety climate were moderately dependable. Further, the association between all items was not near unity, thus implicate that the instruments are not measuring a single construct (von Thaden et al., 2003).

Table 7: Summary statistics and Cronbach's alpha

| Dimension | # of item | Mean | SD | α |
|---|---|---|---|---|
| Safety satisfaction and feedback | 21 | 3.5542 | .47001 | .912 |
| Safety incidents | 7 | 1.5488 | .52642 | .769 |
| Health and safety goals | 5 | 3.5789 | .58998 | .886 |
| Training and competence | 4 | 3.8829 | .54886 | .798 |
| Safety rules and reporting | 7 | 3.8949 | .47573 | .782 |
| Openness in safety communication | 4 | 3.7258 | .60298 | .685 |
| Transition in safety communication | 4 | 3.3548 | .59453 | .634 |
| Work duties | 6 | 2.8432 | .56664 | .660 |
| Supervisor's leadership style | 10 | 3.1277 | .83618 | .945 |
| Supervisor's safety role | 8 | 3.5431 | .56275 | .913 |
| Management commitment | 6 | 3.2779 | .54327 | .714 |
| Safety responsibility | 6 | 3.5731 | .51129 | .715 |
| TOTAL | 88 | OVERALL α | | .950 |

Table 8: Interscale Correlations of the Safety Climate Dimensions and two outcome variables: Safety satisfaction and feedback and Safety incidents

| | LS | RS | MC | SR | SG | TC | RR | OC | TC | WD | SF | SI | Mean | SD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Leadership Style (LS) | 1 | | | | | | | | | | | | 3.1277 | .83618 |
| Role of Supervisor (RS) | .639** | 1 | | | | | | | | | | | 3.5431 | .56275 |
| Management Commitment (MC) | .387** | .449** | 1 | | | | | | | | | | 3.2779 | .54327 |
| Safety Responsibility (SR) | .356** | .495** | .382** | 1 | | | | | | | | | 3.5731 | .51129 |
| Safety Goals (SG) | .434** | .647** | .382** | .551** | 1 | | | | | | | | 3.5789 | .58998 |
| Training & Competence (TC) | .319** | .447** | .227** | .553** | .454** | 1 | | | | | | | 3.9122 | .51971 |
| Rule & Reporting (RR) | .322** | .490** | .250** | .450** | .453** | .581** | 1 | | | | | | 3.9097 | .49641 |
| Openness in Safety Communication (OC) | .226** | .338** | .233** | .366** | .415** | .366** | .386** | 1 | | | | | 3.7258 | .60298 |
| Transition in Communication (TC) | .173** | .233** | .446** | .338** | .211** | .303** | .292** | .294** | 1 | | | | 3.3548 | .59453 |
| Work Duties (WD) | .200** | .274** | .247** | .225** | .314** | .164** | .185** | .252** | .284** | 1 | | | 2.8432 | .56664 |
| Satisfaction & Feedback (SF) | .421** | .595** | .328** | .579** | .646** | .480** | .531** | .411** | .237** | .363** | 1 | | 3.5542 | .47001 |
| Safety Incidents (SI) | .046 | -.119* | -.265** | -.087 | -.131* | -.046 | -.127* | -.166** | -.308** | -.242** | -.079 | 1 | 1.5488 | .52642 |

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

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

## 4.5 Discussion

This article outlines the development of safety climate model that denote twelve dimensions, where six components: health and safety goals, training and competence, rule and reporting, work duties, open communication, and transition communication as predictor variables; four elements such as role of supervisor, management commitment, supervisor's leadership style, and safety responsibility as mediator variables; and safety incidents, and safety satisfaction and feedback as the outcome variables. The internal consistency reliability coefficient for the pilot study was .948 and the revised scale was .950. The results revealed that the measurement constantly assesses what it is intended to measure (Cooper & Phillips, 2004). Content validity defines to what extent a single item in a measure relate its meaning with the underlying theoretical concept. Content validity assessment by safety experts disclosed that 25 items were deleted from the initial group of 119 items. These items were inappropriate, redundant, and comprised of low item-total correlations. Thus, the revised instrument comprised of 94 items. Even though the assessments were subjective, the content validity was ascertained to persistent procedures (Havold & Nesset, 2008).

