PERGAMON

Safety Science 42 (2004) 205–220

SAFETY SCIENCE

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OSCI: an organisational and safety climate inventory

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Accepted 24 June 2003

Abstract

After 20 years of research on safety climate, the study of the relationship between safety climate and organisational climate has just begun and has not been fully explored. In this paper, a questionnaire is presented, OSCI (Organisational and Safety Climate Inventory), to address the characterisation of both organisational climate and safety climate. This instrument comprises 78 items and includes the Organisational Climate Questionnaire and the Safety Climate Questionnaire (Safety as an Organisational Value Scale, Content of Safety Climate Scale, Organisational Safety Practices Scale and Personal Involvement with Safety Scale). Two studies tested the psychometric properties of OSCI. In the first study, six independent judges rated the validity of the scales with the Competing Values Model (Quinn, 1988. A beyond Management. Jossy Bass Pubishers, San Francisco, CA.). The results of this study revealed that these items had good construct validity. A second study was developed to test OSCI's reliability and predictive validity with data collected in 15 industrial organisations, from a total of 930 workers. The results of the final version of the scale supported the instrument's reliability and predictive validity.
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Keywords: Safety climate; Organisational climate; Questionnaire research

1. Introduction

In the last 30 years accidents and safety have been studied from many points of view, from engineering to social psychology, in order to contribute to the reduction

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doi:10.1016/S0925-7535(03)00043-2

of work accidents. While many authors have identified the importance of organisational climate (e.g. ACSNI, 1993; Guldenmund, 2000; Zohar, 1980) and safety climate (e.g. Glendon and Stanton, 2000; Glendon and Litherland, 2001; Zohar, 1980) on issues pertaining to accidents and safety behaviour, the interplay and the relationship between the two has been insufficiently explored. Therefore, the main purpose of this paper is to propose an instrument to assess both organisational climate and safety climate.

Turner (1978) developed the first theoretical analysis of organisational vulnerability to technological disasters emphasising the role of organisational beliefs and norms as a framework to understand organisational safety. In line with this emphasis on social and organisational processes, Zohar (1980) introduced the concept of safety climate, a particular type of organisational climate that allegedly could differentiate between low and high accident-rate companies. Safety climate was understood as the "summary of molar perceptions that employees share about safety" (Zohar, 1980, p.96), influencing the appropriate and adaptive safe behaviour. Some years later, the Chernobyl accident provided evidence of technological vulnerability to accidents and a landmark for the study of organisationally- and socially- induced vulnerability. At this time, the term "safety culture" was introduced to refer to one of the antecedents of this accident (INSAG, 1988, cited in IAEA, 1991). Studies used the terms "safety culture" and "safety climate" interchangeably, giving rise to many discussion papers (e.g. Glendon and Stanton, 2000; Guldenmund, 2000; Mearns and Flin, 1999; Pidgeon, 1998). This issue represented one of the main theoretical problems in this field. The more consensual theoretical approach was revealed to be the one that considers safety climate as a form of organisational climate and places organisational climate as a context for safety climate development.

Unfortunately, the relationship between organisational climate and safety climate has mainly been a theoretical proposition as there is only one empirical study that addressed this problem. This relevant exception is the work developed by Neal et al.(2000) that presented a first and very important test of a model that links organisational climate to safety climate. Results demonstrated that organisational climate predicts safety climate, which in turn is related to safety performance. However this study presents some limitations. The analysis was reduced to a relation of strength between organisational climate and safety climate. Since the two instruments had different backgrounds, it was not possible to explore more specific relationships between the two concepts. Moreover, although departing from an approach very similar to Zohaŕs definition of safety climate, these authors didn't use any of the existing valid instruments to measure this variable. Besides, the sample was limited to one organisation from a very specific sector (one hospital) placing some doubts about the external validity of the study.

To overcome these problems, our research started by analysing the instruments already used by other authors to assess safety climate, considering their theoretical definitions and operationalisations, the psychometric characteristics of the instruments and their inherent predictive validity.

