



PERGAMON

Safety Science 36 (2000) 111–136

SAFETY SCIENCE

www.elsevier.com/locate/ssci

Towards a model of safety culture

M.D. Cooper Ph.D. *

BSMS Inc, 6648 East State Road 44, Franklin, IN 46131. □
e-mail: info@bsms-inc.com

Abstract

Organisational culture is a concept often used to describe shared corporate values that affect and influence members' attitudes and behaviours. Safety culture is a sub-facet of organisational culture, which is thought to affect members' attitudes and behaviour in relation to an organisation's ongoing health and safety performance. However, the myriad of definitions of 'organisational culture' and 'safety culture' that abound in both the management and safety literature suggests that the concept of business-specific cultures is not clear-cut. Placing such 'culture' constructs into a goal-setting paradigm appears to provide greater clarity than has hitherto been the case. Moreover, as yet there is no universally accepted model with which to formulate testable hypotheses that take into account antecedents, behaviour(s) and consequence(s). A reciprocal model of safety culture drawn from Social Cognitive Theory (Bandura, 1986. *Social Foundation of Thought and Action: A Social Cognitive Theory*. Prentice Hall, Englewood Cliffs, NJ.) is offered so as to provide both a theoretical and practical framework with which to measure and analyse safety culture. Implications for future research to establish the model's utility and validity are addressed. © 2000 Elsevier Science Ltd. All rights reserved.

Keywords: Organisational culture; Safety culture; Goal-setting; Reciprocal determinism; Triangulation; Safety climate; Safety behaviour; Safety management systems; Levels of measurement; Levels of analysis

1. Introduction

Many industries around the world are showing an increasing interest in the concept of 'safety culture' as a means of reducing the potential for large-scale disasters, and accidents associated with routine tasks. Publicly stated aims of achieving homogeneous worldwide safety cultures in the offshore (May, 1998), nuclear (Rosen, 1997) and shipping (Payer, 1998) industries testify to its growing importance. Although well intentioned, such aims also illustrate the confusion that

* Tel.: +44-1482-708899.

surrounds the concept. This confusion appears to emanate from fragmented and unsystematic empirical efforts using underspecified theoretical concepts (Kennedy and Kirwan, 1995), that is perhaps due to a lack of an underlying integrative framework (Flin, 1998) which can be used to guide examinations of the safety culture construct in a wide range of contexts.

2. The concept of corporate culture

In response to the recognition that its structure has limitations in providing the 'glue' that holds organisations together, much management thinking over the last two decades has focused on the concept of corporate culture. Some of the writings on the topic (e.g. Peters and Waterman, 1982; Ouchi, 1981; Pascale and Athos, 1981; Deal and Kennedy, 1982; Hofstede, 1990) have been extremely influential among practising managers, mainly via its assumed relationship with organisational performance. It is generally thought that a well-developed and business-specific culture into which managers and employees are thoroughly socialised will lead to stronger organisational commitment, more efficient performance and generally higher productivity (Deal and Kennedy, 1982; Graves, 1986; Hamden-Turner, 1990). Usually based upon a blend of visionary ideas, corporate culture appears to reflect *shared* behaviours, beliefs, attitudes and values regarding *organisational goals, functions* and *procedures* which are seen to characterise particular organisations (Furnham and Gunter, 1993). The maintenance of the dominating corporate culture within any organisation, therefore, is supported by ongoing analyses of organisational systems, goal-directed behaviour, attitudes and performance outcomes (Fry and Killing, 1989). However, due to a general lack of information on how culture works, or how it can be shaped, changed or otherwise managed in practise (Furnham and Gunter, 1993), there is no consistent definition of what corporate culture might be (Williams et al., 1989). The main difference between such definitions appear to reside in their focus on the way people think, *or* on the way people behave (Williams et al., 1989), although some focus on both the way people think and behave (e.g. Margulies and Raia, 1978; Uttal, 1983).

Williams et al. (1989) take issue with the notion that organisational culture reflects *shared* behaviours, beliefs, attitudes and values. They argue that not all organisational members respond in the same way in any given situation, although there may be a tendency for them to adopt similar styles of dress, modes of conduct, and perceptions of how the organisation does, or should, function. Beliefs, attitudes and values about the organisation, its function or purpose can vary from division to division, department to department, workgroup to workgroup, and from individual to individual. Thus, although an organisation may possess a dominating 'cultural theme', there are likely to be a number of variations in the way in which the theme is expressed throughout the organisation (Williams et al., 1989; Hamden-Turner, 1990; Furnham and Gunter, 1993). For example, one department may put safety before production, whereas another department may put production before safety. In the former, risk assessments might always be conducted prior to starting every job,

while in the latter, people circumvent all the safety rules and procedures to ensure continuation of production. It follows, therefore, that several different sub-cultures will emerge from, or form around, functional groups, hierarchical levels and organisational roles, with *very few* behaviours, beliefs, attitudes or values being commonly shared by the *whole* of the organisation's membership. In turn, these sub-cultures may either be in alignment, or at odds, with the dominating 'cultural' theme. This is not surprising given that organisations are "dynamic, multi-faceted human systems that operate in dynamic environments in which what exactly suits at one time and one place cannot be generalised into a detailed universal truth" (Dawson, 1996, p. 162). Pidgeon (1998) argues that differing sub-cultures actually serve a useful function, as they are a valuable resource for dealing with collective ignorance determined by systemic uncertainty because they provide a diversity of perspectives and interpretation of emerging (safety) problems.

3. The concept of safety culture

The term 'safety culture' first made its appearance in the 1987 OECD Nuclear Agency report (INSAG, 1988) on the 1986 Chernobyl disaster. Gaining international currency over the last decade, it is loosely used to describe the corporate atmosphere or culture in which safety is understood to be, and is accepted as, the number one priority (Cullen, 1990). Unless safety is *the* dominating characteristic of corporate culture, which arguably it should be in high-risk industries, safety culture is a sub-component of corporate culture, which alludes to individual, job, and organisational features that affect and influence health and safety. As such the dominant corporate culture *and* the prevailing context such as downsizing and organisational restructuring (e.g. Pierce, 1998) will exert a considerable influence on its development and vice-versa as both inter-relate and reinforce each other (e.g. Williams, 1991). This latter point illustrates that safety culture does not operate in a vacuum: it affects, and in turn is affected by, other non-safety-related operational processes or organisational systems.

4. Definitions of safety culture

Numerous definitions of safety culture abound in the academic safety literature. Uttal (1983), for example, defined it as "shared values and beliefs that interact with an organisation's structures and control systems to produce behavioural norms". Turner et al. (1989), defined it as, "the set of beliefs, norms, attitudes, roles, and social and technical practices that are concerned with minimising the exposure of employees, managers, customers and members of the public to conditions considered dangerous or injurious". The International Atomic Energy Authority (IAEA, 1991) defined safety culture as, "that assembly of characteristics and attitudes in organisations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their

significance". The Confederation of British Industry (CBI, 1991) defined safety culture as, "the ideas and beliefs that all members of the organisation share about risk, accidents and ill health". The Advisory Committee for Safety in Nuclear Installations, subsequently adopted by the UK Health and Safety Commission (HSC, 1993), defined it as,

...the product of individual and group values, attitudes, competencies, and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organisation's health & safety programmes. Organisations with a positive safety culture are characterised by communications founded on mutual trust, by shared perceptions of the importance of safety, and by confidence in the efficacy of preventative measures.

Carnino (1989), Lee (1993) and Lucas (1990) have also proposed other definitions of a similar nature to those above.

All these definitions are relatively similar in that they can be categorised into a normative beliefs perspective (Cooke and Rousseau, 1988), in so far as each is focused to varying degrees on the way people think and/or behave in relation to safety. Likewise, with the exception of the HSC (1993) these definitions tend to reflect the view that safety culture 'is' rather than something that the organisation 'has'. In the former, safety culture is viewed as an emergent property of social groupings, reflecting an 'interpretative view' favoured by academics and social scientists (e.g. Davies, 1988; Turner, 1988; Schein, 1990; Johnson, 1992), whereas the latter reflects the functionalist view that culture has a pre-determined function favoured by managers and practitioners (e.g. Schneider, 1975; Hofstede, 1990; Kono, 1990; Lundberg, 1990; Furnham and Gunter, 1993). It has been argued that both views are commensurate in that managerial functionalist strategies emerge from interpretative contexts (Waring, 1992). This appears to be the case with the HSC's (1993) definition, which takes the view that safety culture is a product emerging from values, attitudes, competencies, patterns of behaviour, etc. As such it reflects both a functionalist view of 'culture' in terms of purpose and an interpretative view in that safety culture is also an emergent property created by social groupings within the workplace, indicating that normative beliefs are both created by, and revealed to, organisation members within a dynamic reciprocal relationship. Nevertheless, Cox and Cox (1996) suggest that the very broadness of the above definitions weaken their scientific utility, indicating that much greater precision is required.

