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UNDERSTANDING SAFETY PERFORMANCE USING SAFETY CLIMATE AND PSYCHOLOGICAL CLIMATE

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Abstract

This paper aims to explore the relationship between psychological climate, safety climate and safety performance. Safety research is increasingly expanding from a central focus on safety specific explanations of safety performance, to encompass more general management principles (e.g. leadership, role stress, and performance management). This research aims to contribute to this body by exploring the way in which psychological climate can be used to explain safety performance. This paper compares the fit of three competing models of safety performance using structural equation modelling. In the first model safety performance is predict by safety climate only, in the second by psychological climate only and the third is a saturated model using both safety and psychological climate. Comparison of the models revealed that the saturated model provides a better and more parsimonious explanation of safety performance than safety climate alone.

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INTRODUCTION

Safety researchers and practitioners have used a range of strategies aimed at making organisations safer. Over time, these strategies or approaches have evolved from being focused on the physical, technical and mechanical elements of the organisation to being increasingly focused on the individual's perceptions of and attitude toward the various aspects of the organisation. As such the safety climate construct has in the past decade been increasingly applied to both describe the state of organisational safety (e.g. Cheyne, Oliver, Tomás, & Cox, 2002; Cox & Cox, 1991; Coyle, Sleeman, & Adams, 1995; Lee, 1998) and predict dependent safety performance variables (e.g. Cheyne, Cox, Oliver, & Tomás, 1998; Cheyne et al., 2002; Neal & Griffin, 2002; Zohar, 2000).

In addition to being explained using safety climate variables, safety performance is increasingly being related to non-safety specific variables such as leadership (Barling, Loughlin, & Kelloway, 2002; Hofmann & Morgeson, 1999; Zohar, 2002), commitment and organisational support (Barling & Hutchinson, 2000; Hofmann & Morgeson, 1999), job satisfaction and job design (Barling, Kelloway, & Iverson, 2003; Hechanova-Alampay & Beehr, 2001; Parker, Axtell, & Turner, 2001) and job security (Probst, 2002; Probst & Brubaker, 2001). The individuals' perceptions of more general management practices are increasingly becoming the focus of research. Specifically, Neal, Griffin and Hart (2000) explored the relationship between organisational climate and the endogenous variables safety climate and safety performance, while Barling and Hutchinson (2000) argue that organisational management and HR practices have significant implications for safety. The aim of this research is to further add to this expanding body of literature by exploring the affect of psychological climate on safety performance.

SAFETY CLIMATE AND SAFETY PERFORMANCE

Safety climate is defined as being a set of perceptions held by individuals toward issues of organisational safety (Guldenmund, 2000; Zohar, 1980). Organisational climates provide context in which individuals determine both the appropriateness of their behaviour, and also the possible consequences of such behaviour (L. R. James & Sells, 1981).

Safety climate is a concept that has been developed by safety researchers to describe organisational environments and specifically the individual employees' perceptions of organisational safety. In a descriptive capacity safety climate data can be used to determine whether an organisation has a 'good' or 'bad' safety climate, as well as areas that require attention and improvement. Safety climate information provides managers with a proactive tool for improving organisational safety and also enables them to map changes and improvements over time (Coyle et al., 1995; Lee, 1998).

In addition to describing organisations, safety climate data can be used to predict organisational safety outcomes. Safety climate has been used to predict accident data (e.g. Zohar, 1980; Zohar, 2002), self-rated proactiveness (Mohamed, 1999), safety activities (Cheyne et al., 2002), and safety behaviour (Neal & Griffin, 2002). This paper contributes to the safety climate literature at a foundation level by analysing the relationship between safety climate and safety performance.

H1: Safety climate will predict safety performance.

PSYCHOLOGICAL CLIMATE, SAFETY CLIMATE AND SAFETY PERFORMANCE

Barling and Hutchison (2000) argue that safety must be integrated into high performance work systems such that they motivate people to produce the highest quality and quantity of goods and services, to be creative, innovative and importantly safe. Barling and Hutchison (2000) state that workforce commitment is a by-product of high performance work systems and that performance outcomes are the final result. Barling and Zacharatos (as cited in Parker et al., 2001, p. 211) contribute further to this argument by stating that self managed work teams, decentralised decision making, high quality job, employment security, extensive training, compensation based on performance (including safety performance), and selective hiring are a few of the key management and HR practices that will assist in achieving high production and safety performance.

