Towards a Model of Safety Culture

M. D. Cooper Ph.D.

Applied Behavioural Sciences Ltd

1060 Holderness Road, Hull, E.Yorks, HU9 4AH, UK

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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 organisations ongoing health & 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) 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 models utility and validity are addressed.*

Key Words:

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 surrounds the concept. This confusion appears to emanate from fragmented and unsystematic empirical efforts, using underspecified theoretical concepts (Kennedy & 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. Usually based upon a blend of visionary ideas, the dominating culture within any organisation is supported by ongoing analyses of organisational systems, goal-directed behaviour, attitudes and performance outcomes (Fry & Killing, 1989). Although a universal definition of what corporate culture might be is lacking, it appears to reflect *shared* behaviours, beliefs, attitudes and values regarding *organisational goals, functions and procedures* which are seen to characterise particular organisations (Furnham & Gunter, 1993). The main difference in definitions of corporate culture appear to reside in their focus on the way people think, *or* on the way people behave (Williams, Dobson & Walters, 1989), although some focus on both the way people think and behave (e.g. Margulies & Raia, 1978; Uttal, 1983).

The idea that corporate cultures reflect *shared* values, beliefs, attitudes and behaviours is disputed by many (e.g. Williams *et al.,* 1989). The argument is that not all corporate members respond in the same way in any given situation, albeit there may be a tendency for them to adopt similar styles of dress, modes of conduct, and perceptions of how the corporate body does, or should, function. As such, a cultural theme may be dominant (e.g. production, quality, safety), but there are likely to be a number of variations in the way in which the theme is expressed or manifests itself. In turn, these may either be aligned or in conflict, with the dominating 'cultural' theme. In other words, corporate culture is *heterogeneous*, not homogeneous. Beliefs, attitudes and values about the corporate body, its function or purpose can vary from division to division, department to department, workgroup to workgroup, and from individual to individual. Different sub-cultures, therefore, will emerge from, or form around, functional groups, hierarchical levels and corporate roles, with *very few* values, beliefs, attitudes or behaviours being commonly shared by the *whole* of the corporate membership. On the basis of such evidence, it is unlikely that industry-wide *homogeneous* safety cultures will ever arise, let alone a global one, particularly as societal (e.g. families, institutions, etc.,), national, political and organisational factors will impinge upon and affect the safety culture construct (Pidgeon, 1998). Questioning whether a unified program of culture change can be designed to span any large-scale organisation, Pidgeon argues that differing sub-cultures actually serve a useful function. He argues that they are a valuable resource for dealing with collective ignorance determined by systemic uncertainty because they provide a diversity of perspectives and interpretation on 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 & 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 organisations structures and control systems to produce behavioural norms'*. Turner, Pidgeon, Blockley & Toft (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 (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 organisations 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 & 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; Johnson, 1992; Turner, 1988), whereas the latter reflects the functionalist view that culture has a pre-determined function favoured by managers and practitioners (e.g. Schneider, 1975; Kono, 1990; Lundberg, 1990; Schein, 1990; Furnham & Gunter, 1993; Hofstede, 1990). 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 & 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 individual's attitudes and perceptions about safety) via questionnaire surveys (e.g. Zohar, 1980; Cooper & Phillips, 1994; Mearns, Flin, Fleming & Gordon, 1997) 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 & Cox, 1991; Lee, MacDonald, & Coote, 1993; Donald & Canter, 1994; Coyle, Sleeman & Adams, 1995; Williamson, Feyer, Cairns & Biancotti, 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 a universal 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 & intensity) of culture (Rousseau, 1988; Schein, 1990), with the fact that culture belongs to a group of people (Rousseau, 1988), with Deal & Kennedy's (1982) definition that culture is 'the way we do things around here', and with Goal-Setting Theory (Locke & Latham, 1990) is '*that observable degree of effort to which all organisational members direct their attention and actions towards improving safety on a daily basis'*.

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, 1998c). 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, monitored and assessed.

Given that organisational cultures are supported by ongoing *analyses* of organisational systems, goal-directed behaviour, attitudes and *performance outcomes* (Fry & Killing, 1989), the definition given for the safety culture '*product*' provides a *dependent variable* with which to assess safety culture improvement initiatives. 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

In practice, 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 & Latham's (1990) Goal-setting theory may also serve to provide the requisite scientific utility sought by Cox & 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 & 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 peoples commitment to safety, and [6] Determining the style & proficiency of an organisations Health & 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 peoples attention and actions towards the management of safety. In goal-theoretic terms, performance is a positive function of goal-difficulty (see Latham & Lee, 1986; Mento, Steel, & Karren, 1987; Tubbs, 1986). 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 & Latham, 1990). Nonetheless, goal-attainment is known to be affected by a number of moderators such as Ability (e.g. Locke, Frederick, Buckner & Bobko, 1984); Goal-commitment (e.g. Erez & Zidon, 1984); Goal-conflict (e.g. Early & Northcraft, 1989); Feedback (e.g. Reber & Wallin, 1984); Task complexity (e.g. Wood & 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 & 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 vs. productivity, quality, etc., (i.e. goal-conflict); communication flows (i.e. feedback); managerial vs. operatives 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 the strategic, tactical and operational levels of the organisation; The presence and quality of the organisations 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, Peterson & Roos (1980) for example identified the interactive relationship between behaviour, situations, and person factors at operator levels, while the 80:20 percent rule implicitly recognised that the strength of someone's behaviour, or the situation (e.g. workflow process) may exert different effects at different moments in time. The interactive relationship between management systems and managerial behaviour was also recognised by Weaver (1971), when he stated that accidents were symptoms of operational error. Adams (1976) also 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 (e.g. 1993), 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 vs. low accident plants, which emphasised the interaction between organisational systems, modes of organisational behaviour, and peoples psychological attributes (e.g. Cohen, 1977; Smith, Cohen & Cleveland, 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 & Phillips, 1995). Organisations have often attempted to change peoples 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 peoples' attitudes (Wilkinson, Allen & Snape, 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 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 refers to members perceptions about and attitudes towards safety goals; patterns of behaviour refers to members day to day goal-directed safety behaviour; and, the style and proficiency of, an organisations health & safety programmes indirectly refers 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'.

Thus, the common thread that can be found in the majority of 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 & Phillips, 1995; Cooper, 1997b). 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 organisations 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.

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 & Powell, 1992). Both Social Learning Theory (SLT) (Bandura, 1977a) and Social Cognitive Theory (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 (See figure 1). SLT and SCT are similar to operant theory in so far as they focus on *cognitively 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 as equally valid within organisations (e.g. Wood, Bandura & Bailey, 1990; Wood & Bandura, 1989), 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).