The results of the factor analysis permit this study to refine the instrument measurement to enhance its usability and validity. All the scales revealed reasonable validity in determining how well the concept is defined by the measure (Hair et al., 1998). Even though some factors are different from previous study, the items in each factor were able to indicate the conceptual definition of the underlying construct. Some of the dimensions are to some extent not similar with previous studies particularly on safety communication, safety rules and feedback about errors/mistakes. Communication dimension appears to be separated into two factors that were label as openness in communication (supported by Sorra & Nieva, 2004) and transition in communication. There is also strong evidence that (1) the items in the safety rules dimension are more consistent with other items in the reporting scale, thus labeled as safety rules and reporting; and (2) the items on feedback about errors/mistakes represent related aspects in the safety satisfaction dimension, thus label as safety satisfaction and feedback. These findings are consistent with Havold & Nesset (2008) study, who found that (1) items in safety rules dimension factored into safety satisfaction dimension, and (2) items about feedback in the learning culture dimension factored into communication dimension. Overall, six items were eliminated, where the factor loading were less than .30 (Hair et al., 1998). The KMO measure of sampling adequacy for all the constructs was above .60 and the Bartlett's Test of Sphericity was significant suggesting that correlations among all the items existed (Cooper & Philips, 2004; Lin et al., 2008). Even though the respondents answered the same questionnaire, and the employees were from the hospital sectors, nevertheless, the occupational categories varied, as

a result, the factor analysis of the safety climate scale were very context dependent (Salminen & Seppala, 2005).

Correlation analysis was applied to determine concurrent validity among the scales. Moderate to higher correlations between safety climate scales revealed that the construct were dependable as reflected by this study findings. Results also suggested that the ten components of safety climate were negatively correlated with safety incidence and positively correlated with each other. The outcome is congruent with Huang et al. (2006) findings of safety climate and self-reported injury that stipulated safety climate is a crucial factor anticipating self-reported injury. This analysis is also inline with Johnson (2007) study on the predictive validity of safety climate where the positive and negative directions of the relationship showed improved safety climate predicted reduction in injury frequency in the workplace and vice versa.

The findings of this study should make a major contribution to the practical and research aspects. In practice, this model should broaden the knowledge of public organizations employers especially in the health care sector regarding the importance of employees' perceptions as a realistic approach of determining whether organization has attained an acceptable level of safety in their workplace. In other words, the safety climate scale can be an effective measurement tool to demonstrate improvement in public hospitals. Furthermore, employees might continue to be more motivated to improve safety when they realize that management is more visible and supportive of safety activities. Besides, the safety climate assessments enable organization to reflect on how to improve problematic areas in their workplace.

## 4.6 Limitation and Future Research

For research purposes, the model presents some insights into the components related to safety climate, which gives the basis for future research in hospital settings. Although this study did not examine all the potential variables that might be reflected on the safety climate concepts, it presents initial inquiry into the significance of exploring the phenomenon from various job position perspectives as an attempt to safety performance in organization particularly in the public hospital sectors. However, this study has some limitations which propose prospect research. One limitation is the cross-sectional inquiry, making the outcomes only relevant to the point during the study. Nonetheless, longitudinal research assessing the standard measures for safety climate in hospital is required that would provide additional and even stronger support for the effects reported in this study. Additional work is required to examine the properties of the safety climate instruments in other hospitals too, especially the private hospitals to ensure that the instruments have valid outcome measures. Secondly, due to

resources constraint, this study focuses only on three state hospitals in the northern of region of Malaysia and excluded data gathering from all 13 state hospitals in Malaysia. It is possible that perceptions of respondents in all 13 state hospitals on safety climate at their workplaces may be different as a result of their ability to deal with various types of patients. Furthermore, it will allow comparisons across different locations. Thirdly, the existence of non-significant relationship between coefficients reduces the significance and strength of correlation coefficients (Johnson, 2007). Thus, further research should replicate this study and employ structural equation modeling to examine the probability of a mediated variable that may influence the non-significant relationships between safety climate dimensions and safety. Lastly, future study is required to further refine this instrument using confirmatory factor analysis to come out with model of good fit, produced parsimonious measures and develop standard measures for examining safety climate in hospital.