Further to the argument proposed by Barling and his colleagues Neal et al. (2000) explored the relationships between an aggregated organisational climate construct, safety climate and safety performance. This paper seeks to further contribute to this body of research by applying the concept of psychological climate, as opposed to organisational climate used by Neal et al. to explanations of safety performance.

Depending on the author or researcher the difference between organisational climate and psychological climate ranges from being semantic to significant. However in this paper, psychological climate and organisational climate have been conceptualised as being conceptually distinct terms. Discussion surrounding the distinction has been primarily associated with the unit of theory and the aggregation of these terms. This scope of this paper however does not encompass a review of this debate, which is published elsewhere (Glick, 1985; L. R. James, 1982; L. R. James, Joyce, & Slocum, 1988; L. R. James & Sells, 1981; Joyce & Slocum, 1984). The conceptual difference applied within this research is that organisational climate focuses more on describing the individual's perceptions of organisational goal, principles and expectations (Strutton & Pelton, 1994). Psychological climate is designed to tap into a more value laden perspective of the organisation encompassing characteristics the individual considers to be psychological meaningful. As such, the psychological climate variable will impact the extent to which the individual engages or disengages with their workplace (Burke, Borucki, & Kaufman, 2002; Koys & De Cotiis, 1991; Ward, 1998).

H2: Psychological climate will predict safety behaviour.

Neal and Griffin (2002) argued that there was a need to investigate safety climate within the context of organisational behaviour. They further argue that there is a need to explore the mechanisms through which safety climate impacts safety performance, and also the impact of organisational variables on safety climate. Research conducted by Neal et al. (2000) found support for their proposition that safety climate mediated the relationship between organisational climate and safety behaviour. This type of relationship will again be explored but using psychological climate as opposed to organisational climate.

H3: The relationship between psychological climate and safety performance will be mediated by safety climate.

H4: The mediation model will be a better fit than either of the models depicted in H1 and H2.

METHOD

Sample and procedure

A total of 1800 questionnaires were administered to a population of employees within a large service provider. This organisation employs approximately 3000 full time staff, and work groups from within this population were randomly selected for participation in this project. From the 1800 questionnaires administered, 800 completed questionnaires were returned. The organisation can

be categorised as a large service provider, and within the group 74.8% of the population were male, 25.2% female. 53.4% of the participants worked predominantly in an office environment, while 46.6% worked in a workshop or out in the field. 75% of the group classified themselves at the basic employee level, 14% at the supervisor/team leader level, 6.5% at the manager level, 1.3% at the senior manager and 3.1% at the general manager level.

Data analysis and measures

The measures were developed according to previous research in the fields of psychological climate, safety climate and safety performance. Each of the items was measured on a 6-point Likert scale. All missing data was replaced using the mean substitution technique and all negatively worded items were recoded. The first step in data analysis was to conduct exploratory factor analysis (EFA). During EFA items that cross loaded were deleted from further analysis and the factor loadings had to be above .4 for the item to be retained.

Following EFA, each of the individual items that relate to each factor were grouped into item parcels. Problems in early analysis of the research models, particularly repeated Heywood cases prompted the decision to group the individual items into parcels of 3 or 4 items. The item parcels are a summation of the individual items and have been grouped together based on the requirement of ensuring that each item parcel reflects each construct to an equal degree (Russell, Kahn, Spoth, & Altmaier, 1998). There are a number of advantages to using parcels, but in this specific study they have had the effect of reducing the idiosyncrasies or anomalies in individual items (Russell et al., 1998).

Confirmatory factor analysis (CFA) and structural equation modelling was used to test the hypotheses. CFA and the creation of a measurement model, provides an indication of whether the items attached with each unobserved construct are significant predictors of that construct (Ho, 2000). The fit of the structural equation models will be assessed using incremental fit indices (e.g. NFI, RFI, IFI, TLI and CFI) and parsimonious fit indices (e.g. PNFI and AIC).

MEASURES

Psychological climate

The psychological climate items were adapted from the measures developed by Jones and James (1979), James and James (1989), Koys and DeCotiis (1991) and Brown and Leigh (1996). Six factors resulted from the psychological climate items; supervision and management (α= .94), role stress (α= .75), understanding of policies, standards and expectations (α= .83), performance management and top down communication (α= .86) and relationships, harmony and trust (α= .72). Example items include “I feel that the demands of my job are sometimes too much for me to handle” and “My work team is focused on achieving the highest standards in performance.”