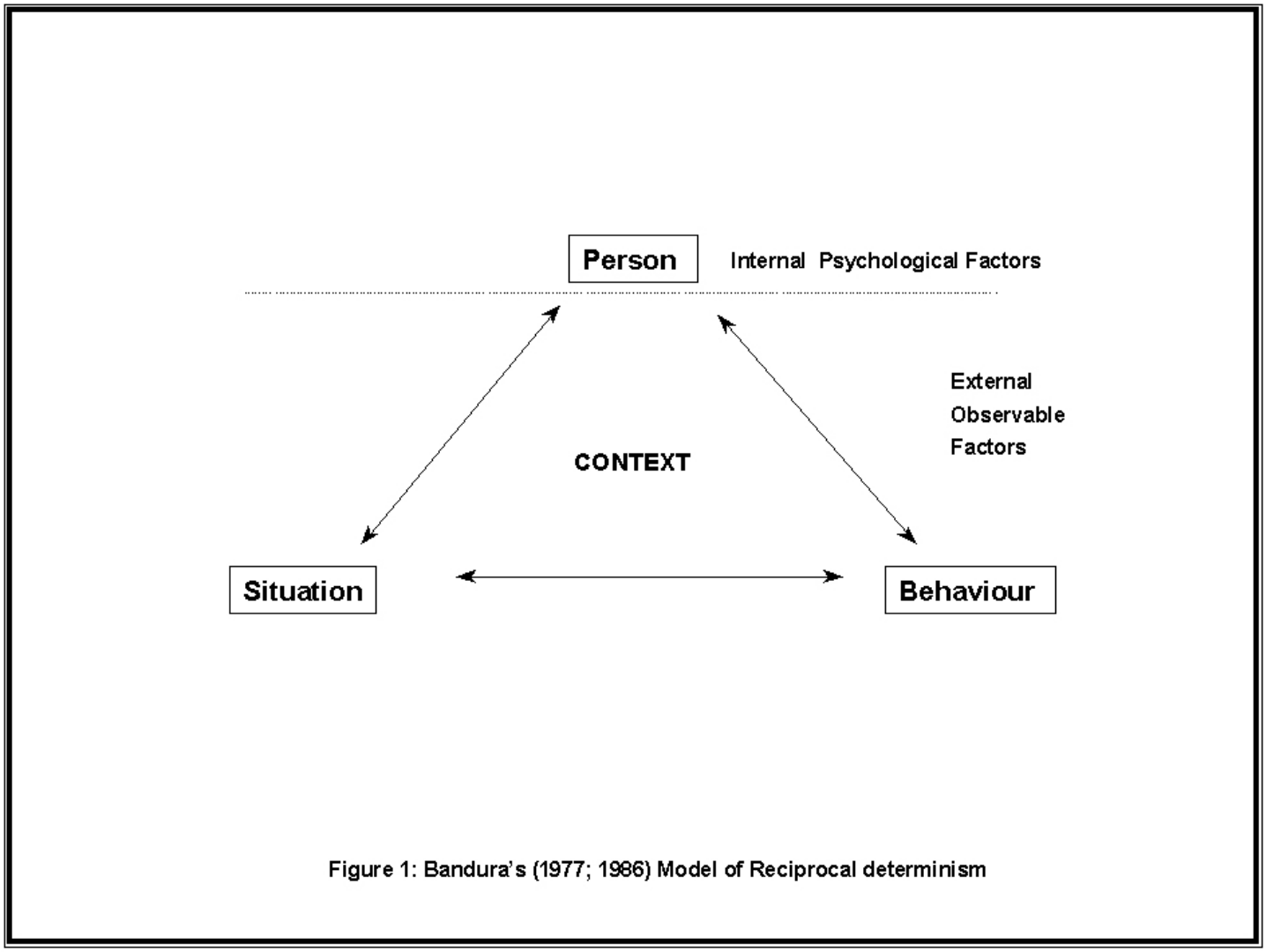


Figure 1: Bandura's (1977; 1986) Model of Reciprocal determinism

6.2 *Analysing Safety culture*

In terms of analysing 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. Heinrich *et al*., 1980; Weaver, 1971; Adams, 1976; 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 persons 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 'objects' 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).

Fourth, it explicitly incorporates the goal-setting paradigm (Wood & Bandura, 1989; Locke & Latham, 1990; Bandura, 1991) advocated above via the setting of sub-goals (Bandura & Schunk, 1981), via task-strategies (e.g. Locke, Frederick, Lee & Bobko, 1984), via self-regulatory processes (e.g. Bandura, 1988), and via self-efficacy mechanisms (e.g. Robertson & 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 & Phillips, 1995; Cooper, 1996, Cooper, 1997a, 1997b) to reflect the concept of safety culture, that contains three elements which encompass *subjective* internal psychological factors, *observable* ongoing safety-related behaviours and *objective* situational features (see figure 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 situational features are assessed via safety management system audits. 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 (see below). 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.