Given the prominence of the HSC's (1993) definition in guiding researchers, one area requiring precision that appears to have been overlooked by all concerned is the 'product' of the safety culture construct. This oversight has led to an overly narrow emphasis on safety climate (i.e. aggregation of individuals' attitudes and perceptions about safety) via questionnaire surveys (e.g. Zohar, 1980; Cooper and Phillips, 1994; Donald and Canter, 1994) with it being used as a surrogate measure of safety culture, at the expense of the *holistic, multi-faceted* nature of the concept of safety culture itself (e.g. Cox and Cox, 1991; Lee et al., 1993; Coyle et al., 1995; Mearns et

al., 1997; Williamson et al., 1997). Defining this product is important as it could help to clarify what a safety culture should look like in an organisation. It could also help to determine the functional strategies required to develop the ‘product’, and it could provide an outcome measure to assess the degree to which organisations might or might not possess a ‘good’ safety culture. In turn, this could help to minimise the current unsystematic and fragmented approaches to researching safety culture and allow meta-analyses to be conducted at some time in the future. One conceptualisation that is consistent with the assessment characteristics (i.e. direction and intensity) of culture (Rousseau, 1988; Schein, 1990), with the fact that culture belongs to a group of people (Rousseau, 1988), with Deal and Kennedy’s (1982) definition that culture is, “the way we do things around here”, and with Goal-Setting Theory (Locke and Latham, 1990) is, “that observable degree of effort with which all organisational members direct their attention and actions towards improving safety on a daily basis”. In the current context, ‘effort’ refers to the interaction between intensity and persistence of energy expenditure. In other words how much energy a person expends to improve safety, and for how long in the face of obstacles. It is self-evident that what constitutes the units of ‘effort’ could differ in different organisations. Nonetheless, the degree to which members consistently confront others about their unsafe acts, the degree to which members report unsafe conditions, the speed with which members implement remedial actions, the degree to which members give priority to safety over production are all *observable* examples of members directing their efforts to improve safety. Once these units of ‘effort’ are identified, it is a relatively simple procedure to develop checklists with which to measure people against. Complementary measures might include outcome indices, e.g. the remedial action completion rate, the number of completed near-miss reports, etc., which could subsequently be analysed by workgroup, department, etc.

Although tentative, this definition of the safety culture ‘*product*’ does at least provide an ongoing, tangible outcome measure (i.e. consequence) that has been severely lacking, hitherto. Some might argue that reductions in accident/incident rates provide a better outcome measure of safety culture (e.g. Clarke, 1998). However, accident rates can be reduced for a number of reasons that have little to do with ‘safety culture’ per se (e.g. under-reporting as a result of incentive schemes). Even if an organisation did actually achieve a genuine zero accident rate, this outcome measure would suffer from a lack of ongoing evaluative data, making it difficult, if not impossible, to determine the quality of its ongoing ‘safety culture’. Thus, reductions in accident and injury rates, although very important, are not sufficient in themselves to indicate the presence or quality of a safety culture, whereas “that observable degree of effort...” is something that can always be measured and assessed.

Given that the maintenance of organisational cultures are supported by ongoing *analyses* of organisational systems, goal-directed behaviour, attitudes and *performance outcomes* (Fry and Killing, 1989), the definition given for the safety culture ‘*product*’ provides a *dependent variable* with which to assess safety culture improvement initiatives (i.e. has the safety culture improvement initiative led people to direct more of their efforts to improving safety). As such, it should become possible to

empirically examine the links between those personal (e.g. values, beliefs, attitudes), behavioural (e.g. competencies, patterns of behaviour) and situational (e.g. organisational systems and sub-systems) aspects of safety culture reflected in the above definitions, to determine their impact on the development of its 'product'. Again, these links could and should be examined singly and in combination, at the level of the individual, the workgroup and the organisation. In this way, the most effective aspects for developing the safety culture 'product' can be identified, which in turn may help to redefine the concept itself with much greater precision.

5. Strengthening the concept of safety culture

Despite notions that culture cannot easily be created or engineered (e.g. Schein, 1990), in practise, the creation or enhancement of a safety culture *is* dependent upon the deliberate manipulation of various organisational characteristics thought to impact upon safety management practices. The very act of doing so means that the manipulations must be goal-directed (Ryan, 1970). Because goals (ideas of future, ideas of a desired end-state) play a strong causal role in action, Locke and Latham's (1990) Goal-Setting Theory may also serve to provide the requisite scientific utility sought by Cox and Cox (1996). This becomes apparent when the specific purposes of the safety culture definitions outlined above are examined. These include: (1) producing behavioural norms (Uttal, 1983); (2) reductions in accidents and injuries (Turner et al., 1989); (3) ensuring that safety issues receive the attention warranted by their significance (IAEA, 1991); (4) ensuring that organisational members share the same ideas and beliefs about risks, accidents and ill-health (CBI, 1991); (5) increasing people's commitment to safety; and (6) determining the style and proficiency of an organisation's health and safety programmes (HSC, 1993). Each of these purposes can be viewed both as sub-goals (i.e. antecedents) that help an organisation to attain its super-ordinate goal (i.e. creating a safety culture), *and* goal-achievements (i.e. consequences) emanating from the creation of an organisation's safety culture.

If these Goal Theory concepts are accepted, the creation of a safety culture simply becomes a super-ordinate goal, that is achieved by dividing the task into a series of sub-goals that are intended to direct people's attention and actions towards the management of safety. In goal-theoretic terms, performance is a positive function of goal-difficulty (Latham and Lee, 1986; Tubbs, 1986; Mento et al., 1987). The greater the challenge, the better people's performance tends to be (assuming the challenge is accepted). Setting a difficult super-ordinate goal (i.e. creating a safety culture) will therefore place challenging demands on individuals, workgroups, departments, and the organisation as a whole. Dividing the task into more manageable sub-goals that are in themselves challenging and difficult (e.g. conducting risk assessments, getting senior managers to 'walk the talk', etc.) should lead to much greater overall goal-attainment of the super-ordinate goal (Locke and Latham, 1990). Nonetheless, goal-attainment is known to be affected by a number of moderators such as ability e.g. Locke et al., 1984a); goal-commitment (e.g. Erez and Zidon, 1984); goal-conflict

(e.g. Earley and Northcraft, 1989); feedback (e.g. Reber and Wallin, 1984); task complexity (e.g. Wood and Locke, 1990); and, situational constraints (e.g. Kuhl, 1992), *as well as* mediators such as direction of attention, effort and persistence, task-specific strategies (Wood and Locke, 1990) and self-efficacy (Bandura, 1986).

In safety culture terms these goal-related moderators could be viewed as being analogous to safety- and job-related training (i.e. ability); degrees of commitment to safety at various hierarchical levels (i.e. goal-commitment); safety versus productivity, quality, etc. (i.e. goal-conflict); communication flows (i.e. feedback); managerial versus operative's role functions (i.e. task complexity); and lack of resources, workpace, job design issues, etc. (i.e. situational constraints). Similarly, the goal-related mediators could also be translated into safety culture terms. For example, direction of attention, effort, and persistence could reflect actual safety-related behaviour(s) at different hierarchical levels of the organisation. The presence and quality of the organisation's decision-making processes could be analogous to task-specific strategies. Self-efficacy could be translated into individuals', workgroups', departments' and/or business units' *confidence* in pursuing particular courses of action to bring about safety improvements. Importantly, each of these moderators and mediators can be examined individually and in various combinations to assess their impact on both the achievement of sub-goals (e.g. conducting risk assessments for all operational tasks) and the super-ordinate goal (i.e. creating a safety culture).

6. Towards a model of safety culture

To greater or lesser degrees, accident causation models recognise the presence of an interactive or reciprocal relationship between psychological, situational and behavioural factors. Heinrich et al. (1980), for example, identified the interactive relationship between behaviour, situations, and person factors at operator levels. Adams (1976) recognised the reciprocal relationship between all three factors, *and* the time-related causal relationship between high-level strategic decisions and tactical operational errors. Reason's (1993, for example), pathogen model also recognises that person, situational and behavioural factors are the immediate precursors of unsafe acts, that the strength of each may differ, and that it may take time for one element to exert its effects on the other two elements (e.g. the temporal relationships between latent conditions and active failures). This reciprocal relationship was also recognised in the work conducted to identify the organisational characteristics of high versus low accident plants, which emphasised the interaction between organisational systems, modes of organisational behaviour, and people's psychological attributes (e.g. Cohen, 1977; Smith et al., 1978). Clearly, therefore, this interactive relationship between psychological, situational and behavioural factors is applicable to the accident causation chain at all levels of an organisation.

The same interactive relationships are also related to cultural change initiatives, as attempts to understand why Total Quality Management (TQM) initiatives have failed, have made clear (e.g. Cooper and Phillips, 1995). Organisations have often attempted to change people's attitudes without considering either job or

organisational features (Atkinson, 1990). Similarly, changes are often made to organisational systems without regard to people's behaviour or attitudes (Seddon, 1989). Moreover, efforts to change people's behaviour often do not take into account the determining effects of organisational systems or people's attitudes (Wilkinson et al., 1991). These findings suggest that change initiatives that disregard the interactive relationship between psychological, behavioural and situational factors when developing a safety culture are doomed to failure.

A perusal of the component parts of the Advisory Committee for Safety in Nuclear Installations (ASCNI) study groups working definition of safety culture (HSC, 1993) also reveals an implicit recognition of this interactive relationship. For example, individual and group values and attitudes refer to members' perceptions about, and attitudes towards, safety goals; patterns of behaviour refer to members' day-to-day goal-directed safety behaviour; and the style and proficiency of an organisation's health and safety programmes indirectly refer to the presence and quality of organisational safety systems to support goal-directed safety behaviour. Moreover, the second section also implicitly recognises the 'reciprocal' relationship between each of these elements, acknowledged in paragraph 80 of the report which states, "the whole is more than the sum of the parts. The many separate practices interact to give a much larger effect" (p. 23).