The first instrument proposed to measure safety climate was developed by Zohar (1980) after a literature review. This 40 item instrument postulates the existence of

eight dimensions and one general index for safety climate level. The results revealed that the instrument was sensitive to different safety climates and specifically that there were differences between industrial sectors (chemical industry presenting a stronger safety climate). In this study the predictive validity of the instrument was also studied and the results revealed a relatively high correlation between general safety level (evaluated by external and independent judges) and safety climate scores. This pioneer work allowed a first approach to this important concept. Successive attempts have been made to overcome some of its limitations, namely, its psychometric quality and a sample limited to industry. Brown and Holmes (1986) carried out research to validate this measure using a confirmatory factor analysis to test the questionnaire factor structure and exploring further differences among industrial workers with different accident experience. The findings did not support the original proposed measurement model and suggested the existence of only three factors (employee perception of how concerned management was about their well-being, employee perception of how active management was with respect to safety, and employee perception of physical risk) measured by ten items. Results also revealed that workers who had experienced work accidents presented a lower perception of management commitment on safety issues. Dedobbeleer and Béland (1991) continued the study of the validity of this questionnaire with a nine item version, administering it to the construction industry. The results of the confirmatory factor analysis reduced the factors to only two: management commitment to safety and workers' involvement in safety. These studies revealed that the instrument developed by Zohar discriminates among organisations with different safety levels and could be applied in different sectors. However, the reduction of successive items limited the initial approach to safety climate. The dimensions of the original Zohar questionnaire focused on perceptions of specific organisational safety practices, while in later studies this instrument was reduced to general statements about safety (as already suggested by Melià and Sesé, 1999).

Williamson et al. (1997) returned to Zohar's safety climate definition to develop a measure of attitudes, perceptions and awareness of safety related to safety climate. The analysis of the final 32 items suggested five factors (personal motivation for safe behaviour, positive safety practices, risk justification, fatalism and optimism) and revealed an acceptable internal consistency. Although this questionnaire was mainly constructed from an individualistic perspective the results also showed some predictive validity. Specifically, workers who had suffered accidents perceived the existence of poorer safety practices in their workplace than those who had not had personal accident experience.

Concomitantly, other safety climate measures were developed from different perspectives. For instance, Ostrom et al. (1993) proposed another instrument, the EG&G Idaho safety norm survey. This survey comprised 12 dimensions (e.g. safety awareness, teamwork, pride and commitment, procedure compliance) that covered 88 statements about safety norms. The results obtained with the application to 4000 employees in industry (mainly from the chemical and nuclear industry) revealed that the questionnaire presented quite good consistency. Even so, in a more careful analysis of the items and respective dimensions it is possible to observe some threats to the

construct validity, mainly due to discrepancies between the definition of norms and the operationalisation of some items, and between dimensions and the corresponding items. The descriptive statistics analysis for different organisations revealed the existence of fewer safety norms in organisations with more accidents.

In sum, this literature review suggests that the field of safety climate is characterised by a great diversity of instruments that are not fully explored in relation to psychometric qualities, validated in samples and does not test comprehensive theoretical models. In fact, some approaches consider the safety climate as organisational perceptions or norms, while others focus on more individual perceptions or risk estimates. Some instruments focus on general characteristics of the safety climate while others look for specific dimensions. In addition the evaluation of predictive validity of the instruments has mainly been done by using self-report measures of accident experience; organisational measures of safety (such as safety expert's evaluations or organisation accident level), being a more adequate and objective way of assessing the predictive validity are much more rare.

The first goal of the present study was to develop an instrument (considering those that already existed) that allowed the characterisation of both organisational and safety climate in order to test their relationship and interplay. A second goal was to develop a theoretically driven and supported instrument, departing from an organisational climate model and allowing the identification of various dimensions to characterise safety climate. Besides, we intended to overcome some of the validity questions present in previous works.

In our approach, both climates (organisational and safety) comprise shared perceptions about organisational values, norms, practices and procedures that can be observed at general or specific levels. Organisational climate is defined as the shared perceptions about organisational values, norms, beliefs, practices and procedures (Denison, 1996; Guldenmund, 2000; Reichers and Schneider, 1990; Schein, 1992; van Muijen, 1998). Safety climate is understood as the shared perceptions about safety values, norms, beliefs, practices and procedures (e.g., Cox and Flin, 1998; Flin et al., 2000; Guldenmund, 2000). At a general level it is possible to evaluate the overall importance given to safety and at a specific level it is important to consider the main orientations, practices and personal involvement with safety.