## 5. Conclusion

The goal of this study was to develop a measure of attitudes and perceptions of safety climate in the workplace. Results of the study were examined using exploratory factor analysis, content validity, concurrent validity and internal consistency reliability. This study has confirmed an empirical relationship between the ten dimensions of safety climate and two outcome variables: safety satisfaction and feedback, and safety incidents. All the constructs demonstrated an acceptable internal consistency. The instrument also confirmed a rational validity in assessing what they are supposed to measure. In conclusion, consistent safety perceptions and attitudes on organizational safety climate justify further research as the perceptions and attitudes may differ among individuals and general perception about safety problems in the workplace should be done longitudinal in order to compare any changes in the safety climate study.

## 6. References

Blegen, M.A., Pepper, G.A. & Rosse, J. 2005. “Safety climate on hospital units: a new measure”, *Advances in Patient Safety*, vol. 4, pp. 429 - 433.

Brislin, R.W. 1970. “Back-translation for cross-cultural research”, *Journal of Cross-Cultural Psychology,* vol. 1, no. 3, pp. 185 – 216.

Brown, R. & Holmes, H. 1986. “The use of a factor-analytic procedure for assessing the validity of an employee safety climate model”, *Accident Analysis and Prevention,* vol. 18, pp. 445 – 470.

Budworth, N. 1997. "The development and evaluation of a safety climate measure as a diagnostic tool in safety management", *IOSH Journal,* vol. 1, pp. 19 – 29.

Carder, B. & Ragan, P.W. 2003. "A survey-based system for safety measurement and improvement", *Journal of Safety Research,* vol. 34, no. 2, pp. 157 – 165.

Cheyne, A., Oliver, A., Tomas, J.M., & Cox, S. 2002. "The architecture of employee attitudes to safety in the manufacturing sector", *Personnel Review,* vol. 31, pp. 649 – 670.

Clarke, S., 1998. "Safety culture on the UK Railway Network", *Work and Stress,* vol. 12, no. 3, pp. 285 - 292.

Clarke, S. 2006. "Safety climate in an automobile manufacturing plant: the effects of work environment, job communication and safety attitudes on accidents and unsafe behaviour", *Personnel Review,* vol. 35, no 4, pp. 413 – 430.

Cooper, D. 1995. "Measurement of safety climate: a component analysis", Institute of Safety & Health (IOSH) Meeting on 1 Feb. 1995. Retrieved: 20 March 2008, from http://www.b-safe.net/articles/bsms1.pdf.

Cooper, M.D. & Phillips, R.A. 2004. "Exploratory analysis of the safety climate and safety behavior relationship", *Journal of Safety Research,* vol. 35, no 5, pp. 497 – 512.

Cox, S. & Cheyne, A. 2000. "Assessing safety culture in offshore environments", *Safety Science,* vol. 34, pp. 111 - 129.

Cox, S. & Cox, T. 1991. "The structure of employee attitudes to safety: a European example", *Work and Stress,* vol. 5, pp. 93 - 106.

Coyle, I.R., Sleeman, S.D. & Adams, N. 1995. "Safety climate", *Journal of Safety Research,* vol. 26, no 4, pp. 247 – 254.

Dawson, B. & Trapp, R.G. 2004. Basic & clinical biostatistics, 4th *ed*., Lange Medical Books/McGraw-Hill, New York.

Dedobbeleer, N. & Beland, F. 1991. "A safety climate measure for construction sites", *Journal of Safety Research*, vol. 22, no. 2, pp. 97 – 103.

Donald, I., & Young, S. 1996. "An attitudinal-based approach to improving safety in organizations", *Leadership & Organization Development Journal,* vol. 17, no. 4, pp. 13-20.

Fleming, M. & Lardner, R. 1999. "Safety culture – the way forward", *The Chemical Engineer*, 16 - 18. Retrieved: 15 January 2007, from http://www.keilcentre.co.uk/downloads/Culture.pdf.

Flin, R., Mearns, K. & Burns, C. 2004. "*Hospital safety climate scale",* University of Aberdeen.

Flin, R., Mearns, K., O'Connor, P. & Bryden, R. 2000. "Measuring safety climate: identifying the common features", *Safety Science,* vol. 34, no. 1-3, pp. 177 – 192.