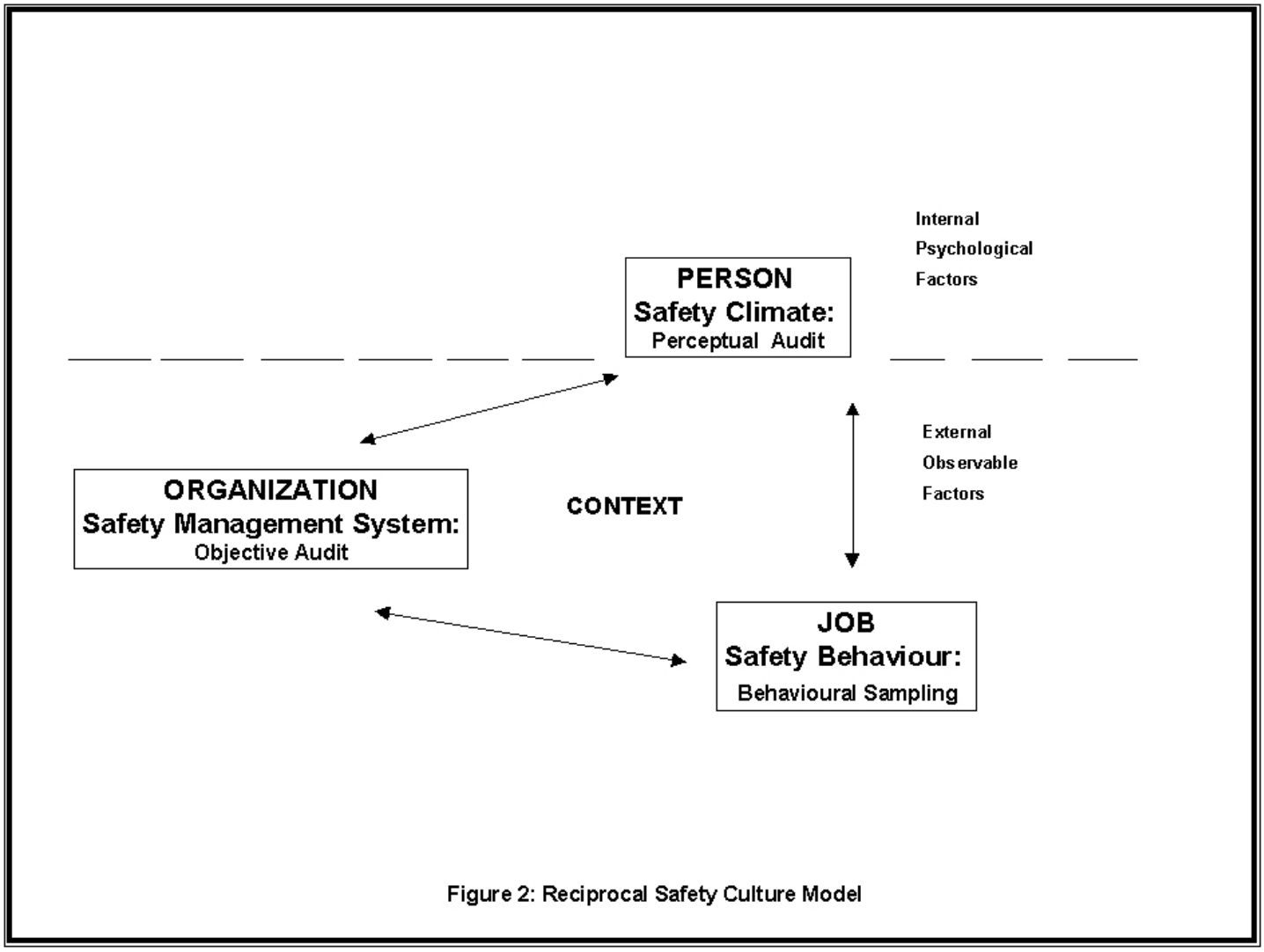


Figure 2: Reciprocal Safety Culture Model

The psychological, behavioural and situational elements of the model can also be broken down into exactly the same reciprocal relationships (See figure 3), thereby allowing the multi-faceted nature of the safety culture construct to be *systematically* examined, both *within* and *between* the three measurement methods. It is recognised that the content of

each element in the model as presented may or may not be fully inclusive in relation to safety culture as it could be argued that what is pertinent to a particular culture cannot be known beforehand. However, those characteristics that have been labelled were derived from diverse sources such as HSG (48) (HSE, 1989); HSG (65) (HSE, 1991); goal-setting theory (Locke & Latham, 1990); behaviour modification research applied to safety (e.g. Sulzer-Azeroff, 1987); safety climate research (e.g. Zohar, 1980); accident causation models (e.g. Reason, 1990); and, studies examining organisational characteristics of high & low accident plants (e.g. Cohen, 1977). As such, the 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.

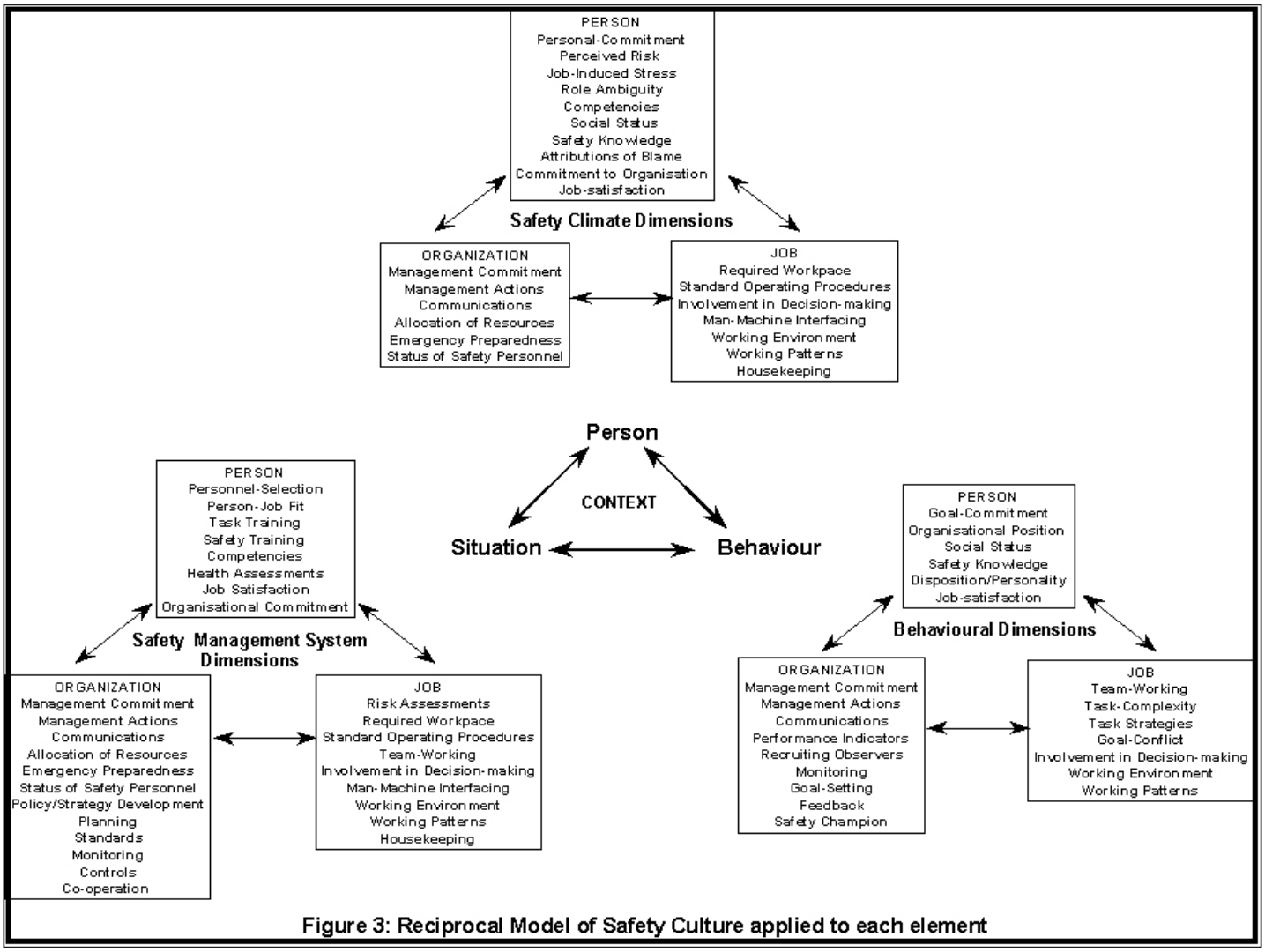


Figure 3: Reciprocal Model of Safety Culture applied to each element

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] beliefs and values, and [3] behaviours and artefacts. For example, Glendon & 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). Guldenmond (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 & Gunter (1993) explored Schein's cultural model and assert that the underlying assumptions need to be manifest in some way (p243): Either by inference from the way that beliefs and values are expressed, or by observing behaviours and artefacts. Johnson & Scholes (1999) reinforce this argument by stating that underlying assumptions are the representation in organisational action of what is taken for granted (p73). It seems sensible, therefore, to assume that any organisations underlying assumptions are reflected in their policies, structure, control systems, styles of management, etc., (Thompson & Luthans, 1990). The middle level consists of publicly declared beliefs and values that are operationalised as attitudes (level 2). Because attitudes have specific objects, Guldenmond places the target of these attitudes into a hardware, software, people and behaviour taxonomy. The most superficial level reflects behaviours and artefacts (level 3). Guldenmond suggests that behaviours might encompass inspections, accidents, near misses, etc., while safety posters, 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 & Fishbein's (1980) and Eagly & 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. p160). Nonetheless, Guldenmond'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 organisations 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 & 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 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-cultures or goals. 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 & Learning Cultures) 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 model is underspecified in many respects (e.g. the relationships between the three elements have not been addressed), this model is very similar to the reciprocal model advocated. The main differences reside in the use of the term 'environment' rather than 'situation' due to this aspect being based on an engineering approach, rather than that of Social Cognitive Theory. 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 universal 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 exhibited '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 Guldenmond 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 organisations current safety climate (see levels of measurement below). From a practitioners 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 organisations 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 & West, 1996), and document analysis (e.g. Kabanoff, 1991; Kabanoff & Holt, 1994).