In order to characterise the organisational and safety climate's main content orientations using a compatible tool, the competing value model (Cameron and Quinn, 1999; Quinn, 1988; Quinn and Spreitzer, 1991) was employed. This model postulates that organisational climate can be characterised by considering two dimensions representing the inherent tensions that organisations have to solve in order to survive: the first dimension emphasises the internal versus external focus, while the second dimension emphasises flexibility versus control. When put together, these two dimensions result in four climate content orientations (support, innovation, rules, goals) (van Muijen, 1998). The fundamental feature of this model is the possibility of simultaneously characterising the strength and the content orientation of climates. Through this model it is possible to analyse the perceptions of general organisational values and norms, and also specific safety values and norms. Besides, to characterise the specific organisational practices and personal involvement with safety the work of other

authors was considered (e.g. Brown and Holmes, 1986; Cooper, 1998; Dedobbeleer and Béland, 1991; Diaz and Cabrera, 1997; Glendon and Litherland, 2001; Mearns and Flin, 1999; Ostrom et al., 1993; Williamson et al., 1997).

Two studies were conducted in order to guarantee and test the quality of the questionnaire, called the Organisational and Safety Climate Inventory (OSCI). The first study deals with the content validity of the questionnaire while the second study tests the reliability, factor structure and predictive validity.

2. Study 1—organisational and safety climate

The goal of this first study was to test the content validity of the items chosen to assess organisational climate and safety climate, i.e. whether the derived items reflected the theoretical dimensions proposed by the competing values model (Quinn, 1988).

2.1. Method

2.1.1. Participants

Six female senior psychology students (who had already attended several courses in organisational psychology and were familiar with Quinn's approach to organisational culture) participated in this study as independent judges.

2.1.2. Materials

2.1.2.1. Organisational climate items. The items for organisational climate were derived from the competing values model, based on the Quinn, (1988) diagnostic tool, the Portuguese version of FOCUS (Neves, 2000; van Muijen, et al., 1999) and on a Portuguese scale of organisational values (Vala et al., 1994). Forty-four items were included, 11 for each climate orientation (support; innovation; goals; rules), representing perceptions of values, norms and beliefs, some examples are presented in Table 1a.

2.1.2.2. Safety climate items. The items for safety climate orientations were created by the authors by applying the competing values model to the field of safety. Sixteen items were used, four for each safety climate orientation (see Table 1b). Ten items were adapted from Ostrom et al., (1993) and, in order to balance the item's dis-

Table 1a
Examples for organisational climate items (translated to English)

Content	Item example
Support	In your organisation workers' participation in organisational daily operation is important.
Innovation	In your organisation individual initiative is important.
Goals	This organisation is very competitive, always striving to beat rival companies.
Rules	In this organisation hierarchy is very important, ''nothing can be done'' without supervisor approval.

Table 1b
Examples for safety climate items (translated to English)

Content	Item example
Support	In this organisation people's safety is very important.
Innovation	In this organisation new safety norms are frequently implemented.
Goals	In this organisation people are always trying to work with more safety, even when their performance is already safe.
Rules	In this organisation it is very important to follow safety rules.

tribution, four were developed by our team following the definitions for safety climate orientations.

2.1.2.3. Category definition for organisational and safety climate. The categories in which the items should be coded were explained to the judges and afterwards the judges received a booklet with the definitions for each category (see Appendices 1 and 2).

2.1.3. Procedure

Each judge worked independently. They received a list with the items, the booklets and a coding grid with which they would classify each item according to the category definitions.

The material was given to the judges after a brief explanation of their task. In the first phase, the judges had to read the categories and fully understand the definitions and subsequently classify the items.