Safety climate

The safety climate items have been adapted from the work of a number of researchers, particularly Mearns, Flin, Gordon and Fleming (1998), Neal, Griffin and Hart (2000) and Cheyne, Oliver, Tomás and Cox (2002) as well as the literature review conducted by Guldenmund (2000). Following EFA three safety climate factors remained; safety management (α = .88), safety standards (α = .75) and safety communication (α= .67). Aside from safety communication, each of the reliability coefficients was sufficient (i.e. >.07). Improvements to the safety communication scale were sought through the deletion of items, however none could be made. The use of confirmatory factor analysis to further test the adequacy of this scale, and the theoretical importance of the concept resulted in the decision to retain the safety communication factor.

Example items include “I feel that all levels of management at X always make sure that my workmates and I continually focus on improving safety” and “I feel that all staff at X are involved in discussion regarding safety issues.”

Safety performance

The safety performance items were adapted from the work of Neal, Griffin and Hart (2000) and Cheyne, Oliver, Tomás and Cox (2002). One safety performance factor emerged from the EFA, safety reporting and behaviour (α= .76). Example items include “I always consider the safety of workmates” and “I look the other way if I see workmates behaving unsafely, their behaviour is their business.”

RESULTS

CFA results

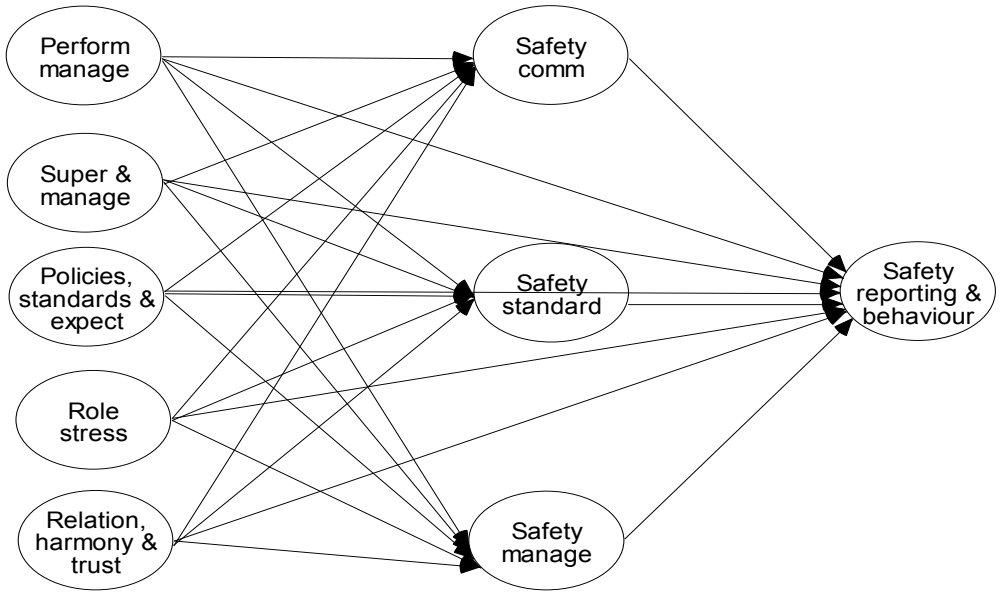
Results for the measurement model or confirmatory factor analysis were conducted using the AMOS program (Arbuckle & Wothke, 1999). The measurement model provided a good fit to the data. The chi-square was insignificant, however this is a reflection of sample size (N= 800, df= 239) = 724.54, p<.05 not the adequacy of the model. The goodness of fit indices, presented in Table Two, is each above .9 which indicates that the model is a good fit to the data.

Table One: Measurement model: Incremental fit indices

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.937	.921	.957	.946	.957
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

The hypothesised structural equation model is presented in Figure One

Figure One: Saturated model: Psychological climate (PC) → safety climate (SC) → safety performance (SP)



Three models, each of which are nested in the saturated model (Figure one), have been competed against each to determine which is a better fit. In the H1 (SC→SP) model the unconstrained paths are those between the safety climate measures and the safety performance measure. The H2 (PC→SP) represents the relationship between the psychological climate factors and the safety performance factors, and as such all other paths have been constrained. In the saturated model, H3 (PC→SP; PC→SC; SC→SP) model no paths have been constrained.