The behavioural aspects of safety culture can be examined via peer observations, self-report measures and/or outcome measures (e.g. Cooper, Phillips, Sutherland & Makin, 1994; Komaki, Barwick & Scott, 1978; Sulzer-Azeroff, 1987). Analysing an organisations accident history for the previous two years often reveals a relatively small number of safety behaviours that have been implicated in the vast majority of the organisations accidents (See Cooper 1994; Cooper 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 type 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 (see Komaki, 1998). Similarly, composite outcome measures such as the numbers of completed remedial actions, risk assessments and /or the number of reported near-misses, the numbers of people safety trained, 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 an organisations policies, operating procedures, management systems, control systems, communication flows, and workflow systems (Thompson & Luthans, 1990), as well as factors such as noise, heat, light, and physical proximity associated with the immediate working environment (Peponis, 1985). As such, this wide range of cultural influences should be measured via audits of safety management systems (see Glendon & McKenna, 1995; Waring, 1996; and Cooper, 1997b).

9. Quantification Strategy

To quantify safety culture two relatively simple things have to occur. The first requires that the tools used to measure each element of the model possess 'point to point' correspondence of 'matched' factors. This can be illustrated by using the measurement of management's commitment as an example. Questions could be asked about it via a safety climate survey (e.g. are they perceived to be committed by the workforce) and a safety management system audit (e.g. what is the safety budget, relative to the total budget). The degree to which managers visibly demonstrated their commitment (i.e. exhibited commitment behaviours) would also be monitored via self-monitoring on 'self-report' measures or by a third party using an observational checklist (e.g. the frequency with which management 'walked the talk').

The second is to use a common metric across each of the three elements. Percentages are perhaps the easiest to use as they are commonly found in safety management system audits, safety climate surveys and behavioural safety initiatives. In principle, the percentage score for each element is calculated. The scores relative to each other would indicate which of the three elements was weaker or stronger. This area could then become the focus of attention and action. The average of the percentage scores for all three elements would provide an overall safety culture 'score'. Importantly, a safety culture score could be derived for individuals, workgroups, departments, etc., to enable comparisons between different sub-cultures at different levels of an organisation. Each of the individual element scores, and / or the overall score could be placed within some banding scale indicating where the group, department, organisation, etc., resides (e.g. Alarming (#1) to Excellent (#5)). Over a period of time, it may become possible to norm such banding scales, so that [1] organisations could directly compare themselves with each other, so as to promote 'best practices', and [2] researchers can examine and account for any differences in safety culture between organisations (Donald, 1999, personal communication). Importantly, other metrics such as 'Z' scores could be derived from both percentages and mean average scores derived from rating scales, to provide quantitative indices of safety culture.

10. Levels of Measurement

Pennings & Gresov (1986) linking *external* predisposing influences with *internal* organisational determinants, describe culture as a relationship between six sub-systems at two levels: The industry or societal level (external) and the organisational (internal) level. The six sub-systems encompass the [1] the external market, industry or ecosystem, [2] external structures (e.g. families, statutory bodies, professional institutions) and [3] external ideology (e.g. values, beliefs, symbols and ceremonies) [4] internal task environment, [5] internal structures (e.g. functional, hierarchical, divisional) and [6] internal ideology. The task environment represents the 'modes' and 'means' of production and their synchronisation. The external/internal structures refers to the system of positions and their interrelationships (e.g. shift teams, workareas, departments, management control systems, etc.,), while ideology represents people's belief systems and values, and their manifestation via symbols, and ceremonies, etc. Each individual sub-system is also construed as blocks or family of variables (p326). Importantly, Penning & Gresov's three sub-systems are analogous to the three elements of the reciprocal model: Task environment is conceptually equated to the behavioural or job element; internal structures equate with the situational or organisational element, and the internal ideology equates to the psychological or person aspects. Since each of these reciprocal safety culture model elements can also be viewed as comprising 'blocks or families' of variables (see figure 3), Penning & Gresov's framework is ideally suited for guiding the systematic measurement of safety culture, as each can be construed as a mirror image of the other.

The 4 x 3 matrix in figure 4 illustrate the relationships between all of these subsystems at four levels: External; Internal *Strategic;* Internal *Tactical;* and, Internal *Operational.* Given that no subsystem or partial set of variables can be explained without reference to the other subsystems and their linkages, it is important to understand both the *within* block and *between* block variable interrelationships if the *loci of [safety] culture* is to be identified (Louise, 1985). Even at this *macro* level, it is evident that any one of the *between* sub-system nodes will share a reciprocal influence with at least five or eight related sub-systems, with causal flows and feedbacks moving horizontally, diagonally and vertically. At any particular level, each sub-system will be influenced by the other two sub-systems at that level, as well as the three sub-systems from the level immediately above and/or below. This indicates that any attempts to measure safety culture will need to examine and explain the influence these sub-systems exert on each other.