2.2. Results

A comparison was made between the judges' coding results and the initial theoretical categories in order to test the content validity of the items. To proceed to these analyses, Cohen's Kappa index was calculated (according to Cohen, 1960, 1968). The results revealed that the items for organisational climate presented a reasonable Kappa (0.77) and the same occurred for the four climate contents with Kappas ranging from 0.69 and 0.91. However, to improve the content validity of the scale it was decided to remove the items that were miscoded by at least three judges. Following this procedure six items were removed (one from rules, two from innovation and three from goals). A second Kappa calculation was performed for this final version of the scale with 38 items (see Table 2) and very good Kappas were obtained for the organisational climate scale (0.87) and for the content sub-scales which ranged from 0.83 to 0.94.

A similar analysis procedure was applied to the safety climate content. The results for the first version of the scale also showed reasonable Kappas for the safety climate content (0.63) and for the four safety climate contents (0.55–0.88). Nevertheless, after some items were removed, the second Kappa calculation for the resulting 12 items

Table 2
K Cohen for Organisational Climate and Safety Climate Content (final version)

Climate content	Items	K Cohen
Support	11	0.91
Goals	8	0.83
Innovation	8	0.88
Rules	10	0.94
Organisational (total)	38	0.87
Support	4	1.00
Goals	2	0.84
Innovation	3	0.92
Rules	3	0.94
Safety (total)	12	0.92

(see Table 2) presented very good results for both the safety climate scale (0.92) and for the four content sub-scales ranging from 0.84 and 1.0.

The results of this first study show that the statements used to assess both organisational climate and safety climate were compatible with our theoretical framework. In fact, the Kappa values indicate that both groups of questions were correctly identified by the judges into the categories proposed by Quinn's model.

3. Study 2—OSCI development

Based on our definitions of organisational climate and safety climate the Organisational and Safety Climate Inventory (OSCI) was developed comprising the two scales already presented and three more scales were included to cover the propositions of other authors. Contrary to other authors, who have used, indiscriminately, individual and organisational variables in the evaluation of safety climate and predictive validity, in our approach all the scales focus on the organisational level. The same applies to the predictive validity, which is assessed through objective organisational accident indices.

This second study aims at analysing the psychometric attributes of OSCI, namely its reliability, factor structure and predictive validity.

3.1. Method

3.1.1. Participants

The sample included 930 participants from 15 Portuguese organisations in different sectors (e.g. chemical industry, electricity industry, public administration, and health). These participants represented about 40% of the workforce of those organisations.

The majority of participants were male (78.8%) with ages ranging between 20 and 60 years old (43.8% with ages between 31 and 45), and education levels from 4th

grade to graduates (65.9% at least 6th grade). These workers had extensive experience of working in the organisation (mean tenure = 14.8 years) and belonged to all hierarchical levels, although the majority (61.4%) were operators. The sample stratification was based on the relative size of the various departments in the companies, resulting in a random sample in which the various departments were represented proportionally.

3.1.2. Materials

The material collected for this study included the OSCI inventory and, in order to test predictive validity, statistical information regarding accidents was also gathered for each company.

The initial full version of OSCI included 125 items in two questionnaires: OSCI— Organisational Climate Questionnaire and OSCI— Safety Climate Questionnaire. The specific scales of Organisational Climate Content and Safety Climate Content tested in the first study were included in these questionnaires. After a first set of reliability analyses of the scales the initial version was reduced to 78 items (final version) and it is this version that is described and analysed below.

3.1.2.1. OSCI—organisational climate questionnaire. The organisational climate questionnaire includes 22 items covering the four content dimensions (support, goals, rules, and innovation) already described in study 1 and presented in Table 2. The answers were given on a seven point Likert-type scale (1— totally disagree to 7— totally agree). An average score is computed for each content dimension and besides an organisational climate strength index was composed to allow the characterisation of the overall climate strength. This index corresponds to the mean of the four content dimensions.

3.1.2.2. OSCI—safety climate questionnaire. The safety climate questionnaire includes four main scales: safety climate content scale, safety as an organisational value scale, organisational safety practices scale and personal involvement with safety scale. Table 3 presents the structure of the safety climate section.

Content of safety climate scale. The content of the safety climate scale is an adaptation of the ICOS organisational climate scale to assess safety issues, and includes 11 items covering the four content dimensions already described in study 1 and presented in Table 2. The answers were given on a seven point Likert-type scale (1- totally disagree to 7- totally agree). An average score is computed for each content dimension and besides safety climate content, strength index was composed to allow the characterisation of the overall climate strength. This index corresponds to the mean of the four content dimensions.