Glendon, A.I. & Stanton, N.A. 2000. "Perspectives on safety culture", *Safety Science*, vol. 34, pp. 193-214.

Goetsch, D.L. 2005. Occupational safety and health for technologists, engineers and managers, 5th ed., Prentice Hall, New Jersey.

Hair, J.F., Anderson, R.E., Tatham, R.L. & Black, W.C. 1998. Multivariate data analysis, 5th ed., Prentice Hall International, Inc., New Jersey.

Hale, A.R., Heming, B.H.J., Carthey, J. & Kirwan, B. 1997. "Modelling of safety management systems", *Safety Science,* vol. 26, no. 1/2, pp. 121 – 140.

Hassan, A., Nor Azimah, C.A. & Chandrakantan, S. 2005. "*Reducing workplace injury through effective management practices: some empirical evidence from Malaysian companies*", Presented at the 18th Asian Conference on Occupational and Environmental Health on 11 – 13 May 2005 at Wellington, New Zealand.

Havold, J.I., & Nesset, E. 2008. "From safety culture to safety orientation: validation and simplification of a safety orientation scale using a sample of seafarers working for Norwegian ship owners. *Safety Science*, Article in Press, pp.1 – 22.

Health and Safety Executive (HSE). 2002. "Safety culture: a review of the literature", Retrieved: 20 March 2004, from http://www.hse.gov.uk/research/hsl_pdf/2002/hsl02-25.pdf.

Health and Safety Executive (HSE). 2005. "A review of safety culture and safety climate literature for the development of the safety culture inspection toolkit", Retrieved: 20 March 2007, from http://www.hse.gov.uk/RESEARCH/rrpdf/rr367.pdf.

Hong Kong Occupational Safety and Health Council. 1998. "Survey of Health and Safety Climate in Hong Kong Hotel Industry", Retrieved: 23 April 2008, from http://www.oshc.org.hk/download/research/27/2/e_hotel_industry.DOC.

Hsu, S.H., Lee, C.C., Wu, M.C., & Takano, K. 2007. "Exploring cross-cultural differences in safety climate of oil refinery plants in Japan and Taiwan", in Proceedings of the International Conference on Business and Information. Tokyo, Japan, 11-13 July 2007. Retrieved: 20 March 2008, from http://ibacnet.org/bai2007/proceedings/Papers/2007bai7280.doc.

Huang, Y.H., Ho, M., Smith, G.S., Chen, P.Y. 2006. "Safety climate and self-reported injury: assessing the mediating role of employee safety control", *Accident Analysis and Prevention*, vol. 38, pp. 425 – 433.

Johnson, S.E. 2007. "The predictive validity of safety climate", *Journal of Safety Research*, vol. 38, no. 5, pp. 511 – 521.

Kho, M.E., Carbone, J.M., Lucas, J. & Cook, D.J. 2005. "Safety climate survey: reliability of results from a multicenter ICU survey", *Quality Safety Health Care,* vol. 14, pp. 273 – 278.

LaMontagne, A.D., Barbeau, E., Youngstrom, R.A., Lewiton, M., Stoddard, A.M., McLellan, D., Wallace, L.M. & Sorensen, G. 2004. "Assessing and intervening on OSH programmes: effectiveness evaluation of the Wellworks-2 intervention in 15 manufacturing worksites", *Occupational & Environmental Medicine,* vol. 61, pp. 651 – 660.

Law, W.K., Chan, A.H.S. & Pun, K.F. 2006. "Prioritising the safety management elements: a hierarchical analysis for manufacturing enterprises", *Industrial Management & Data Systems,* vol. 106, no. 6, pp. 778 – 792.

Lin, J. & Mills, A. 2001. "Measuring the occupational health and safety performance of construction companies in Australia", *Facilities,* vol. 19, no. 3/4, pp. 131 – 138.

Lin, S.H., Tang, W.J., Miao, J.Y., Wang, Z.M. & Wang, P.X. 2008. "Safety climate measurement at workplace in China: a validity and reliability assessment", *Safety Science*, vol. 46, no. 7, pp. 1037 – 1046.

Marsh, T.W., Robertson, I.T., Duff, A.R., Phillips, R.A., Cooper, M.D. & Weyman, A. 1995. "Improving safety behavior using goal setting and feedback", *Leadership & Organization Development Journal,* vol. 16, no. 1, pp. 5 – 12.