Thus, the common thread that can be found in the evidence presented above is the implicit or explicit recognition of the interactive relationship between psychological, behavioural and organisational factors. Consequently, rather than being solely concerned with shared perceptions, meanings, values and beliefs as many writers propose, it can be cogently argued that organisational culture is, "The product of multiple goal-directed interactions between people (psychological), jobs (behavioural) and the organisation (situational)" (Cooper and Phillips, 1995, p. 6; Cooper, 1997b, pp. 17). Viewed from this perspective, the prevailing organisational culture is reflected in the *dynamic reciprocal relationships* between members' perceptions about, and attitudes towards, the operationalisation of organisational goals; members' day-to-day goal-directed behaviour; and the presence and quality of the organisation's systems and sub-systems to support the goal-directed behaviour. In essence this definition reflects Bandura's (1986) model of reciprocal determinism derived from Social Cognitive Theory (SCT).

6.1. Reciprocal determinism

People are neither deterministically controlled by their environments nor entirely self-determining. Instead they exist in a state of reciprocal determinism with their environments whereby they and their environments influence one another in a perpetual dynamic interplay (Davis and Powell, 1992). Both Social Learning Theory (SLT) (Bandura, 1977a) and SCT (Bandura, 1986) explain psychosocial functioning in terms of triadic reciprocal causation, whereby an individual's internal psychological factors, the environment they are in and the behaviour they engage in, all operate as interacting determinants that influence each other bi-directionally (Fig. 1). SLT and SCT are similar to operant theory in so far as they focus on *cognitively*

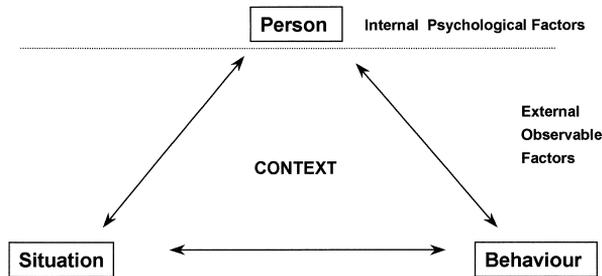


Fig. 1. Bandura's (1977a, b, 1986) model of reciprocal determinism.

based antecedents (e.g. goals or expectancies), behaviours, and consequences (e.g. self-evaluative rewards and/or punishers), while also stressing the use of *observable* variables for assessment purposes. Moreover, both also recognise that an employee might model behaviours learnt from observing others. These learnt behaviours are then further refined through self-corrective judgements based on information feedback derived from performance. In turn, as employees master the learnt behaviours their self-efficacy increases (self-efficacy is defined as the conviction that one can successfully execute the behaviour(s) required to produce the [stated] outcomes) (Bandura, 1977b). Bandura states that reciprocity does not mean that the different sources of influence are of equal strength, neither do the reciprocal influences occur simultaneously. Rather it takes time for a causal factor to exert its influence and to activate reciprocal influences. This bi-directionality of influence means that people are both products and producers of their environment. In other words, situations are as much the function of the person as the person's behaviour is a function of the situation (Bowers, 1973), indicating that people self-regulate their own behaviour, in so far as they rely on cognitive supports and manage relevant environmental cues and consequences (Bandura, 1991). These same principles are equally valid within organisations (e.g. Wood and Bandura, 1989; Wood et al., 1990), particularly in the domain of managerial decision making which is one of the key routes by which 'pathogens' or 'latent conditions' are introduced into organisations (Reason, 1993, 1997).

6.2. Analysing safety culture

Bandura's reciprocal model appears to offer the perfect framework with which to analyse organisational (safety) 'culture' for a number of reasons: first, the psychological, behavioural and situational elements of the model precisely mirror those accident causation relationships found by a number of researchers (e.g. Weaver, 1971; Adams, 1976; Heinrich et al., 1980; Reason, 1990). The potency of the Reciprocal Determinism Model for analysing 'culture', therefore, resides in the explicit recognition that the relative strength of each source may be different in any given situation: e.g. the design of the production system may exert stronger effects on someone's work-related behaviour than that person's attitudes.

Second, its dynamic nature suits the measurement of human and organisational systems that operate in dynamic environments (Dawson, 1996), particularly as the

reciprocal influence exerted on each element, by the other two elements, may not occur simultaneously: e.g. it may take time for a change in behaviour to exert an influence and activate the reciprocal relationship with the work-flow system and/or work-related attitudes.

Third, it provides a ‘triangulation’ methodology with which to encourage multi-level analyses (Jick, 1979). Triangulation refers to the combination of methodologies in the study of the same phenomenon (Denzin, 1978), whereby multiple reference points are used to locate an object’s exact position (Smith, 1975). As such, given the appropriate measuring instruments, triangulation allows researchers to take a *multi-faceted* view of safety culture, so that the reciprocal relationships between psychological, behavioural and situational factors can be examined with a view to establish antecedents, behaviour(s), and consequence(s) *within specific contexts*. Moreover, triangulation lends itself to testing the external validity of the ‘safety culture construct’ (i.e. via a between-method validation process) and crosschecking each method involved in the triangulation process for internal consistency or reliability (i.e. via a ‘within-methods’ triangulation approach).

Finally, it explicitly incorporates the goal-setting paradigm (Wood and Bandura, 1989; Locke and Latham, 1990; Bandura, 1991) advocated above via the setting of sub-goals (Bandura and Schunk, 1981), via task-strategies (e.g. Locke et al., 1984b), via self-regulatory processes (e.g. Bandura, 1988), and via self-efficacy mechanisms (e.g. Robertson and Sadri, 1993). Thinking of the measurement of safety culture in these terms, therefore, provides an organising framework to assist in ongoing practical assessments and analyses, with which the *holistic, multi-faceted* nature of the safety culture construct can be more fully examined in depth.

Bandura’s model of reciprocal determinism has been adapted (Cooper and Phillips, 1995; Cooper, 1996, 1997a, b) to reflect the concept of safety culture. It contains three elements which encompass *subjective* internal psychological factors, *observable* ongoing safety-related behaviours and *objective* situational features (Fig. 2). In this adaptation, the internal psychological factors (i.e. attitudes and perceptions) are assessed via safety climate questionnaires, actual ongoing safety-related behaviour is assessed via checklists developed as a part of behavioural safety initiatives, while the

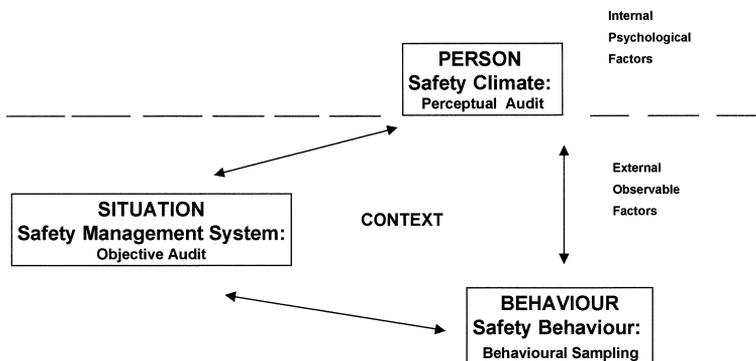


Fig. 2. Reciprocal safety culture model.

situational features are assessed via safety management system audits/inspections. Since each of these safety culture components can be directly measured in their own right, or in combination, it becomes possible to quantify safety culture in a meaningful way at many different organisational levels, which hitherto has been somewhat difficult. Accordingly, the reciprocal framework also has the potential to provide organisations with a common frame of reference for the development of ‘benchmarking’ partnerships with other business units or organisations. This latter point may be particularly important to industries where there is substantial use of specialist sub-contractors (e.g. construction and offshore), as people from different organisations will be able to communicate in the same language. Additionally, it provides a means by which the prevailing safety culture of different business units, departments or work areas can usefully be compared.

The psychological, behavioural and situational elements of the model can also be broken down into exactly the same reciprocal relationships thereby allowing the multi-faceted nature of the safety culture construct to be *systematically* examined, both *within* and *between* the three measurement methods. As such, the reciprocal model provides an integrative way of thinking about the many processes that impact on safety culture. It also provides a triangulated set of measurement instruments that are not solely dependent upon incident or accident indices, and a dynamic framework that provides the means with which to conduct multi-level analyses of the safety culture construct to identify where cause–effect relationships do and do *not* exist.