Table Two: Chi-square, Goodness of fit values: Incremental fit indices (NFI, RFI, IFI, TLI, CFI), Parsimonious Normed Fit Index (PNFI), Akaike Information Criterion (AIC), and Model Comparisons

	df	CMIN	P	NFI	RFI	IFI	TLI	CFI	PNFI	AIC
Constrained: SC→SP	63	1966.537	<.001	.830	.805	.849	.826	.848	.725	2092.537
Partially constrained: PC→SP	68	1951.811	<.001	.831	.803	.850	.824	.849	.712	2087.811
Hypothesised PC→SC→SP	83	799.098	<.001	.931	.914	.951	.939	.95	.751	965.098
Model comparisons										
Hypothesised vs. constrained PC→SC→SP vs. SC→SP	20	1167.439	<.001	.101	.103	.109	.112	.102	.026	-1127.439
Hypothesised vs. partially constrained PC→SC→SP vs. PC→SP	15	1152.713	<.001	.100	.102	.112	.114	.101	.039	-1122.713
Partially constrained vs. constrained	5	14.726	.012 <.05	.001	.001	-.002	-.002	.001	-.013	-4.726

Hypothesis one, presented in Figure Two, represents the relationship between the safety climate factors and the dependent safety performance factor (N=800, df= 63)=1966.54, p<.001. Each of the paths presented in hypothesis one is positive and significant according to the critical ratio test (i.e. >±1.96). This model also indicates that 81% of the variance in the dependent variable has been explained by the safety climate variables. This model supports hypothesis one.

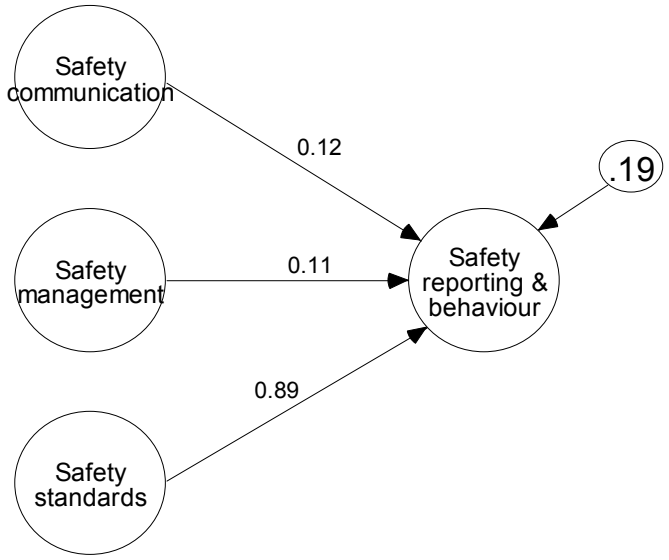


Figure Two: Hypothesis one with path coefficients

Note: All coefficients are standardised and only those statistically significant (<.05) are displayed

Hypothesis two, depicted in Figure Three, examines the relationship between the psychological climate factors and the safety performance factor (N=800, df= 68)=1951.81, p<.001. Only two of the paths between the psychological climate factors and the dependent safety reporting and behaviour factor were significant. The paths between the independent variables policies standards and expectations and role stress and the dependent variable safety reporting and behaviour are both positive in nature. Therefore, the support for hypothesis two is limited.