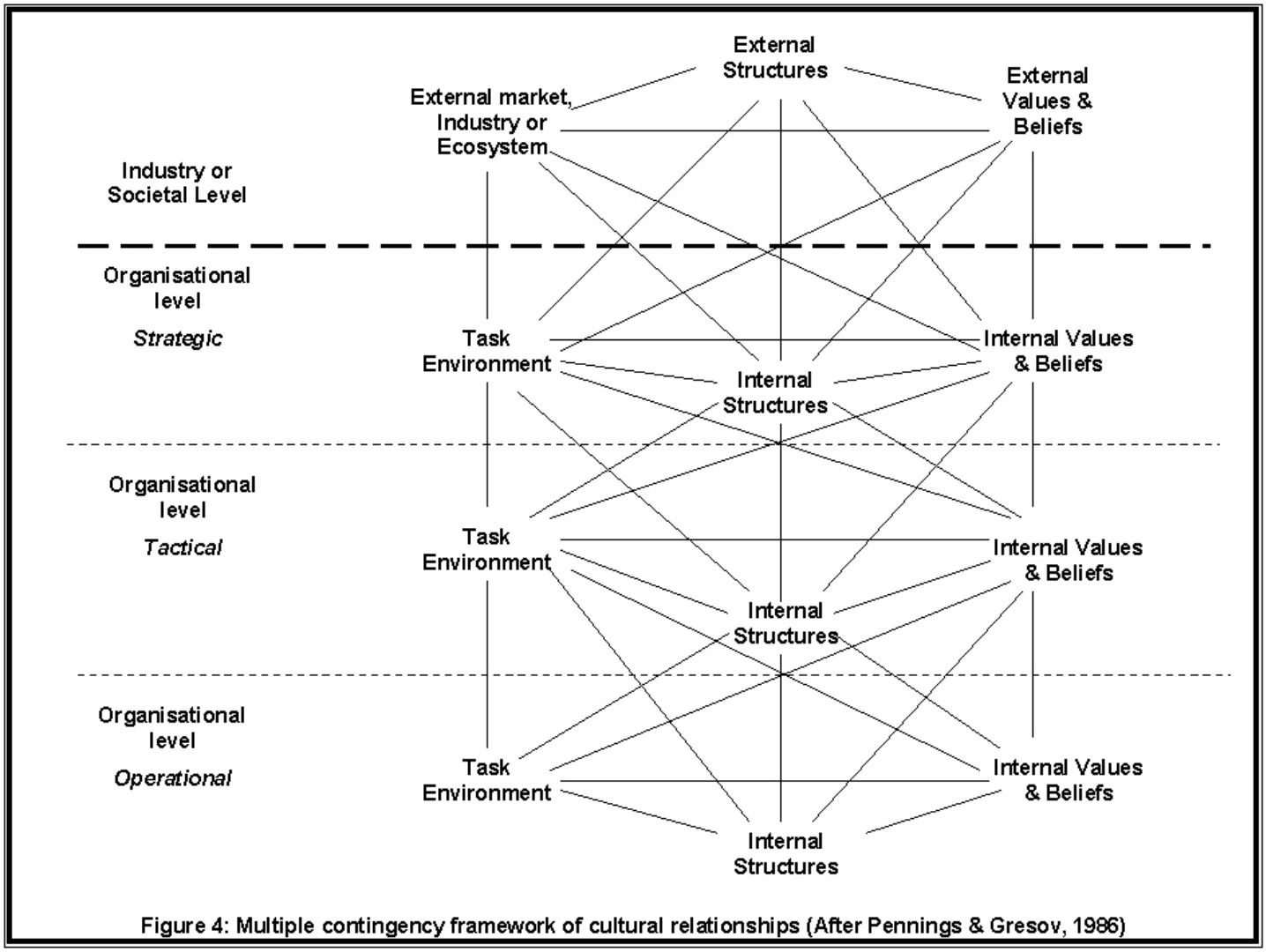
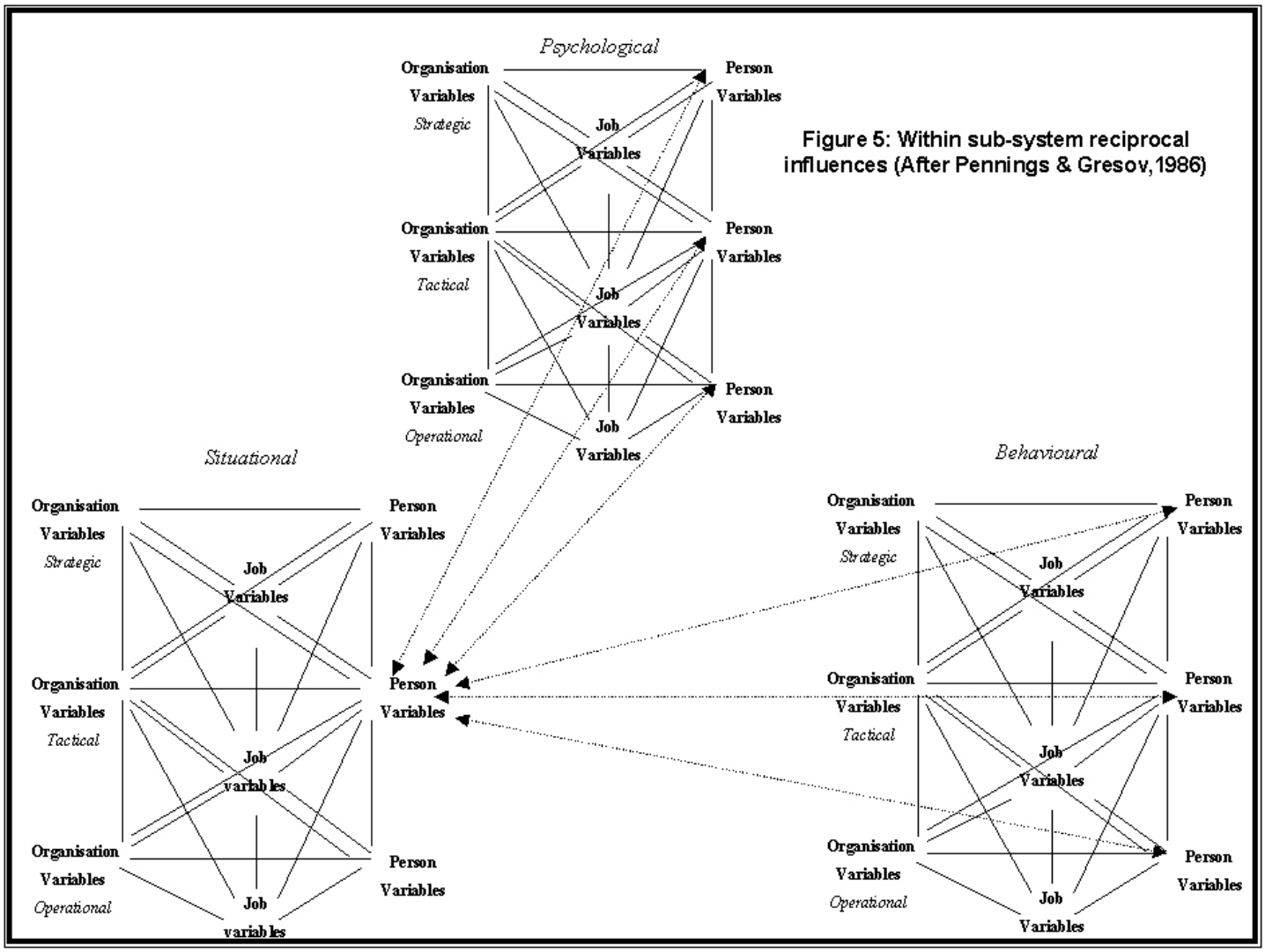


Figure 4: Multiple contingency framework of cultural relationships (After Pennings & Gresov, 1986)

When the blocks of variables within the framework are examined at the *micro* level, as shown in figure 5, which represents a *within* block relationship, it becomes apparent that there are many different types of reciprocal influences that require examination and explanation. For example, at the strategic and tactical levels there are eight person-to-person, eight situational-to-situational, and eight behavioural-to-behavioural reciprocal influences, two of which are at the same level, and three of which are from the level immediately above and three immediately below. At the external and operational levels there are five such reciprocal influences. Person-to-situation, person-to-behavioural, and behavioural-to-situational influences each total nine in number. Thus, at the lowest and highest levels there are 17 possible reciprocal relationships and 26 at the middle levels (i.e. 8 at the same level, and 9 each at the higher and lower levels). Moreover, depending upon which level is examined some of these reciprocal influences are also direct (*Proximal*) or indirect (*Distal*). For example, if the operational level is examined, there will be distal influences emanating from the strategic level (i.e. they are distal in the sense that they have to extend through the tactical level to exert their influence at the operational level).



Extending this to account for *all three* within block relationships *and all three* between block relationships at the *micro* level, it becomes evident that there are 68 possible reciprocal relationships to examine at the highest and lowest levels (i.e. 17 *within* x 3 blocks = 51 plus 17 *between* = 68), and 104 at the middle levels (i.e. 26 *within* x 3 blocks = 78 plus 26 *between* =104). Depending upon the level of analyses (see below) these reciprocal relationships also need to be multiplied by the number of variables used for measurement. Thus the number of linkages and their complexity suggests that a systematic approach to the measurement of [safety] culture is required: both from the bottom-up and top-down (see Glendon & Stanton, 1998). It also highlights the need for researchers to report the levels of measurement and the associated within and between cell correlations for all the possible reciprocal influences pertinent to their studies.