7. Comparisons with other (safety) culture models

One method of examining whether or not the reciprocal model may have universal applicability is to compare it with other models of (safety) culture. A literature search reveals that very few models of organisational (safety) culture exist. Those that do tend to be adaptations of Schein’s (1992) three-layered cultural model that assesses: (1) core underlying assumptions; (2) espoused beliefs and values; and (3) behaviours and artefacts; e.g. Glendon and Stanton (1998) use Schein’s model in a theoretical attempt to locate where (safety) climate resides in relation to organisational (safety) culture. They also add breadth (i.e. the extent to which cultural elements are shared across an organisation or are localised) and time (i.e. cultural drivers have a past, a present, and a future). Guldenmund (1998) also conceptualises safety culture as a three-level model, whereby each level might be examined separately, or together. The ‘core’ is thought to reflect unspecified basic underlying assumptions that permeate the whole organisation (level 1). Guldenmund has not developed this aspect of the model, but Furnham and Gunter (1993) explored Schein’s cultural model and assert that the underlying assumptions need to be manifest in some way (p. 243): either by inference from the way that beliefs and values are expressed, or by observing behaviours and artefacts. Johnson and Scholes (1999) reinforce this argument by stating that underlying assumptions are the representation in organisational action of what is taken for granted (p. 73). It seems

sensible, therefore, to assume that any organisation's underlying assumptions are reflected in their policies, structure, control systems, styles of management, etc. (Thompson and Luthans, 1990). The middle level consists of publicly declared beliefs and values that are operationalised as attitudes (level 2). Because attitudes have specific objects, Guldenmund places the target of these attitudes into a hardware, software, people and behaviour taxonomy. The most superficial level reflects behaviours and artefacts (level 3). Guldenmund suggests that behaviours might encompass inspections, accidents, near-misses, etc., while safety posters, Personal Protective Equipment (PPE), etc., could be construed as artefacts. As currently conceptualised, however, neither model appears to account for the dynamic nature of culture. Instead, they seem to reflect a linear sequence of cause and effect in so far as the core assumptions dictate people's beliefs and values, which in turn dictates behaviour and the artefacts that reflect the core assumptions. To a large degree this one-way linear sequence mirrors both Azjen and Fishbein's (1980) and Eagly and Chaiken's (1993) model of attitude and behaviour relationship. However, this simple cause-effect model has been shown to be inadequate in many ways (e.g. Festinger, 1957) as it is known that changing behaviour can, and often does, change attitude (e.g. Bandura, 1986, p. 160). Nonetheless, Guldenmund's level 3 is analogous to the behavioural aspects of the reciprocal model, whereby measurement would take some form of behaviour sampling. The psychological aspects are analogous to level 2, whereby safety climate measures are used to assess people's attitudes and perceptions about safety. The situational elements are analogous to level 1, whereby an audit could be used to examine organisation policies, management styles, etc.

Johnson (1992) amalgamates both Schein's (1990) and Hofstede's (1990) culture models. He presents a 'cultural web' that examines level 1 by asking about the dominant paradigm (underlying assumptions), controls and organisation; level 3 is examined via power relationships, stories, symbols (artefacts), rituals and routines (behaviours). As a whole, the cultural web examines level 2 (beliefs and values). Unlike the previous two models of culture based on Schein's work discussed above, Johnson has translated his model into a practical, interpretative tool for assessing culture. As such he has provided a means with which to *qualitatively* examine the prevailing safety culture at any moment in time, while specifically linking the web to the organisation's political, symbolic and structural aspects. Buchan (1999) has applied the cultural web many times, with different groups in many countries to the topic of safety culture in the offshore petrochemical industry. Importantly, the cultural web can also be subsumed within the reciprocal model. For example, the dominant paradigm, stories and symbols could reflect the perceptual/psychological aspects. Rituals and routines and power relationships could be reflected within the behavioural aspects, while the organisation and control elements could be reflected in the situational aspects.

Primarily aimed at preventing organisational, as opposed to individual, accidents, Reason (1997) proposes that a safety culture comprises of various other sub-cultures. Sub-culture is a term that can be used interchangeably to refer to a sub-group of people (i.e. department, workgroup) and an aspect of culture itself (e.g. safety culture is a sub-culture of corporate culture). Reason uses the latter meaning to equate

safety culture with an ‘informed culture’, which is dependent in turn upon a ‘reporting culture’ that is underpinned by a ‘just culture’. Simultaneously, a ‘flexible culture’ is required if the organisation is to reconfigure itself in the light of certain kinds of dangers, which in turn will require a ‘learning culture’. In other words an informed culture (equivalent to a safety culture) comprises of many types of situationally specific cultures (not all of which are safety related), which interact with each other to create the ‘informed culture’. Although underspecified in many respects, the model appears to represent a goal-setting paradigm, in that to engineer a safety culture (super-ordinate goal) it has to be broken down into a series of sub-goals (i.e. develop reporting, just, flexible and learning cultures). Each of these is again dependent upon achieving a further series of sub-goals. In this case, the vast majority of goals and sub-goals relate to management information systems. However, Reason does include other aspects of ‘traditional’ safety management in his model (pp. 219–220). Importantly, Reason’s approach can also be subsumed within the psychological (e.g. just cultures), behavioural (e.g. reporting cultures) and situational (i.e. flexible and learning culture) elements of the reciprocal model. Indeed, doing so may shed light on how each of these sub-cultures interact with each other to create the ‘informed (or safety) culture’.

Geller (1997) also proposes a ‘Total Safety Culture’ model that encompasses ‘the safety triad’ (e.g. Geller, 1989) that recognises the dynamic and interactive relationships between person, environment and behaviour. Moreover, he advocates 10 principles or values that form the basis of a total safety culture. Although the relationships between the three elements have not been addressed, this model is very similar to the reciprocal model advocated here. The main differences reside in the use of the term ‘environment’ rather than ‘situation’, this aspect being based on an engineering approach rather than that of SCT. Restricting the term ‘environment’ to the localisation of factors present on the ‘shopfloor’ (e.g. equipment, tools, machines, etc.) does not address the wider aspects of organisations (e.g. policies, strategies, etc.). Nonetheless, it is self-evident that the reciprocal model encompasses the ‘Total Safety Culture’ model.

In summary, it would appear that the reciprocal model has some general applicability, particularly as it incorporates the underlying features of existing (safety) culture models. Indeed, this strength can be put to good use to allow both the qualitative and quantitative aspects of safety culture to be explored. For example, researchers could make use of Schein’s three-layered model using the ‘cultural web’ to examine the qualitative aspects of safety culture and their meanings. Subsequently, the findings of the cultural web could be used to develop *quantitative* tools that exhibit ‘point-to-point correspondence’ of ‘matched’ factors. Alternatively, quantitative researchers could subsequently adopt the qualitative approach to discover the meanings behind the patterns that emerge from their quantitative research. In either event, the findings of both approaches could be examined via the reciprocal model, which may shed light on the concept of safety culture beyond those found from using only one or the other of these models. However, even if this did not occur, the reciprocal model could still be retrospectively mapped onto other models for comparative purposes, thus providing a common framework with which to draw

together disparate research using the different models. Accordingly, the reciprocal model has the potential to facilitate future meta-analyses of safety culture research.

8. Measurement tools

There are a variety of quantitative and qualitative data collection tools available that can be used to measure the psychological, behavioural and situational aspects of safety culture. Issues related to the reliability and validity of such measures will not be discussed here as they are dealt with in most texts concerned with measurement (e.g. Oppenheim, 1992) and it is assumed that most readers are familiar with the concepts.

In terms of the psychological aspects, perhaps the most familiar tool is the ubiquitous safety climate questionnaire (e.g. Zohar, 1980). Although there are a number of varieties (see Guldenmund, 1998, for a review), these comprise of a series of questions that measure people's beliefs, values, attitudes and perceptions along various dimensions of safety thought to be important to the development of safety culture (e.g. management commitment). These are then used to survey individuals within organisations. Despite the fact that they are actually measuring the psychological climate of an individual at that moment in time, the scores tend to be aggregated at either the group or organisation level to provide indices of the organisation's current safety climate. From a practitioner's point of view the central idea is to use the results to reveal strengths and weaknesses in safety management practices and direct the appropriate remedial actions. From an academic perspective they are used to provide insights into the relationships between each dimension, and how each of these interacts with outcome measures (e.g. behaviour, accident rates, etc.). Empirical examinations of how safety climate interacts with the organisation's overall safety culture (assuming that researchers have adopted some model of safety culture) have not yet been conducted. Alternative measures for capturing the psychological aspects include group interviews and discussion groups, perhaps using the 'Cultural Web' as the starting point (e.g. Buchan, 1999), archival data (e.g. La Porte, 1996), Repertory Grids, and Twenty Statement Tests (e.g. Locatelli and West, 1996), and document analysis (e.g. Kabanoff, 1991; Kabanoff and Holt, 1994).

The behavioural aspects of safety culture can be examined via peer observations, self-report measures and/or outcome measures (e.g. Komaki et al., 1978; Sulzer-Azaroff, 1987; Cooper et al., 1994). Analysing an organisation's accident history for the previous 2 years often reveals a relatively small number of safety behaviours that have been implicated in the vast majority of the organisation's accidents (Cooper 1994, 1997b). Other sources from which to glean 'safe behaviours' include risk assessment documentation, standard operating procedures, permits to work, group discussions, etc. The 'safe' behaviours identified from these analyses are then placed on observational checklists and trained observers regularly monitor personnel against them. The observations are then translated into 'safety percentage scores' to provide feedback to those being monitored. These types of behavioural measures can also be developed for self-monitoring purposes for different layers of management, so

that managerial ‘safety behaviours’ can also be monitored. Other behavioural measures could encompass leadership behaviours (Komaki, 1998). Similarly, composite outcome measures such as the number of completed remedial actions, risk assessments and/or the number of reported near-misses, the numbers of people receiving safety training, the number of weekly inspections completed, the number of safety audits conducted, etc., may also provide alternative behavioural measures.