Safety as an organisational value. This scale includes five general statements about the importance attributed to safety in the company (e.g. "In this organisation the safety of people is something very important"). The answers were also given on a seven point Likert-type scale (1- totally disagree to 7- totally agree).

Table 3
Structure and composition of the safety climate questionnaire

Scale	Dimensions	Number of items	Alpha
Content of safety climate	Support	4	0.78
	Goals	2	0.72
	Innovation	2	0.72
	Rules	3	0.79
Safety as an organisational value	Safety as an organisational value	5	0.83
Organisational safety practices	Management safety activities	3	0.77
	Safety training	3	0.82
	Safety effectiveness	4	0.77
	Quality of safety communication	4	0.72
	Effects of required work pace on safety	4	0.77
	Organisational learning from accidents	4	0.79
Personal involvement with safety	Personal commitment to safety	3	0.73
	Safety internalisation	2	0.75
	Safety pride	3	0.78

Organisational safety practices scale. This scale was developed to include specific and relevant organisational safety behaviours (Cooper, 1998; Flin et al., 2000) and followed the items suggested by Carroll (1998), Cox and Cox (1991), Faria (1996), Lee (1998), Ostrom et al. (1993), Williamson et al. (1997). It includes 22 statements related to management safety activities (e.g. reversed item "Management only starts to worry about safety after an accident"), safety training (e.g. "In this organisation safety training is done on a regular basis"), safety effectiveness (e.g. "In this organisation the safety equipment is always available"), organisational learning with accidents (e.g. "In this organisation when an accident occurs safety norms are readjusted"), quality of safety communications (e.g. reversed item "In this organisation we do not discuss safety statistics") and the effects of required work space on safety (e.g. reversed item "In my organisation sometimes is necessary to take risks in order to finish our work faster"). The answers were given on a seven point Likert-type scale (1— totally disagree to 7— totally agree). An average score is calculated for each of the six safety practices and an organisational safety practices strength index was also computed (the mean of the six types of practices).

Personal involvement with safety scale. This last scale refers to various aspects of workers personal involvement with safety, and includes eight statements adapted from other authors (Cox and Cox, 1991; Ostrom et al., 1993). It comprises three dimensions: personal commitment to safety (e.g. "In this organisation people consider safety as an individual responsibility"), safety internalisation (e.g. "In this organisation people work safely even when the supervisor is not present") and safety pride (e.g. "In this organisation people feel proud of working safely"). The answers were given on a seven point Likert-type scale (1— totally disagree to 7— totally agree). An average score is computed for each involvement dimension and, besides, a personal involvement strength index was composed corresponding to the mean of the three personal involvement dimensions.

3.1.2.3. Accident data. Accident data were collected from each company, considering three main criteria pointed out by the Responsible Care (1998) definitions. The first index referred to the Accident Rate, namely lost time through injury, defined as "an instantaneous bodily defect so that the individual is physically or mentally unable—as determined by a competent medical authority—to work on a schedule day or shift, resulting in at least three days off the job" (Responsible Care, 1998, p.9). The second index was the Accident Frequency Rate, understood as the amount of time lost through injuries per million working hours. The third index was Severity Rate defined as the number of workdays lost per million working hours.

This data was only analyzed for the seven organizations that had accident indices well defined and that followed the definitions presented above.

3.1.3. Procedure

The study was conducted in two main phases. In the first phase the initial contact was established and data were collected for describing the company and accidents. In the second phase the questionnaire was distributed to the participants in an anonymous envelope. The envelope contained three items: a letter from the team leader presenting the study, a brief set of questionnaire instructions, and the questionnaire. As soon as the study was concluded, each company received a report with their main results. All data were obtained during the year 2000.

3.2. Results

3.2.1. Reliability

The OSCI reliability was assessed calculating Cronbach's coefficient alpha, inter-item correlations and item-total correlations for all the organisational and safety scales, dimensions and indices.

The reliability of the final version of the Organisational Climate Questionnaire reveals a very good internal consistency for all the dimensions (alphas from 0.77 to 0.90). This version also presents reasonable inter-item correlations varying between 0.32 and 0.77 and good item-total correlations that ranged from 0.42 to 0.86.