11. Levels of Analyses

As well as accounting for the levels of measurement, understanding the dynamic and multi-faceted nature of safety culture will also require the use of different levels of analyses, that encompasses single-level, multiple-level, multiple-variable and multiple-relationship analyses (See Dansereau & Alutto, 1990 for an excellent review). Louise (1985) suggests that the *locus of culture* may reside in any one of a number of internal levels of an organisation as well as levels external to the organisation. As such, individuals, dyads, groups and collectives (e.g. departments, business units, divisions, organisation, market sector, statutory bodies, society, nation states) all offer different levels of analyses. After Dansereau & Alutto (1990), at each single-level of analyses there may be differences *within* and *between* entities. The degree of variation or co-variation in the measurement scores obtained could and should be used to ascertain whether or not that level of analyses be accepted or rejected. Where there is significant variation *within* the entity at that level of analyses (e.g. group) it indicates heterogeneity (e.g. culture varies between group members). Where there are no significant differences *within* an entity at that level of analyses (e.g. group) it indicates homogeneity (or universality) suggesting that that is where the locus of culture actually exists. Attention is then turned to *between* entity differences at the same level of analyses (e.g. between groups). No differences *between* entities at the same level could indicate that the locus of culture does indeed reside at that level of analyses (e.g. group). B*etween* entity differences signal that one or more of the entities (e.g. groups) shares more, or less, of a particular culture characteristic than the other entities at the same level-of analyses. Thus, the most appropriate single-level of analyses is indicated by variation either within *or* between entities (see table 1). An inappropriate level-of-analyses is signalled when variation does or does not exist *within and between entities at the same time*. Where statistically significant variation and co-variation occurs within *and* between the entities at a level of analyses, it is suggested that be rejected in favour of a lower level of analyses. This is due to the lower level of analyses (e.g. department) being free to vary within and between the higher level of analyses (e.g. organisation) which means that no consistent universality (culture) will be present. Where no variation or co-variation within *and* between the entities exist, this level of interest is rejected in favour of a higher level of analyses. Although the latter could indicate that the locus of culture has been found, there is insufficient variation to discern differences at that level, signalling that multiple-level analysis is warranted.

	Locus of Culture	*Differences Within*	*Accept*	*Differences Between*	*Accept*	*Differences Within & Between*	*Reject & Go Higher*	*Differences Within & Between*	*Reject & Go Lower*
External	**Nation State**	Y	Y	Y	Y	N	-	Y	Y
	Societal	Y	Y	Y	Y	N	Y	Y	Y
	Statutory Bodies	Y	Y	Y	Y	N	Y	Y	Y
	Market	Y	Y	Y	Y	N	Y	Y	Y
	Industry	Y	Y	Y	Y	N	Y	Y	Y
Internal Strategic	**Organisation**	Y	Y	Y	Y	N	Y	Y	Y
	Division	Y	Y	Y	Y	N	Y	Y	Y
Internal Tactical	**Business Unit**	Y	Y	Y	Y	N	Y	Y	Y
	Department	Y	Y	Y	Y	N	Y	Y	Y
	Workarea	Y	Y	Y	Y	N	Y	Y	Y
Internal Operational	**Group**	Y	Y	Y	Y	N	Y	Y	Y
	Dyad	Y	Y	Y	Y	N	Y	Y	Y
	Individual	Y	Y	Y	Y	N	Y	Y	-

Table 1: Single-level of analyses decision table (After Dansereau & Alutto, 1990).

Multiple-level analyses provide the means to combine different levels-of analyses to facilitate understanding of the relationships between lower (e.g. groups) and higher levels (e.g. departments) of analyses. Dansereau & Alutto (1990) suggest four types of multiple-level analyses: Cross-level, Level-specific, Emergent formulation and a null formulation. Cross-level means both levels are accepted; Level-specific means that the lower level is accepted and the higher level rejected; Emergent formulation means the lower level is rejected and the higher level accepted; and the null formulation means both are rejected (see table two). The basis for acceptance and rejection for each is the variance or co-variance within and/or between variables as for single-level analyses. Danseraeu & Allutto (1990) also describe one method of deciding how variables associate with the four types of multiple-level analyses. First, they suggest that single-level analyses be conducted at *all* the levels pertinent to a piece of research. Second, for each single-level of analyses, select and examine one of the four alternatives (Within, Between, No variance within & between, and Variance within & between). Third, examine the results from the single level analysis at several levels, two at a time. Fourth, select and examine a multiple-level alternative (i.e. Cross-level, Level specific, Emergent or Null) for any number of levels of analysis (p219). If the method is systematically applied, it is possible to test whether or not entities at a lower level of analyses aggregate to higher levels, thereby providing empirical evidence of independent or related level-specific effects.

Type of Multiple Analyses	*Level of Analyses*	*Within Entity Variance*	*Between Entity Variance*	*No Within & Between Variance*	*Within & Between Variance*	*Accept*	*Reject*
Cross- level	Higher	Y	Y			Y	
	Lower	Y	Y			Y	
Level-specific	Higher				Y		Y
	Lower	Y	Y			Y	
Emergent	Higher	Y	Y		Y		
	Lower			Y			Y
Null	Higher			Y			Y
	Lower			Y			Y

Table 2: Multiple-level analyses decision table (After Dansereau & Alutto, 1990).

Because the reciprocal model explicitly encompasses multiple variables (e.g. perceptual, behavioural and situational measures), there is a need to extend the levels-of analyses procedures to any number of variables. Again after, Danseraeu & Allutto (1990) this is achieved by placing the multiple variables on a continuum: At one end all the variables relate to each other (*Related variables case*), and at the other end of the continuum all the variables are independent of each other *(Independent variables case*). Two other *cases* form the middle: Generally Related or Unrelated. *Generally related cases* indicate that more variables relate than are independent. In the *generally unrelated case*, more variables are independent than related. At the mid-point, as many related variables exist as independent variables. Because each of the four cases are mutually exclusive they can be used to assert different alternatives for within-cell and between-cell correlations, at different levels of analyses. The *Related variables case* is of interest when, for example, trying to establish relationships between psychological, behavioural and situational variables. The *Independent variables case* is pertinent when trying to establish the difference between, for example, safety climate and self-report measures of accident involvement. The *Generally related case* is appropriate when the focus is on multiple independent measures that relate to one or more dependent variables. The *Generally unrelated case* is relevant when, for example, developing independent dimensions for safety climate measures, but the dimensions contain related variables. In principle, relationships between the variables would again be assessed via within-cell and between-cell correlations to facilitate the linking of different variables to different levels of analyses.

In combination, single-level, multiple-level and multiple-variable analyses equate to multiple-relationship analyses (i.e. associating multiple variables with multiple levels of analyses) that can be used to ascertain whether variables are the same (*multiplexed*) or vary (*contingent*) under different conditions or settings (See Dansereau, Alutto & Yammarino, (1984); and Dansereau & Markham, (1987a, 1987b) for more details). In summary, the analytic framework provided by Dansereau *et al*., allows the identification of the locus of culture at many different levels of analyses. Perhaps even more importantly, it also offers a means by which disparate research groups can analyse their results in a consistent manner within a common framework, which in turn will facilitate future meta-analyses. Moreover, Dansereau et al's work shows the importance of reporting the variance and the mean averages associated with the variables of interest within a study.