Nahrgang, J.D., Morgeson, F.P. & Hofmann, D.A. 2007. "Predicting safety performance: a meta-analysis of safety and organizational constructs", Poster session presented at the 22nd Annual Conference of the Society for Industrial and Organizational Psychology, New York. Retrieved: 15 April 2008, from http://www.msu.edu/~morgeson/nahrgang_morgeson_hofmann_2007.pdf.

National Occupational Health and Safety Commission (NOHSC). 2002. "Extending the use of OHS positive performance indicators in Australian industry", Retrieved: 2 April 2006, from http://www.nohsc.gov.au/PDF/Statistics/ReportExtendingtheuseofPPIs.pdf#search='safety%20performance%20measurement%20tools'

Neal, A. & Griffin, M.A. 2002. "Safety climate and safety behaviour", *Australian Journal of Management,* vol. 27, Special Issue.

Neal, A., Griffin, M.A. & Hart, P.M. 2000. "The impact of organizational climate on safety climate and individual behavior", *Safety Science,* vol. 34, pp. 99 – 109.

Page-Bucci, H. 2003. "The value of Likert scales in measuring attitudes of online learners", Retrieved: 22 March 2007, from http://www.hkadesigns.co.uk/websites/msc/reme/likert.htm.

Petersen, D. 2000. "Safety management 2000: our strengths & weaknesses", *American Society of Safety Engineers: Professional Safety*, pp. 16 – 19.

Rozhan, O., Rohayu, A.G. & Rasidah, A. 2001. "Great expectations: CEOs' perception of the performance gap of the HRM function in the Malaysian manufacturing sector", *Personnel Review*, vol. 30, no. 1, pp. 61 – 80.

Salminen, S. & Seppala, A. 2005. "Safety climate in Finnish-and Swedish-speaking companies", *International Journal of Occupational Safety and Ergonomics,* vol. 11, no. 4, pp. 389 – 397.

Shannon, H.S. & Norman, G.R. 2008. "Deriving the factor structure of safety climate scales", *Safety Science*, Article in Press, pp. 1 – 3.

Sosial Security Organization (SOCSO) 2008. "Industrial statistic based on industrial sectors", Retrieved: 22 June 2008, from http://www.perkeso.gov.my.

Sorra J.S. & Nieva V.F. 2004, September. "Hospital on patient safety culture", (Prepared by Westat, under Contract No. 290-96-0004). AHRQ Publication No. 04-0041. Rockville, MD: Agency for Healthcare Research and Quality. Retrieved: 22 March 2007, from http://www.ahrq.gov/qual/hospculture/hospcult.pdf.

Tabachnick, B.G. & Fidell, L.S. 2007. Using multivariate statistics, Pearson Education Inc., Boston.

Tomas, J.M., Melia, J.L. & Oliver, A.M. 1999. "A cross validation of a structural equation model of accidents: organisational and psychological variables as predictors of work safety", *Work and Stress,* vol. 13, no. 1, pp. 49 – 58.

Vassie, L.H. & Lucas, W.R. 2001. "An assessment of health and safety management within working groups in the UK manufacturing sector", *Journal of Safety Research,* vol. 32, no. 4, pp. 479 – 490.

von Thaden, T.L., Wiegmann, D.A., Mitchell, A.A., Sharma, G. & Zhang, H. 2003. "*Safety culture in a regional airline: results from a commercial aviation safety survey",* Paper presented at the 12th International Symposium on Aviation Psychology, Dayton, OH.

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,* vol. 25, no. 1 – 3, pp. 15 – 27.

Yule, S., Flin, R. & Murdy, A. 2007. "The role of management and safety climate in preventing risk-taking at work", *International Journal of Risk Assessment and Management,* vol. 7, no. 2, pp. 137 – 151.

Zohar, D. 1980. "Safety climate in industrial organizations: theoretical and applied implications", *Journal of Applied Psychology, vol.* 65, no. 1, pp. 96 – 102.

Zohar, D. 2008. "Safety climate and beyond: a multi-level multi-climate framework", *Safety Science*, vol. 46, no. 3, pp. 376 – 387.