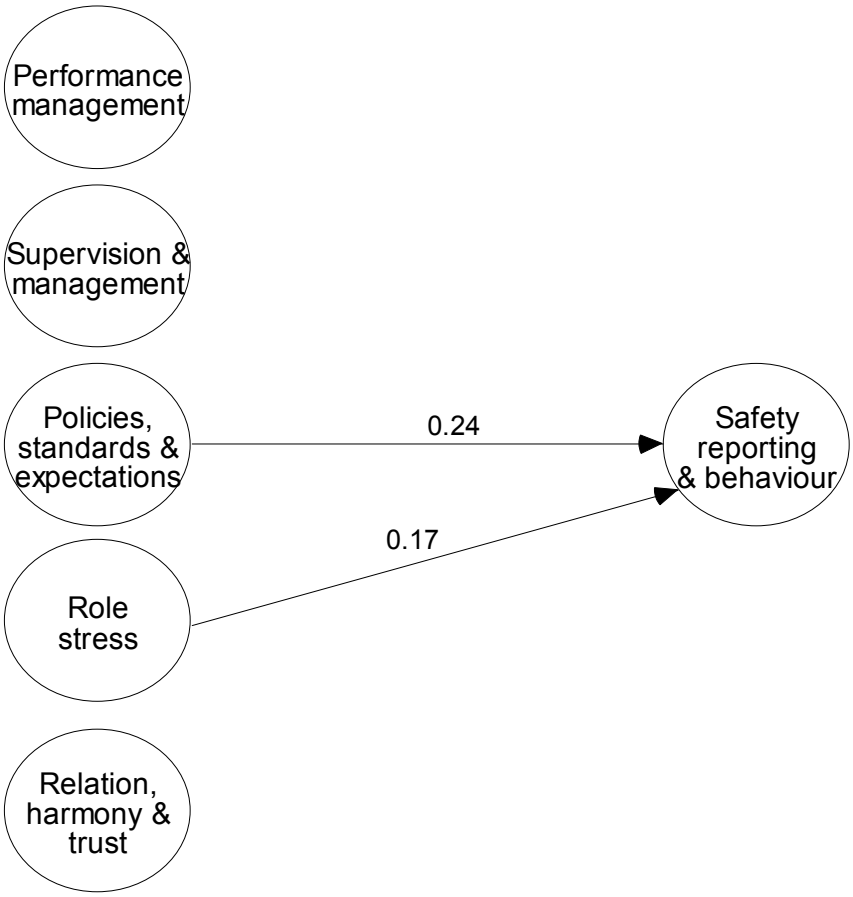


Figure Three: Hypothesis two with path coefficients

Note: All coefficients are standardised and only those statistically significant (<.05) are displayed

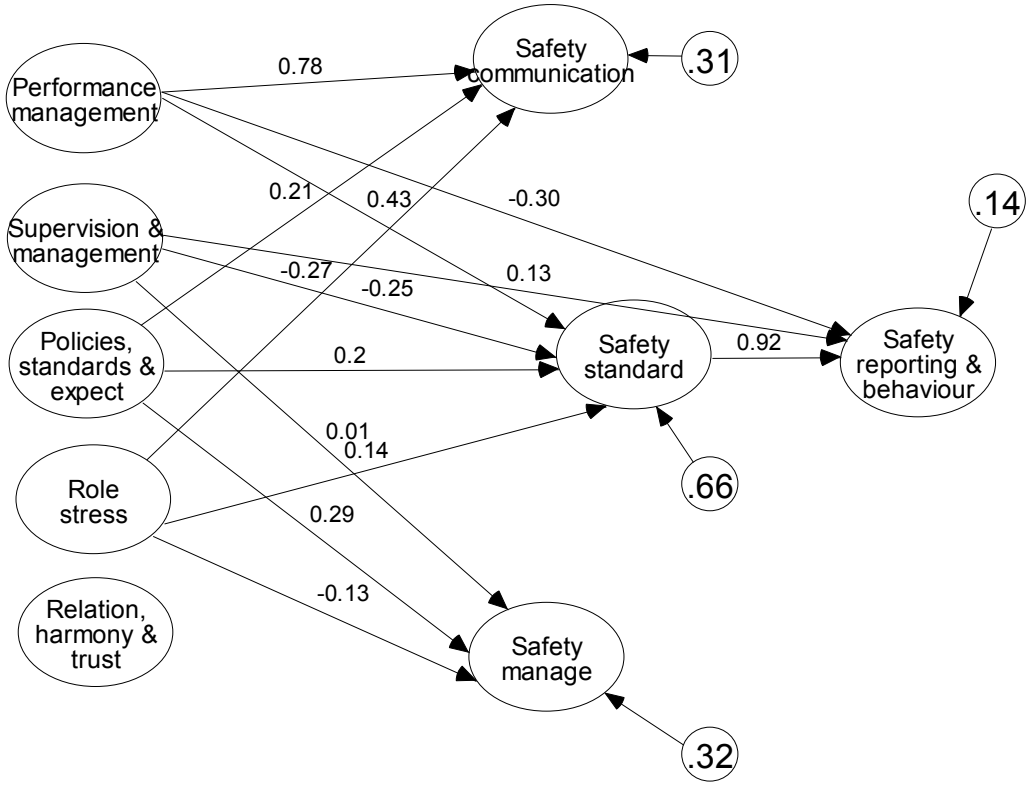
The final model tested was the saturated model, hypothesis three (see Figure Four), in which psychological climate predicts safety climate and safety performance, and where safety climate also predicts safety performance (N=800, df= 83) = 799.098, *p*<.001. This model was a highly significantly better fit than the hypothesis one and hypothesis two models, supporting hypothesis four.

A negative significant relationship exists between the performance management and top down communication factor (Beta= -0.3) and a significant positive relationship between supervision and management (Beta = 0.13) and the dependent variable. The only significant relationship between

the safety climate factors and the dependent variable is between safety standards and is positive (Beta=0.92).