12. Supporting Evidence

The full model has not yet been applied in any one organisation, although empirical efforts undertaken by the author and colleagues to examine these reciprocal relationships clearly support it. For example, a study conducted in a UK packaging manufacturers (Cooper *et al*., 1994) showed the impact of situational features (both societal and organisational) on employees ongoing safety behaviour, while a change initiative not only improved such behaviours, but also employees perceptions of the company's safety climate (Cooper & Phillips, 1994). The influence exerted by societal factors on the observed percentage of safe behaviours was demonstrated towards the end period of the study when safety performance declined and the accident rate increased. During this four-week period, a significant number of employees were involved in the organisation and preparation of the local town carnival. Over the four-week period they would complete their work shift, and then construct the carnival floats. Thus a build up of fatigue over a period of time was thought to be impacting upon performance at work (illustrating the importance of collecting *qualitative* data to assist in determining the impact of the prevailing context on actual safety performance). Moreover, the influence of organisational factors (at the tactical level) was shown to be associated with the increased accident rate that occurred during a maintenance shutdown that also took place during the carnival period. Different trades people were getting in each other's way (e.g. an electrician working directly alongside a welder), and causing various types of injury. An examination revealed that this method of working was due to a lack of planning the maintenance according to a pre-determined schedule by the engineering management team. Thus, the reciprocal influences of situational features (societal & organisational) on safety behaviours were demonstrated. In this study, despite the reductions in accidents, no statistically significant correlations could be established between overall safety performance (i.e. the percentage of safe behaviours) and the plants actual accident rates (r=. 095), suggesting that intervening factors were mediating the relationship. Three specific organisational (situational) factors for which data were available were examined: Shiftwork, Machine downtime, and Sickness & Holiday absenteeism. No statistically

significant relationship was found between accident rate and shiftwork. However, a significant correlation (r= 0.68, p<. 01) was found between machine downtime and accident rate, and sickness absenteeism and accident rate (r= 0.75, p<. 01) in the casting department. The factor common to both machine downtime and sickness absenteeism was increased activity rate or workpace, again illustrating the impact of situational variables (i.e. nature of the task & sickness absenteeism) on behaviour (i.e. accidents).

A pre and post intervention safety climate questionnaire study was also carried out as a part of this behavioural safety research (Phillips, Cooper, Sutherland & Makin, 1993; Cooper & Phillips, 1994). During the pre-test the casting department's perceptions of workpace were the most negative compared to the other six departments [F(1,6)=9.40, p<.0000]. Fifteen months later this department's perceptions of workpace remained the most negative during the post-intervention study [F(1,6)=3.46,p<.01] although the treatment effect size (Cohen, 1977) showed a medium to large improvement after the behavioural safety initiative (d =0.67), demonstrating the influence that changes in safety behaviour exerted on perceptions of safety climate in the casting department. Statistically significant differences were also found between accident and non-accident personnel in their perceptions of workpace, during both distributions. Personnel were divided into four groups to try and ascertain whether or not the severity of accident had an impact on perceptions of workpace: Accident free; Minor injury; Lost Time injury; and Minor injury plus Lost time injury. During the pre-test, accident free personnel were much more positive about the required workpace than the three accident involved groups. No real differences emerged between the minor injury only group and the lost-time injury only group, whereas personnel who experienced both minor and lost-time injuries were much more negative [F(3,274)=7.58,p<.01]. Thus, accident experience appeared to significantly influence personnel's perceptions of workpace. During the post test it was noticeable that significant improvements in perceptions of safety climate *per se* were found for the accident free group and the minor injury group, but not the lost-time injury only or minor plus lost-time injury groups [F(3,180)=4.14, p<.01]. Thus, the study showed that the behavioural safety initiative exerted less influence on the perceptions of personnel involved in lost-time accidents. Moreover, they also show that as accident involvement increases perceptions of safety climate become correspondingly more negative. These findings again demonstrate the reciprocal influences between behavioural and psychological factors.

Duff, Robertson, Cooper & Phillips (1993) also showed the impact that different approaches to goal setting (situational) exerted on safety behaviour in the UK construction industry. A behavioural safety intervention (a) and withdrawal (b) experimental design (abab) was employed on six construction sites with three experimental protocols: Training & Feedback; Goal-setting & Feedback; and Training, Goal-setting & Feedback. Within the goal setting protocols, on four sites matched for type of build, construction phases, numbers of personnel, etc., personnel either set participative goals or were assigned goals that were corrected for goal-difficulty levels using a goal equalising method (see Cooper, 1992). Three categories of behavioural safety measures were introduced with four-week time lags between them: Scaffolding, Access to Heights and Housekeeping. A fourth category of personal protective equipment (PPE) was used as a control category throughout the 52-week experiment. Utilising Cohen's (1977) 'd' statistic, the results revealed that overall the intervention improved safety performance (the percentage of safe behaviour) on all six sites involved in the study (d=0.41). The control category showed no appreciable improvement (d=0.07). When moderator analyses were conducted for type of goal-setting, participative goals increased overall performance (d= 1.02) whereas assigned goal setting decreased overall performance (d=-0.19). Further moderator analyses for intervention period showed that overall performance increased dramatically during the first intervention period (d=1.65) but declined during the second intervention period (d=-0.84). The third moderator analyses focused on the interaction between intervention period and type of goal setting. This revealed stark differences in performance. During the first intervention performance for participative goal setting (d=2.42) was 1.48 standard deviations greater than assigned goal setting (d=0.94). During the second intervention, although there was a decline in performance for both goal-setting strategies, the magnitude of decline for participative goal setting (d=-0.31) was considerably less than for assigned goal setting (d=-1.36). These results clearly indicate the influence that goal setting method (situational) exerts on safety performance (behaviour).

The results of other research groups also demonstrate these types of reciprocal relationships. For example, Hurst, Young, Donald, Gibson and Muyselaar (1996) utilised a safety management system audit tool (Situational) and a safety attitude survey measuring psychological variables (Donald & Canter, 1994) at six major hazard sites in four European countries (Greece, Holland, Portugal & UK) to compare each methods utility in predicting accident performance data. Attempts were made to include data comprising lost-time frequency rate and loss-containment frequency rate. However, because of difficulties associated with interpretation and categorisation between the different organisations, self-reported accident (SRA) rates (behavioural) proved to be more reliable in data collection terms. In addition two modification factors that encompassed Pipework and Vessel generic failure rates were used (i.e. the ratio of the PRIMA adjusted failure rate to the generic failure rate is termed the modification factor) to provide a performance measure of the process safety management system (PSMS). Although completely independent, a strong correlation was obtained between the PSMS modification factors and SRA rates illustrating the situation-behaviour relationship. Conversely, the correspondence between the SAQ scores and SRA was very poor, indicating a poor psychological–behavioural predictive relationship. However, this result may be due to the influence of societal or national (external) cultures on perceptions of safety within the organisations concerned (Pidgeon, 1998). A low correlation between the results of the PRIMA audit and the SAQ indicated that each method was measuring distinctly different aspects of safety culture, which supports the use of different methods with which to measure safety culture. However, it should be recognised that this could simply be a reflection of a lack of 'point-to-point correspondence' between the two measurement methods.