With regard to the final version of the Safety Climate Questionnaire (Table 3) this also presents very good internal consistency for all the scales and dimensions with alphas ranging from 0.72 to 0.83 and reasonable inter-item correlations (ranging from 0.32 to 0.79) and item-total correlations (between 0.44 and 0.74).

3.2.2. Confirmatory factor analysis

Following the procedure already used by other authors (Brown and Holmes, 1986; Dedobbeleer and Béland, 1991; Melià and Sesé, 1999; Neal et al., 2000) the final version of the safety climate questionnaire was submitted to a confirmatory factor analysis (using AMOS 4.0 structural equations modeling program). The main goal of this analysis main goal was to test if the theoretically driven structure of the safety climate questionnaire was reflected in the data. This goal was accomplished through two steps. In a first step, a test of a second order structure of the questionnaire was conducted, where the four scales (content of safety climate; safety as an organisa-

tional value; organisational safety practices; personal involvement with safety) represented the first order factors and the safety climate was the second order factor. Results, considering some of the more consensual goodness fit statistics (Byrne, 2001; Kline, 1998), revealed that the model fitted well the data ($\chi^2/df = 4.39$; RSMR = 0.03; GFI = 0.91; NNFI = 0.95; CFI = 0.96; RMSEA = 0.07).

In a second step a similar procedure was applied to confirm the dimensional structure for each scale. These results showed that the dimensions reflected the data well enough for the organisational safety practices scale ($\chi^2/df = 3.41$; RSMR = 0.04; GFI = 0.93; NNFI = 0.92; CFI = 0.94; RMSEA = 0.06), and for the personnel involvement with safety scale ($\chi^2/df = 3.95$; RSMR = 0.02; GFI = 0.98; NNFI = 0.97; CFI = 0.98; RMSEA = 0.06).

In both analyses the only goodness of fit index that was less acceptable was the chi-square value. Even though this index reached significant levels, this fact is mainly explained by the sample size (too large). In fact many authors stress that for large samples the chi-square is always significant (Byrne, 2001, p. 81; Kline, 1998, p. 128).

The results of the confirmatory factor analyses, for the final version of the safety climate questionnaire, revealed that the structure of these scales cover the data well enough and suggest that this structure applies to different organisational sectors with equal success.

The association between organisational climate content and safety climate content was also tested using the structural equation modeling approach. Results revealed a strong association ($r = 0.72$), with organisational climate explaining 52% of the safety climate variance (RSMR = 0.03; GFI = 0.96; NNFI = 0.97; CFI = 0.98; RMSEA = 0.08). These are much more robust effects than those reported by Neal et al. (2000).

3.2.3. Predictive validity

The predictive validity of the questionnaire was examined through correlations among organisational climate, safety climate and accident data. To proceed with this analysis, each organisation was considered as a case and only companies that gave the information needed were included. The descriptive results obtained for each organisation (see Table 4) suggest that OSCI strength indices can differentiate between organisations (respectively, $F_{(14,797)} = 9.55$, $P < 0.001$; $F_{(14,865)} = 11.89$, $P < 0.001$; $F_{(14,809)} = 29.69$, $P < 0.001$; $F_{(14,738)} = 26.93$, $P < 0.001$; $F_{(14,819)} = 17.22$, $P < 0.001$). For instance, organisation three presents the strongest organisational and safety climate and at the same time the lowest number, frequency and severity of accidents. On the other hand, organisation eight presents a weaker climate and simultaneously the highest incidence of accidents.