The situational aspects of safety culture tend to be reflected in organisation’s policies, operating procedures, management systems, control systems, communication flows, and workflow systems (Thompson and Luthans, 1990). As such, this wide range of cultural influences should be measured via audits of safety management systems (Glendon and McKenna, 1995; Waring, 1996; Cooper, 1997b). Other factors such as noise, heat, light, and physical proximity associated with the immediate working environment (Peponis, 1985) could be assessed via weekly inspections or environmental surveys.

9. Research issues

Progress over the last decade on the concept of safety culture appears to have been somewhat slow. In contrast, safety climate measures that focus solely upon the values, beliefs, attitudes and perceptual aspects of the construct (see Guldenmund, 1998, for a review) have been widely researched and used as surrogate measures of safety culture, to the detriment of its holistic, multi-faceted nature. Research has not generally been focused upon an integrative framework that encompasses safety climate, safety management systems, or actual ongoing safety-related behaviour(s), despite the fact that many definitions of the construct actually embrace all three of these psychological, behavioural and situational factors. The reciprocal model of safety culture offered above attempts to provide such an integrative framework. Nonetheless, because this framework asserts that reciprocal interactions between psychological — behavioural — situational variables ought to be the unit of study in relation to safety culture, it is probable that alternative research paradigms, designs and data-gathering techniques will be required than have been used hitherto. A useful starting point to establish the efficacy and utility of the reciprocal model would be for researchers to re-analyse their existing data sets to establish: (1) whether or not the reciprocal relationships between the three elements hold in different settings; and (2) under what conditions do the relationships alter. In turn, this may help to explain the variance previously unaccounted for in their studies. A number of research questions generated by the reciprocal model are outlined below to illustrate some issues that the model might fruitfully address, although it is acknowledged that many other substantive issues still await examination.

9.1. *Reciprocal influences (between-methods)*

Although psychological factors and behaviour(s) operate as reciprocal determinants of each other, very little research has attempted to validate an organisation’s

safety climate results against members' *actual* ongoing safety-related behaviour(s). Instead, studies appear to use self-reported measures of behaviour (e.g. Cabrera and Isla, 1998; Cheyne et al., 1998; Mearns et al., 1998), which could be affected by biases such as social-desirability responses (Paulhaus, 1989). Similarly, with few exceptions little work has been undertaken to examine the reciprocal influence that improvements in actual safety-related behaviours might exert on the measured safety climate. Because the influences of one element are altered by their reciprocal effects, it seems appropriate for multiple alternating repeated measures of these elements (i.e. safety climate, safety behaviours, safety climate, safety behaviour, etc.), utilising cross-lagged correlational analytic techniques to be undertaken (Von Eye, 1990a). Provided that the variables under investigation are matched, such research may provide some answers to the 'chicken-egg' debate, and whether or not it is possible to attribute overt behaviour to a person's attitudes (e.g. Rajecki, 1990), although it is recognised that this will require longitudinal research designs (Von Eye, 1990b). Such research might also shed some light on the debate about whether it is better to focus on attitude change techniques or safety behaviour initiatives (e.g. Lee, 1998) to bring about improvements in safety culture. Reporting the results in terms of treatment effect sizes which take into account sample size, the mean and variance may also prove useful as they lend themselves to meta-analyses of the topic (e.g. Hunter and Schmidt, 1990).

The reciprocal influence of safety behaviour and safety management systems in relation to developing or enhancing a safety culture is another issue that warrants attention. For example, although the *potential safety environment* set by an organisation's safety management system(s) is likely to be identical for all members, the *actual safety environment* experienced by a person, workgroup, department, etc., is dependent upon that person's, workgroup's, or department's ongoing perceptions and safety-related behaviour. Depending upon which side of the reciprocal process is chosen for examination, the safety management system may be seen to control the members' behaviour, or conversely, the members' behaviour might be determining the efficacy of the safety management system. As such, it appears useful to examine the degree to which safety management systems actually influence people's behaviour, and *vice-versa*, at the strategic, tactical and operational levels of organisations. However, it must be recognised that antecedents (e.g. production pressures) and the potential consequences (e.g. rewards/punishment) for compliance or non-compliance may also exert a moderating effect on this reciprocal relationship. The degree to which internal politics impact on the reciprocal relationship between safety behaviour and safety management systems also warrants attention as does the influence of external cultural influences such as market sector, industry and the legislature (e.g. Pidgeon, 1998).

Investigations of the reciprocal relationships between safety climate and safety management systems could also provide some useful insights into safety culture (e.g. Hurst et al., 1996). Safety climate measures provide *subjective assessments* of various safety characteristics, whereas safety management system audits tend to provide somewhat more *objective evidence* about the presence and quality of particular safety characteristics. Although many safety climate studies report statistical differences in

scores due to hierarchical level, company or occupation, very little attention is actually paid to the links between safety climate and particular characteristics of safety management systems. Measuring both on matched dimensions should provide an external validity check on employee responses to safety climate measures, and may also shed light on other issues. For example, does the presence of certain safety management system characteristics predict the scores of safety climate measures? If so, what combinations of these characteristics are the better predictors? Which safety management system characteristics influence which aspects of safety climate (i.e. descriptive, affective and behavioural)? Does people's commitment to safety determine the prevailing safety culture, or does safety culture actually induce people to becoming committed to safety? It is worth noting that, despite its assumed importance, there is very little empirical research surrounding actual commitment to safety in general, although Cooper (1997a) did find that personal commitment to safety was negatively associated with job-related risk perceptions, indicating a reciprocal relationship between the two variables. Similarly, within a behavioural safety study in the UK construction industry, Marsh et al. (1998) found that management's commitment to the improvement process influenced the commitment of the workforce, which in turn affected actual performance. Notwithstanding these studies, apart from findings that top management's commitment to safety is a feature of low-accident companies (e.g. Cohen et al., 1975; Smith et al., 1978) there appears to be a paucity of research in this area. Lindgard and Rowlinson (1994) present a useful theoretical overview of commitment research and attempt to illustrate the effects that commitment at the group and organisational level may exert on behavioural safety techniques in the Hong Kong construction industry.

It is known that psychological and environmental influences function as joint rather than separate determinants of behaviour (Bandura, 1977a). However, the degree to which each element influences the other in relation to developing, enhancing or maintaining organisational safety culture is unknown. Therefore, in accordance with Bandura's views, in order to explain the process of reciprocal interaction between safety climate, safety management systems and safety-related behaviours, it would seem appropriate to analyse how much one element is conditional on the other two, and over what time-period the reciprocal relationships exert their influence, within given contexts. This will require researchers to specify the conditional probabilities under which each element will exert an influence on the other two elements, in an ongoing sequence. In this way, it may prove possible to examine both the internal and external validity of the reciprocal safety culture model, and the external validity of the safety culture construct itself. Another advantage offered by such a design is that it enables researchers to track an organisation's safety culture over extended periods of time thereby enhancing knowledge about its dynamic nature, within specified contexts.

9.2. *Reciprocal influences (within-methods)*

Similar to the issues discussed above, research also needs to be undertaken to examine the reciprocal relationships between the psychological, behavioural and

situational characteristics within each measurement method. In this way questions about reliability and validity issues can be addressed, methodological artefacts can be identified, individual factors that moderate or mediate the elements' relationship with safety culture can be teased out, and the presence and strength of any reciprocal interactions between these characteristics can be identified.

Meta-analytic research of the goal-setting literature (Wagner and Gooding, 1987) has indicated that correlations between two sets of perceptual data (e.g. safety climate scores and self-reported accidents) gathered at the same time with the same instrument and respondents (percept–percept), tend to be somewhat larger than those for perceptual–objective (percept–situation) data-capturing techniques (e.g. safety climate scores and the number of actual accidents reported within the same organisation). Although it is acknowledged that such correlations could be influenced by factors such as the coding scheme used or the levels of measurement, percept–percept research designs may lead researchers to over-estimate the importance of the relationships they find. This has obvious implications for measuring safety climate. For example, many safety climate studies combine attitudinal, affective, behavioural and descriptive constructs within the same measure, with some studies reporting the links between these constructs and measures of employees' 'satisfaction with safety' (e.g. Mearns et al., 1997). However, climate measures that include attitude scales run the risk of muddying the climate construct itself (Miller and Monge, 1986), which may be one of the reasons that different factor structures tend to emerge from different research groups. An example of this is provided by Williamson et al. (1997) who examined the role of safety perceptions and safety attitudes with 1560 workers from different industries. Perceptions were defined as items relating to the individual's views about their situation (i.e. specific to them) whereas the attitude items reflected the individual's beliefs about safety (i.e. safety ideals). Positively skewed responses were obtained for 77% of the attitude items but only 31% of the perceptual items, across all the companies involved. Assuming this finding is generalisable, such responses might negate many factor analytic studies of safety climate (e.g. Cox and Cox, 1991; Lee, 1998; Mearns et al., 1998) and any relationships or conclusions derived from structural equation modelling (e.g. Cheyne et al., 1998). This is not to argue that attitudes towards safety should not be measured, rather that we should specify much more clearly why they should be included in climate measures, what their purpose is, and how these interact with the remaining measured scales. In addition, questions about cause–effect still remain: i.e. does 'satisfaction with safety' affect the way employees describe the prevailing safety climate, or does the prevailing safety climate affect employees' descriptions of 'satisfaction with safety'? Other issues to be answered from safety climate research relate to which safety climate constructs (i.e. descriptive, affective, attitudinal and behavioural) provide the most accurate predictors of an organisation's actual safety performance? How does the predictive validity of these constructs differ within and between the strategic, tactical and operational levels of an organisation? How much of the variance in climate scores is due to percept–percept artefacts? In what way do these constructs actually relate to each other in a meaningful way? And, in what way do the constructs actually relate to the concept of safety culture?