Although the above studies used a *between-methods* approach, examinations conducted from a *within-method* approach also appear to support it. For example, Cooper (1997a) examined the hypotheses that risk perception (psychological) is culturally determined by group (situational) characteristics (Douglas, 1985). The results of a construction industry risk perception questionnaire (Duff *et al*., 1993) that measured the frequency of occurrence, the likelihood of an injury and the severity of injury of particular construction related hazards were subjected to one and two-way ANOVAs. Although no significant effects emerged for trade or industry experience (Wilson, 1989) or for accident involvement (Saari, Tech & Lathela, 1981), main effects were obtained for hierarchical level, illustrating the influence of one as opposed to all three situational variables on psychological factors. A series of one-way ANOVA's were then conducted on the data obtained from 10 separate distributions of various safety climate questionnaires developed by the author in UK chemical, manufacturing and food industries. In all but one of the distributions, significant differences emerged between process workers and managers perceptions of risk with F values ranging between 4.93 to 43.18, and associated p values of <.05 to <.0000. Subsequently, in attempts to understand each group's 'frame of reference' stepwise multiple regression analyses were conducted on each data set. This revealed that process workers perceptions of risk appear to be determined by one job factor (i.e. behavioural), three internal psychological factors and ten organisational factors (i.e. situational). Conversely, the managerial group's perceptions of risk appeared to be determined by one job factor, two internal psychological factors and only five organisational factors. Thus risk perception (psychological) appears to be culturally determined by hierarchical level (situation) within the workplace. Interestingly, the required workpace (behavioural) which is at the heart of the safety-productivity conflict (situational), was the one job factor that both groups use as their frame of reference when assessing risk (psychological). Salminen & Saari (1995) addressed the safety-productivity conflict in a safety climate study carried out in the Finnish construction industry. They asked 294 personnel connected with serious occupational accidents to estimate the effects on safety and productivity of 26 remedial actions. The responses were analysed according to the respondent's role in an accident: victim, eyewitness, safety representative, foremen, general manager and safety officer. Overall, the respondents indicated that addressing the situational aspects (e.g. machines & equipment, providing more spacious work sites), and behavioural aspects (e.g. housekeeping) would simultaneously improve both productivity and safety, although clear differences of opinion were found between the foremen and all other respondents, and between employees and employers. Thus the results again indicate that role position (situation) will affect perceptions of safety climate. Many other safety climate studies also reveal the influence that behavioural or situational factors exert on perceptions or attitudes (psychological). For example, behavioural features such as accidents and risk-taking in the nuclear industry (Lee, 1998) have been demonstrated to influence perceptions of safety climate. Similarly, such perceptions have differed according to situational features such as seniority, occupation, age, and shift patterns in the offshore petrochemical industry (Mearns, Flin, Gordon & Fleming, 1998), hierarchical levels (Clarke, 1998a) or high vs. low accident workgroups (Guest, Peccei & Thomas (1994) in the rail industry, and organisational and social factors on offshore petroleum platforms (Rundmo, 1993).

Applied Behavioural Analyses (e.g. Cooper, Heron & Heward, 1987) are used to examine an organisations accident records within a behavioural safety initiative to develop behavioural observation checklists. These analyses reveal the antecedents that triggered an unsafe behaviour and the consequences to the person for behaving unsafely that reinforce that behaviour. Very often a perusal of the antecedents reveals the associated organisational 'pathogens' or 'latent conditions' that exerted an influence on the person's behaviour (Reason, 1988). In other words, the interactions between employees safety behaviour, their internal motivators (psychological) *and* the associated system faults (situational) are identified (Cooper, 1996). Clarke (1994) interviewed 38 train drivers and revealed that incidents such as signalling failures were often not reported (behaviour) because of their perceptions of a number of organisational features (situation) such as bureaucratic form-filling procedures, poor management response and a lack of feedback. A follow-up study with 128 train drivers investigated their intentions to report incidents. Again due to their perceptions of management's lack of response to such reports, the train drivers intentions to report were determined by the perceived situational relevance of the incident. Signalling failures or signal passed at red would be reported, whereas trespassing incidents involving the public or debris on the line would not (Clark, 1998b).

Hudson, Wagenaar, Reason, Groeneweg, Van der Meeren and Visser (1991a) and Hudson, Groeneweg Reason, Wagenaar, Van der Meeren and Visser (1991b) from the Universities of Leiden and Manchester developed the 'Tripod' approach for the Petrochemical Industry that uses Failure State Profile checklists in attempts to discover the

underlying causes of accidents or 'latent conditions' (Reason, 1997). In essence, these are safety management system audits that use yes/no responses. Operating personnel specific to a particular drilling operation are asked to complete these, which takes about 35 minutes. In one study (Hudson *et al*., 1991b) the generation of a Failure State Profile was subsequently compared to a Failure State profile derived from analyses of an accident database. Very similar profiles were obtained indicating that people's perceptions of the safety management system (situation) were accurate. Indeed the numbers and types of accidents related to specific safety General Failure Types were highly correlated (r=0.92).

In summary, although at a very early stage the available evidence does suggest that the reciprocal model of safety culture has much merit as an analytical framework with which to tease out both linear and curvilinear relationships within and between those psychological, behavioural and situational variables that impact on safety management practices and safety culture, at many different levels of an organisations functioning (i.e. strategic, tactical and operational).

13. 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 has been the case 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.

13.1 Reciprocal influences (*Between-methods*)

Although internal psychological factors and behaviour(s) operate as reciprocal determinants of each other, very little research has attempted to validate an organisations safety climate results against members *actual* ongoing safety-related behaviour(s). Instead studies appear to use self-reported measures of behaviour (e.g. Cheyne, Cox, Oliver & Tomas, 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 (see 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 (see 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 & 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 organisations 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 persons, workgroups, or departments safety-related behaviour. Does employee safety behaviour, therefore, control the safety management system(s), or does the safety management system(s) control employee safety 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 provide *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, Davies, Phillips, Duff, Robertson, Weyman & Cooper (1998) found that management's commitment to the process influenced the commitment of workforce behavioural observers, which in turn affected actual performance. Notwithstanding these studies, apart from findings that top management commitment to safety is a feature of low-accident companies (e.g. Cohen, Smith & Cohen, 1975; Smith *et al*., 1978) there appears to be a paucity of research in this area. Lindgard & 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 organisations safety culture over extended periods of time thereby enhancing knowledge about its dynamic nature, within specified contexts.

13.2 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 & Gooding, 1987) has indicated that correlations between two sets of perceptual data (e.g. safety climate scores and

self-report 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' (Mearns *et al*., 1997). However, climate measures that include attitude scales run the risk of muddying the climate construct itself (Miller & 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 & Cox 1991; Mearns *et al*., 1998; Lee, 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 there 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 organisations 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 & Winn, 1989; Sulzer-Azeroff, Harris & Blake-McCann, 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. HSE, 1997; Cooper, 1997b; 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 (see Stewart & Townsend, In press), 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 & 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 & proficiency of the organisations H & S programmes that creates the 'safety culture' *product*, or is it that the prevailing safety culture *product* actually determines the style and proficiency of these H & S programmes?

13.3 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 & 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). Most studies adopting this approach appear to account for 50-60 percent only, of the overall variance when conducting factor analyses to examine the instrument's architecture. A perusal of many such studies also shows that the within and between variance obtained from ANOVA's 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 subcultures present within the different organisations or sites surveyed appear to be ignored. This latter issue is important, as the reciprocal influences on these subcultures 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 & 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 (See Furnham & 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 & 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.

14. 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 peoples 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 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. Although some evidence is available to support it, much more is required. 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.

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