Organisational climate strength, as shown in Table 5, only correlated with one indicator, the accident rate in 1999, suggesting an association between a stronger organisational climate and fewer accidents. On the other hand, safety climate content, safety practices and personal involvement were all highly correlated with the accident rate in 1999 (see Table 5) and the strength of safety practices was also found to be strongly associated with a lower frequency rate in 1999. Although the

Table 4
Descriptive results for organisational and strength of safety climate and 1999 accident data for each organisation ($n = 15$)[a]

Org	OCS		SOV		SCS		OSPS		PISS		Ac.	FR	SR
	M	S.D.	M	S.D.	M	S.D.	M	S.D.	M	S.D.			
1	5.32	1.01	5.79	1.11	5.50	1.05	5.21	0.91	5.34	1.02	5	–	–
2	4.68	0.95	4.99	1.02	3.96	0.88	3.91	0.62	4.33	0.92	24	–	–
3	5.92	0.79	6.41	0.69	6.09	0.85	5.86	0.82	6.09	0.74	0	0.0	0.0
4	5.42	1.03	6.02	0.88	5.67	0.85	5.43	1.01	5.74	1.13	1	3.5	–
5	5.54	0.75	5.72	0.94	5.07	1.01	4.96	0.87	5.18	0.87	–	8.7	0.20
6	5.68	0.68	5.94	0.82	5.30	0.86	5.13	0.85	5.26	0.92	–	13.9	0.37
7	4.96	0.79	5.26	0.96	4.96	0.89	4.99	0.84	5.10	0.87	5	3.9	0.12
8	5.28	0.86	5.19	1.24	4.39	1.13	4.47	0.78	4.48	1.07	20	44	0.60
9	4.69	1.24	4.82	1.27	3.99	1.26	3.86	0.85	4.40	1.09	6	–	–
10	5.04	1.14	4.91	1.39	3.56	1.20	3.89	0.83	4.32	1.19	–	–	–
11	5.31	0.94	5.27	1.10	4.29	0.95	4.28	0.75	4.60	0.95	–	–	–
12	5.35	1.03	5.33	1.18	3.92	1.26	4.10	0.82	4.29	1.27	–	–	–
13	5.98	0.35	6.33	0.56	5.53	0.65	5.39	0.31	5.71	0.79	–	–	–
14	5.11	1.12	5.60	1.16	4.69	0.97	4.50	0.68	5.13	0.98	–	–	–
15	4.37	1.17	4.58	1.12	4.08	1.03	4.49	0.75	3.97	0.98	–	–	–

[a] OCS—Organisational Climate Strength index; SOV—Safety as an organisational value; SCS—Safety Climate Strength index; OSPS—Organisational Safety Practices Strength index; PISS—Personal Involvement with Safety Strength index; Ac—Accident rate for 1999; FR—Frequency Rate for 1999; SR—Severity Rate for 1999.

Table 5
Correlations (Rho Spearman) and effect size for relations between organisational and strength of safety climate and accident data for 1999 ($n = 7$)[a]

	Accidents		Frequency rate		Severity rate	
	ρ	r^2	ρ	r^2	ρ	r^2
Strength of organisational climate	−0.865*	0.75	−0.31	0.09	−0.30	0.09
Strength of safety climate	−0.955**	0.91	−0.77	0.59	−0.60	0.36
Strength of safety as a value	−0.883**	0.78	−0.77	0.59	−0.60	0.36
Strength of safety practices	−0.883**	0.78	−0.83*	0.69	−0.70	0.49
Strength of personal involvement	−0.955**	0.91	−0.77	0.59	−0.60	0.36

[a] **$p < 0.01$ and * $p < 0.05$

other correlations, e.g. for severity rate, were not found to be statistically significant, all the results are in the expected direction. In other words, all the associations seem to suggest that a stronger safety climate is associated with fewer accidents and with less severe accidents. It should be noted, however, that although our effect sizes are quite good (R^2 between 0.36 and 0.92) the limited number of the companies lowers the power of the test, and sometimes these are not statistically significant. In general,

these results suggest that OSCI has some capacity to predict and distinguish organisations with different accident levels.

4. Discussion

The present paper reports the development of a new instrument intended to measure organisational climate and safety climate (OSCI). This questionnaire was developed considering the theoretical definition of both concepts and after a literature review in this field (Cooper, 1998; Flin et al., 2000). Organisational climate is understood to be the shared perceptions about organisational values, norms, beliefs, practices and procedures (Denison, 1996; Guldenmund, 2000; Reichers and Schneider, 1990; Schein, 1992; van Muijen, 1998) and safety climate as the shared perceptions about safety values, norms, beliefs, practices and procedures (e.g., Cox and Flin, 1998; Flin et al., 2000, Guldenmund, 2000). The questionnaire was developed and its validity and reliability were analysed in two studies.