In relation to ongoing safety-related behaviour(s) much evidence is available to show that behavioural safety performance management techniques have great utility for improving safety (e.g. McAfee and Winn, 1989; Sulzer-Azaroff et al., 1994). However, very little research in this area has examined the moderating or mediating effects of job-related factors (e.g. team-working, size of workgroups, task-complexity, goal-conflicts, task strategies, etc.), person factors (goal-commitment, self-efficacy, self-regulation, hierarchical level, social status, etc.), and organisational factors (e.g. communications, management's commitment, resource availability, etc.) on actual safety behaviour and on the development of safety culture per se. Similarly, no work has been undertaken on the reciprocal relationships between these variables.

Safety management systems come in all shapes and sizes, with some configurations exerting greater effects than others do. However, despite much agreement about the *processes* of safety management (e.g. Cooper, 1997b; HSE, 1997; Reason, 1997), the effects of the *content* of such systems and sub-systems on safety performance has largely been ignored, making it difficult to assess what an optimal safety management system should look like. Similarly, little *empirical evidence* is available to show *how* safety management processes affect and influence the psychological, behavioural and situational factors involved in developing a safety culture. Reason's (1993) 'pathogen' model may provide the basis for the systematic examination of these issues. For example, an examination of the effects of strategic decision making on safety culture appears to be very important. The short-, medium- and long-term safety-related goals that are set by the senior management team, how they conduct safety-related cost-benefit analyses (Stewart and Townsend, 2000), and how they balance safety with other organisational issues may prove useful areas to examine. How such decisions are influenced by the decision-maker's 'self-efficacy' (Wood and Bandura, 1989), market conditions, legislation and how these decisions influence organisational self-regulatory mechanisms also appear to be fruitful areas to examine. An examination of the different ways in which line-management implement these strategic decisions might provide further evidence of the effectiveness of such decisions in developing a safety culture. Arguably, one of the most important issues that warrants attention is the influence that human resource issues, purchasing and supply decisions, and decisions emanating from finance and legal departments exert on the development of organisational safety culture. Accordingly, the reciprocal relationships between safety management systems and other management systems, including their associated control systems and information systems, and the influence each exerts on organisational safety culture are also areas worthy of examination. Moreover, we may be able to address the question about whether it is the style and proficiency of the organisation's health and safety programmes that creates the 'safety culture' *product*, or is it that the prevailing safety culture *product* actually determines the style and proficiency of these health and safety programmes?

9.3. Methodological issues

Much of the published research to date on the concept of safety culture/climate has failed to justify the levels of analyses reported (Dansereau and Alutto, 1990). It

is very common, for example, to find safety climate studies aggregating their data to reflect multi-site samples, rather than site-specific samples. Although this has obvious appeal in increasing sample sizes, the disadvantages of introducing error variance outweigh this approach (i.e. people can only respond in relation to the prevailing safety climate in their place of work, not across organisations, industries or countries). A perusal of many such studies also shows that the within- and between-variance obtained from analysis of variances and/or correlations, and the associated sub-group sample sizes, or degrees of freedom are not being reported. This makes it difficult to evaluate the importance of the findings reported and will almost certainly influence any future meta-analytic attempts at summarising the research to date. The contextual richness of such studies is also diminished as the different sub-cultures present within the different organisations or sites surveyed appear to be ignored. This latter issue is important, as the reciprocal influences on these sub-cultures that emanate from the internal strategic, tactical and operational levels cannot be examined with a view to identifying the locus of culture/climate within the organisations surveyed (Pennings and Gresov, 1986). Similarly, given that safety culture is a sub-feature of organisational culture there is a need to develop or use existing organisational culture measurement instruments (Furnham and Gunter, 1993) and compare or cross-correlate the results of these with those obtained from safety culture/climate measuring instruments. In this way, it will eventually become possible to identify the locus of safety culture with much greater precision. Moreover, it would appear that the influence of external influences that emanate from societal variables (e.g. families), market sectors, industries, legislatures, nations, etc., have been ignored (Pennings and Gresov, 1986; Pidgeon, 1998). Despite the obvious difficulties, until such time as these are measured and their influence on organisational safety culture is evaluated, there will always be a gap in our collective knowledge.

10. Summary

Many definitions of organisational safety culture tend to focus on the way people think or behave. However, most research investigating this culture construct has tended to focus solely on the way people think (i.e. their values, beliefs, attitudes, perceptions) about various aspects of safety, via safety climate measures, which have tended to be used as surrogate measures of safety culture. Issues related to situational constraints and people's actual behaviour have tended to be ignored. This may be due to the broadness of the many safety culture definitions that make it difficult to operationalise the concept in a consistent manner. A conceptualisation of the safety culture '*product*' is offered here with which to provide a *dependent variable*, that can be used to evaluate the effectiveness of the many goal-directed manipulations that researchers may adopt when examining safety culture. Research also appears to have ignored the purpose of safety culture. Logic informs us that any attempts to develop or otherwise improve safety culture must, by definition, be goal directed. As such it is recommended that researchers adopt a goal-setting paradigm

that views the creation of a safety culture as a super-ordinate goal, which is achieved by developing and pursuing multiple sub-goals. One advantage of doing so is that we do not have to re-invent the wheel as much goal-setting research has already identified the many moderators and mediators that influence goal achievement. Consistent with the goal-setting paradigm, accident-causation research, and triangulation methodology, a reciprocal model of safety culture is also offered to allow the dynamic, multi-faceted, holistic nature of the safety culture construct to be more fully examined, at many different levels of an organisation. The sheer number of research issues generated by this reciprocal model demonstrates the current limitations of our collective knowledge about the safety culture construct. It is imperative, therefore, that we take a much broader view if we are to guide the theoretical development of the safety culture construct *and* those organisational practices that reduce injuries and save lives.

Acknowledgements

The author wishes to thank the four anonymous reviewers for their invaluable comments on an earlier draft of this paper.

References

- Adams, E., 1976. Accident causation and the management systems. *Professional Safety* October (ASSE).
- Atkinson, P.E., 1990. *Creating Culture Change: The Key to Successful Total Quality Management*. IFS Publications, Kempston.
- Azjen, I., Fishbein, M., 1980. *Understanding Attitudes and Predicting Social Behavior*. Prentice-Hall, Englewood Cliffs, NJ.
- Bandura, A., 1977a. *Social Learning Theory*. Prentice-Hall, Englewood Cliffs, NJ.
- Bandura, A., 1977b. Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review* 84, 191–215.
- Bandura, A., 1986. *Social Foundations of Thought and Action: A Social Cognitive Theory*. Prentice-Hall, Englewood Cliffs, NJ.
- Bandura, A., 1988. Self-regulation of motivation and action through goal systems. In Hamilton, V., Bower, G., Frijda, N. (Eds.), *Cognitive Perspectives on Emotion and Motivation*. Kluwer Academic Publishers, Dordrecht.
- Bandura, A., 1991. Social cognitive theory of self-regulation. *Organizational Behavior and Human Decision Processes* 50, 248–287.
- Bandura, A., Schunk, D.H., 1981. Cultivating competence, self-efficacy, and intrinsic interest through proximal self-motivation. *Journal of Personality and Social Psychology* 41, 586–598.
- Bowers, K.S., 1973. Situationism in psychology: an analysis and a critique. *Psychological Review* 80, 307–336.
- Buchan, R., 1999. Safety can't wait: a global campaign for transformational change. SPE/IADC 52797. In: *Proceedings of the 1999 SPE/IADC Drilling Conference*, Amsterdam, March 9–11.
- Cabrera, D.D., Isla, R., 1998. The role of safety climate in a safety management system. In: Hale, A., Baram, M. (Eds.), *Safety Management: The Challenge of Change*. Elsevier Science, Oxford, pp. 93–105.
- Carnino, A., 1989. Preventing human errors: progress made in this field. In: *Proceedings of a Conference on Human Reliability in Nuclear Power*, October 1989, IBC Technical Services, London.
- CBI, 1991. *Developing a Safety Culture*. Confederation of British Industry, London.