Considerable amounts of variance in the endogenous variables have been explained by the exogenous variables. 86% of the variance in safety reporting and behaviour has been explained by the psychological climate and safety climate variables. Additionally, the psychological climate factors explain 69% of the variance in the safety communication factor, 34% in the safety standards factor and 68% in the safety management factor.

Figure Four: Hypothesis three with coefficients



Note: All coefficients are standardised and only those statistically significant (<.05) are displayed

DISCUSSION

Competing the hypothesised models indicates that the mediated model (H3) is a significantly better fit than the H1 and H2 models. Therefore, H4 is also supported with the data indicating that not only is the mediated model a better fit but also a more parsimonious fit. Neal et al. (2000). Argue that not enough is known about the factors that influence safety climate. The results of this research are aimed at contributing to this body of knowledge.

The impact of incorporating the psychological climate factors in the relationship between safety climate and safety performance has been significant. The psychological climate factors have had such a profound impact on the nature of the relationships that significant relationships between safety climate and safety performance have become insignificant. The implications of this are that we are able to get a better understanding of the way in which the individuals' perceptions of their work environment impact individual behaviour. Additionally, these results provide a tentative indication of the way in which the individuals' perceptions impact the assessment of acceptable

and appropriate behaviours. The outcome of this hypothesis supports the proposition suggested by a number of authors (e.g. Barling & Hutchinson, 2000; Beckmerhagen, Berg, Karapetrovic, & Willborn, 2003; Berger, 1999; Hechanova-Alampay & Beehr, 2001; Hemingway & Smith, 1999; Hofmann & Morgeson, 1999; Reason, Parker, & Lawton, 1998) that individuals do not base their safety specific behaviours on safety climate alone, but rather the perceived organisational environment more generally.

Figure Four indicates that the relationship between psychological climate or the organisational environment and safety performance will not be effective without the articulation of clear and explicit safety standards. Through establishing such performance standards and expectations, general management practices such as performance management and top down communication, policies standards and expectations and a low role stress environment will positively influence safety behaviour. It was unexpected that the impact of psychological climate would be focused so much through safety standards. This relationship however has been supported by previous research suggesting that talking about safety and managing safety as an issue, will not equate to changes in safety performance (Berger, 1999; Hofmann & Stetzer, 1996; Reason et al., 1998), but that employees must be lead by example and be motivated to achieve excellence (Barling et al., 2003). Excellence can only be achieved if the employees understand the standards of excellence.

There are four negative relationships which must be noted but which can not necessarily be explained. Initially, the negative relationship between the management and supervision factor and safety standards could be considered to be a result of managers and supervisors 'managing' other organisational issues, such as production, with such intensity that safety is pushed aside. Alternatively, the management style may be excessively prescriptive and as such may be impacting the extent to which employees feel empowered which has been shown in past research to impact safety performance (Hechanova-Alampay & Beehr, 2001).

A second negative relationship is between performance management and top down communication and safety reporting and behaviour. This relationship may indicate that performance management and the majority of top down communication is centrally focused on productivity related performance issues. This focus on production based performance negatively impacts safety because it is not focused on safety, and safety is not prioritised. The final two negative relationships are between role stress and the two safety climate factors safety communication and safety management. This negative relationship could indicate that role conflict and role overload reflects the clash that occurs between production and safety. This relationship could be argued to be such that without the experience of such role conflict and overload the individual perceives safety communication and safety management to be inadequate.

The impact of psychological climate on the relationship between safety climate and safety performance was not expected. Interestingly however is the fact that the psychological climate factors have explained approximately 68% of the variance in the safety climate factors, safety communication and safety management. This relationship provides support for the hierarchical ordering between general and more specific organisational climates, and specifically that specific climates (i.e. safety, service, innovation) fit under the broader umbrella of organisational climates as has been proposed by a number of authors (Neal et al., 2000; Schneider, Salvaggio, & Subirats, 2002; Schneider, White, & Paul, 1998; Zohar, 1980).

IMPLICATIONS

There are a number of implications of these results in both research and practice. From a perspective of research and academe it is hoped that the placement of safety performance in a general management context will broaden our perspectives in terms of performance management and stakeholder management. The impact of psychological climate on safety climate and safety performance is quite powerful and this should have implications for the way in which we conceptualise the relationship between organisational safety issues and organisational safety performance.

The implications for industry and practice emphasise the inability of paper based safety management, and the latest technology to take the risk out of the organisation. Risk is attached to the individual, because it is based on individual perception. Until the individual believes in organisational safety standards and is committed to the organisational environment, accidents rates will not be decreased below the existing plateau.

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