The first study aimed to test the construct validity of the items that were created to measure organisational climate and safety climate content (starting from the competing values model of Quinn, 1988) . The results obtained using Cohen's Kappa suggested that removing some items would improve its content validity. After a review the final items presented very good construct validity.

In the second study the OSCI was tested in order to further explore its reliability and predictive validity. After a first reliability analysis some items were removed and the final version of the questionnaire comprised 78 items. This final version presents a very good reliability and a reasonable predictive validity. Results confirmed the factor structure of the safety climate questionnaire. Even though it was not our goal to test the association between organisational climate and safety climate, a first analysis was conducted and the results appeared very positive.

This research represents an effort to articulate two concepts that are often misleading and misunderstood (Guldenmund, 2000; Mearns and Flin, 1999; Pidgeon, 1998) by using a coherent theoretical approach. Thus, based on extensive literature review, the theoretical concepts were clearly defined and their operationalisation was mainly theoretically driven. The OSCI follows recent suggestions of Neal et al. (2000). Represents an innovation in the safety field since it is the first instrument that allows the characterisation of both organisational and safety climate using the same theoretical model to comprise both climate contents. In other words, with this inventory it will be possible to directly test the relationship between an organisation's climate and its safety climate.

It should also be noted that this instrument was applied in 15 organisations belonging to very different sectors (from services to industry). This fact increases the OSCI's external validity.

Finally, another main feature of the proposed instrument is the fact that it includes general and specific dimensions of safety climate. Using OSCI it is possible to characterise safety climate in a more general way referring to the overall impor-

tance given to safety (as already done by e.g. Brown & Holmes, 1986) and it is also possible to identify strengths or weaknesses at a more specific level (e.g. safety training). This feature allows for the use of OSCI as a diagnostic and intervention tool for organisational safety climate.

In the future, further research is needed to determine if the present questionnaire still predicts accidents in a bigger sample and to verify if the OSCI also has some discriminant and convergent validity and presents stability over time. Moreover, it is also important to analyse specific relationships between organisational climate and safety climate to acknowledge more specific consequences for practical interventions in this field. Finally, it would also be very valuable, as already suggested by other authors (e.g. Guldenmund, 2000), to explore the relation between safety climate and safety culture in order to conclude about the nature and relevance of these two approaches.

Acknowledgements

This research was supported by the Foundation for Science and Technology through the PRAXIS Program, PRAXIS/P/PSI/13042/1998. We would like to express our gratitude to all the organizations that allowed us to collect the data we needed to conduct this study.

The authors also thank two anonymous reviewers for valuable comments on an earlier draft of this manuscript.

Appendix A. Definitions for organisational climate orientations

Orientation	Definition
Support	It is characterised by an emphasis on flexibility with a focus on the internal organisation. This means that the organisation emphasises the human resources, teamwork and participation. The main goal is group maintenance.
Innovation	It represents an emphasis on flexibility, but with a focus on the external environment, thus expressing an emphasis on being innovative, encouraging individual initiative. The main goal is personal and organisational development.
Goals	It corresponds to the external focus but with a control emphasis. The concern here is to be productive, achieve goals and to dominate the market. The main goal is competitiveness.
Rules	It is characterised by an emphasis on control, with a focus on the internal environment, thus revealing great stress on the hierarchy power, stability. The main goal is the implementation of regulations.

Appendix B. Definitions for Safety Climate orientations

Orientation	Definition
Support	It is characterised by an emphasis on flexibility with a focus on the internal organisation, which means that the organisation emphasises the workers' well-being, teamwork and participation in safety issues. The main goal is to work safely.
Innovation	It represents an emphasis on flexibility but with a focus on the external environment, expressing an emphasis on being innovative in safety, encouraging individual initiative for safety issues. The main goal is to continuously improve the safety measures.
Goals	It corresponds to the external focus, but with a control emphasis. The concern here is to reduce the number of accidents, and the main goal is to define safety goals.
Rules	It is characterised by an emphasis on control with a focus on the internal environment, revealing great stress on defining rules, controlling safety rules behaviour, and setting punishments for misbehaviour. The main goal is the implementation of safety regulations.

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