- Cheyne, A., Cox, S., Oliver, A., Tomas, J.M., 1998. Modelling safety climate in the prediction of levels of safety activity. *Work and Stress* 12, 255–271.
- Clarke, S., 1998. The measurement of safety culture. Paper presented at the 24th International Congress of Applied Psychology, Safety Culture Symposium, 9–14 August, San Francisco, CA, USA.
- Cohen, A., 1977. Factors in successful occupational safety programs. *Journal of Safety Research* 6, 168–178.
- Cohen, A., Smith, M., Cohen, H.H., 1975. Safety Programme Practices in High vs. Low Accident Rate Companies — An Interim Report (US Department of Health, Education and Welfare, Publication No. 75–185). National Institute for Occupational Safety and Health, Cincinnati, OH.
- Cooke, R.A., Rousseau, D.M., 1988. Behavioural norms and expectations: a quantitative approach to the assessment of organizational culture. *Group and Organization Studies* 13, 245–273.
- Cooper, M.D., 1994. Implementing the behaviour based approach to safety: a practical guide. *The Safety and Health Practitioner* 12 (11), 18–23.
- Cooper, M.D., 1996. The B-Safe Programme. Applied Behavioural Sciences, Hull.
- Cooper, M.D., 1997a. Evidence from safety culture that risk perception is culturally determined. *International Journal of Project and Business Risk Management* 1, 185–201.
- Cooper, M.D., 1997b. Improving Safety Culture: A Practical Guide. J Wiley, Chichester.
- Cooper, M.D., Phillips R.A., 1994. Validation of a safety climate measure. Occupational Psychology Conference of the British Psychological Society, 3–5 January, Birmingham.
- Cooper, M.D., Phillips, R.A., 1995. Killing two birds with one stone: achieving total quality via total safety management. *Leadership and Organization Development Journal* 16, 3–9.
- Cooper, M.D., Phillips, R.A., Sutherland, V.J., Makin, P.J., 1994. Reducing accidents using goal setting and feedback: a field study. *Journal of Occupational and Organisational Psychology* 67, 219–240.
- Cox, S., Cox, T., 1991. The structure of employee attitudes to safety: a European example. *Work and Stress* 5, 93–106.
- Cox, S., Cox, T., 1996. Safety, Systems and People. Butterworth-Heinemann, Oxford.
- Coyle, I.R., Sleeman, S.D., Adams, N., 1995. Safety climate. *Journal of Safety Research* 26, 247–254.
- Cullen, W.D., 1990. The Public Inquiry into the Piper Alpha Disaster. HMSO, London.
- Dansereau Jr., F., Alutto, J.A., 1990. Level-of-analyses issues in climate and culture research. In: Schneider, B. (Ed.), *Organizational Culture and Climate*. Jossey-Bass, San Fransisco, CA, pp. 193–236.
- Davies, L.J., 1988. Understanding organizational culture: a soft systems perspective. *Systems Practice* 1, 11–30.
- Davies, G.F., Powell, W.W., 1992. Organisation — environment relations. In: Dunnette, M.D., Hough, L.M. (Eds.), *Handbook of Industrial and Organizational Psychology*. pp. 315–375.
- Dawson, S., 1996. *Analysing Organisations*, 3rd Edition. Macmillan, London.
- Deal, T., Kennedy, A., 1982. *Corporate Cultures*. Addison-Wesley, Reading, MA.
- Denzin, N.K., 1978. *The Research Act*, 2nd Edition. McGraw-Hill, New York.
- Donald, I.J., Canter, D.V., 1994. Employee attitudes and safety in the chemical industry. *Journal of Loss Prevention in the Process Industry* 7, 203–208.
- Eagly, A.H., Chaiken, S., 1993. *The Psychology of Attitudes*. Harcourt Brace Jovanovich, Fort Worth, TX.
- Earley, P.C., Northcraft, G.B., 1989. Goal setting, resource interdependence, and conflict management. In: Rahim, M. (Ed.), *Managing Conflict: An Interdisciplinary Approach*. Praeger, Westport, CT.
- Erez, M., Zidon, I., 1984. Effect of goal acceptance on the relationship of goal difficulty to performance. *Journal of Applied Psychology* 69, 69–78.
- Festinger, L., 1957. *A Theory of Cognitive Dissonance*. Stanford University Press, Stanford, CA.
- Flin, R., 1998. Safety culture: identifying and measuring the common features. Paper presented at the 24th International Congress of Applied Psychology, Safety Culture Symposium, 9–14 August, San Francisco, CA, USA.
- Fry, J.N., Killing, D.J., 1989. Vision check. *Business Quarterly Canada* 54, 64–69.
- Furnham, A., Gunter, B., 1993. *Corporate Assessment*. Routledge, London.
- Geller, S., 1989. Managing occupational safety in the auto industry. *Journal of Organizational Behavior Management* 10, 181–185.

- Geller, S., 1997. *The Psychology of Safety: How to Improve Behaviors and Attitudes on the Job*. CRC Press LLC, Florida.
- Glendon, A.I., McKenna, E.F., 1995. *Human Safety and Risk Management*. Chapman & Hall, London.
- Glendon, A.I., Stanton, N., 1998. Safety culture: top down and bottom up approaches. Paper presented at the 24th International Congress of Applied Psychology, Safety culture Symposium, 9–14 August, San Francisco, CA, USA.
- Graves, D., 1986. *Corporate Culture: Diagnosis and Change*. St Martins Press, New York.
- Guldenmund, F.W., 1998. The nature of safety culture: a review of theory and research. Paper presented at the 24th International Congress of Applied Psychology, Safety culture Symposium, 9–14 August, San Francisco, CA, USA.
- Hamden-Turner, C., 1990. *Corporate Culture: From Vicious to Virtuous Circles*. Random Century, London.
- Heinrich, H.W., Peterson, D., Roos, N., 1980. *Industrial Accident Prevention*. McGraw-Hill, New York.
- HSC, 1993. ACSNI Study Group on Human Factors. 3rd Report: Organising for Safety. Health and Safety Commission, HMSO, London.
- HSE, 1997. *Successful Health and Safety Management (HS(G)65, 2nd Edition)*. Health and Safety Executive, HMSO, London.
- Hofstede, G., 1990. *Cultures and Organisations: Software of the Mind*. McGraw-Hill, London.
- Hunter, J.E., Schmidt, F.L., 1990. *Methods of Meta-Analysis*. Sage, London.
- Hurst, N.W., Young, S., Donald, I., Gibson, H., Muyselaar, A., 1996. Measures of safety management performance and attitudes to safety at major hazard sites. *Journal of Loss Prevention in the Process Industries* 9, 161–172.
- IAEA, 1991. *Safety Culture (Safety Series No 75- INSAG-4)*. International Nuclear Safety Advisory Group, International Atomic Energy Authority, Vienna.
- INSAG, 1988. *Basic Safety Principles for Nuclear Power Plants (Safety Series No 75- INSAG-3)*. International Nuclear Safety Advisory Group, International Atomic Energy Agency, Vienna.
- Jick, T.D., 1979. Mixing qualitative and quantitative methods: triangulation in action. *Administrative Science Quarterly* 24, 602–611.
- Johnson, G., 1992. Managing strategic change — strategy, culture and action. *Long Range Planning* 23, 9–19.
- Johnson, G., Scholes, K., 1999. *Exploring Corporate Strategy*, 5th Edition. Prentice-Hall, Europe.
- Kabanoff, B., 1991. Equity, equality, power and conflict. *Academy of Management Review* 16, 416–441.
- Kabanoff, B., Holt, J., 1994. Changes in the espoused values of Australian organisations 1986–1990. Paper presented at the National Academy of Management Conference, Dallas, TX.
- Kennedy, R., Kirwan, B., 1995. The failure mechanisms of safety culture. In: Carnino, A., Weimann, G. (Eds.), *Proceedings of the International Topical Meeting on Safety Culture in Nuclear Installations*. American Nuclear Society of Austria, Vienna, pp. 281–290.
- Komaki, J.L., 1998. *Leadership from an Operant Perspective*. Routledge, London.
- Komaki, J., Barwick, K.D., Scott, L.R., 1978. A behavioral approach to occupational safety: pinpointing and reinforcing safe performance in a food manufacturing plant. *Journal of Applied Psychology* 63, 434–445.
- Kono, T., 1990. Corporate culture and long-range planning. *Long Range Planning* 23, 9–19.
- Kuhl, J., 1992. A theory of self-regulation: action vs. state orientation, self-discrimination, and some applications. *Applied Psychology: An International Review* 41, 97–129.
- La Porte, T., 1996. High reliability organisations: unlikely, demanding and at-risk. *Journal of Contingencies and Crisis Management* 4, 60–71.
- Latham, G.P., Lee, T.W., 1986. Goal setting. In: Locke, E.A. (Ed.), *Generalizing from Laboratory to Field Settings*. Lexington Books, Lexington, MA, pp. 101–107.
- Lee, T., 1993. Seeking a safety culture. *ATOM Journal* 429, 20–23.
- Lee, T., 1998. Assessment of safety culture at a nuclear reprocessing plant. *Work and Stress* 12, 217–237.
- Lee, T.R., MacDonald, S.M., Coote, J., 1993. Perceptions of risk and attitudes to safety at a nuclear reprocessing plant. Fourth Conference on European Technology and Experience in Safety Analysis and Risk Management. Society for Risk Assessment (Europe), Rome, October.

- Lindgard, H., Rowlinson, S., 1994. Construction site safety in Hong Kong. *Construction Management and Economics* 12, 501–510.
- Locatelli, V., West, M.A., 1996. On elephants and blind researchers: methods for accessing culture in organisations. *Leadership and Organisational Development Journal* 17, 12–21.
- Locke, E.A., Latham, G.P., 1990. *A Theory of Goal Setting and Task Performance*. Prentice-Hall, Englewood Cliffs, NJ.
- Locke, E.A., Frederick, E., Buckner, E., Bobko, P., 1984a. Effects of previously assigned goals on self-set goals and performance. *Journal of Applied Psychology* 69, 694–699.
- Locke, E.A., Frederick, E., Lee, C., Bobko, P., 1984b. The effect of self-efficacy, goals and task strategies on task performance. *Journal of Applied Psychology* 69, 241–251.
- Lucas, D.A., 1990. Wise men learn by others harm, fools by their own; organisational barriers to learning the lessons from major accidents. In: Walter, M.H., Cox, R.F. (Eds.), *Proceedings of the Safety and Reliability Society Symposium September 1990*, Altrincham. Elsevier Applied Science Publishers, London.
- Lundberg, C.C., 1990. Surfacing organisational culture. *Journal of Managerial Psychology* 5, 19–26.
- Margulies, N., Raia, A., 1978. *Conceptual Foundations of Organizational Development*. McGraw-Hill, New York.
- Marsh, T., Davies, R., Phillips, R.A., Duff, A.R., Robertson, I.T., Weyman, A., Cooper, M.D., 1998. The role of management commitment in determining the success of a behavioural safety intervention. *Journal of the Institute of Occupational Safety and Health* 2, 45–56.
- May, J., 1998. Safety since Piper Alpha. *Offshore International*, 125–127
- McAfee, R.B., Winn, A.R., 1989. The use of incentives/feedback to enhance workplace safety: a critique of the literature. *Journal of Safety Research* 20, 7–19.
- Mearns, K., Flin, R., Fleming, M., Gordon, R., 1997. *Human and Organisational Factors in Offshore Safety*. HSE Books, Sudbury.
- Mearns, K., Flin, R., Gordon, R., Fleming, M., 1998. Measuring safety climate on offshore platforms. *Work and Stress* 12, 238–254.
- Mento, A.J., Steel, R.P., Karren, R.J., 1987. A meta-analytic study of the effects of goal setting on task performance: 1966–1984. *Organizational Behaviour and Human Decision Processes* 39, 52–83.
- Miller, K.I., Monge, P.R., 1986. Participation, satisfaction, and productivity: a meta-analytic review. *Academy of Management Journal* 29, 727–753.
- Oppenheim, A.N., 1992. *Questionnaire Design, Interviewing and Attitude Measurement*. Pinter, London.
- Ouchi, W., 1981. *Theory Z: How American Business can Meet the Japanese Challenge*. Addison-Wesley, Reading, MA.
- Pascale, R.T., Athos, A.G., 1981. *The Art of Japanese Management*. Warner, New York.
- Paulhaus, D.L., 1989. Social desirability responding: some new solutions to old problems. In: Buss, D.M., Cantor, N. (Eds.), *Personality Psychology: Recent Trends and Emerging Dimensions*. Springer, New York, pp. 201–209.
- Payer, H., 1998. ISM Code: The future impact. *Safety at Sea* 350, 12–14.
- Pennings, J., Gresov, C., 1986. Technoeconomic and structural correlates of organisational culture: an integrative framework. *Organization Studies* 7, 317–334.
- Peponis, J., 1985. The spatial culture of factories. *Human Relations* 38, 357–390.
- Peters, T.J., Waterman, R.H., 1982. *In Search of Excellence*. Harper & Row, New York.
- Pidgeon, N., 1998. Safety culture: key theoretical issues. *Work and Stress* 12, 202–216.
- Pierce, D.F., 1998. Does organizational streamlining hurt safety and health. *Professional Safety* 43 (12), 36–40.
- Rajecki, D.W., 1990. *Attitudes*, 2nd Edition. Sinauer Associates, Inc. Publishers, Sunderland, MA.
- Reber, R.A., Wallin, J.A., 1984. The effects of training, goal-setting, and knowledge of results on safe behavior: a component analysis. *Academy of Management Journal* 27, 544–560.
- Reason, J., 1990. The contribution of latent human failures to the breakdown of complex systems. *Philosophical Transactions of the Royal Society Series B* 327, 475–484.
- Reason, J., 1993. Managing the management risk — new approaches to organisational safety. In: Wilpert, B., Qvale, T. (Eds.), *Reliability and Safety in Hazardous Work Systems: Approaches to Analysis and Design*. LEA Hove, pp. 7–22.

- Reason, J., 1997. *Managing the Risks of Organizational Accidents*. Ashgate Publishing Ltd, Aldershot, Hants.
- Robertson, I.T., Sadri, G., 1993. Managerial self-efficacy and managerial performance. *British Journal of Management* 4, 37–45.
- Rosen, M., 1997. Towards a global nuclear safety culture. *Nuclear Energy* 36 (4), 287–289.
- Rousseau, D.M., 1988. The construction of climate in organizational research. In: Cooper, C.L., Robertson, I.T. (Eds.), *International Review of Industrial and Organizational Psychology*, Vol 3. Wiley, Chichester, pp. 139–158.
- Ryan, T.A., 1970. *Intentional Behaviour*. Ronald Press, New York.
- Schein, E., 1990. Organizational culture. *American Psychologist* 45, 109–119.
- Schein, E., 1992. *Organisational Culture and Leadership*, 2nd Edition. Jossey-Bass, San Francisco CA.
- Schneider, B., 1975. Organisational climate: individual preferences and organisational realities revisited. *Journal of Applied Psychology* 60, 459–465.
- Seddon, J., 1989. A passion for quality. *The TQM Magazine* May, 153–157.
- Smith, H.W., 1975. *Strategies of Social Research: The Methodological Imagination*. Prentice Hall, Englewood Cliffs, NJ.
- Smith, M., Cohen, H.H., Cleveland, R.J., 1978. Characteristics of successful safety programmes. *Journal of Safety Research* 10, 87–88.
- Stewart, D.A., Townsend, A.S., 2000. Is there more to 'Health & Safety is Good Business' than avoiding unplanned costs. *Journal of the Institution of Occupational Safety and Health* (in press).
- Sulzer-Azaroff, B., 1987. The modification of occupational safety behavior. *Journal of Occupational Accidents* 9, 177–197.
- Sulzer-Azaroff, B., Harris, T.C., Blake-McCann, K., 1994. Beyond training: organizational management techniques. *Occupational Medicine: State of the Art Reviews* 9, 321–339.
- Thompson, K.R., Luthans, F., 1990. Organizational culture: a behavioral perspective. In: Schneider, B. (Ed.), *Organizational Culture and Climate*. Jossey-Bass, San Francisco, CA, pp. 319–344.
- Tubbs, M.E., 1986. Goal-setting: a meta-analytic examination of the empirical evidence. *Journal of Applied Psychology* 71, 474–483.
- Turner, B.A., 1988. Connoisseurship in the study of organizational cultures. In Bryman, A. (Ed.), *Doing Research in Organizations*. Routledge, London, pp. 108–122.
- Turner, B.A., Pidgeon, N., Blockley, D., Toft, B., 1989. Safety culture: its importance in future risk management. Position paper for the Second World Bank Workshop on Safety Control and Risk Management, Karlstad, Sweden.
- Uttal, B., 1983. The corporate culture cultures. *Fortune Magazine* October 17.
- Von Eye, A. (Ed.), 1990a. *Statistical Methods in Longitudinal Research*, Vol. 1. Principles and Structuring Change. Academic Press, Boston, MA.
- Von Eye, A. (Ed.), 1990b. *Statistical Methods in Longitudinal Research*, Vol. 2. Time Series and Categorical Longitudinal Data. Academic Press, Boston, MA.
- Wagner, J.A., Gooding, R.Z., 1987. Shared influence and organisational behavior: a meta-analysis of situational variables expected to moderate participation-outcome relationships. *Academy of Management Journal* 30, 524–541.
- Waring, A.E., 1992. Organisational culture, management and safety. 6th British Academy of Management Conference, University of Bradford.
- Waring, A.E., 1996. *Safety Management Systems*. Chapman & Hall, London.
- Weaver, D., 1971. Symptoms of operational error. *Professional Safety*, October (ASSE).
- Wilkinson, A., Allen, P., Snape, E., 1991. TQM and the management of labour. *Employee Relations* 13, 24–31.
- Williams, J.C., 1991. Safety cultures — their impact on quality, reliability, competitiveness and profitability. In: Matthews, R.H. (Ed), *Reliability '91*. Elsevier Applied Science, Amsterdam, pp. 15–25.
- Williams, A., Dobson, P., Walters, M., 1989. *Changing Culture: New Organizational Approaches*. IPM, London.
- Williamson, A.M., Feyer, A.M., Cairns, D., Biancotti, D., 1997. The development of a measure of safety climate: the role of safety perceptions and attitudes. *Safety Science* 25, 15–27.

- Wood, R., Bandura, A., 1989. Social cognitive theory of organizational management. *Academy of Management Review* 14, 361–384.
- Wood, R.E., Locke, E.A., 1990. Goal setting and strategy effects on complex tasks. In Staw, B., Cummings, L. (Eds.), *Research in Organizational Behavior*, Vol. 12. JAI Press, Greenwich, CT.
- Wood, R., Bandura, A., Bailey, T., 1990. Mechanisms governing organizational performance in complex decision-making environments. *Organizational Behavior and Human Decision Processes* 46, 181–201.
- Zohar, D., 1980. Safety climate in industrial organisations: theoretical and applied implications. *Journal of Applied Psychology* 65, 96–102.