

# Perspectives on safety culture

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## Abstract

Overviewing selected elements from the literature, this paper locates the notion of safety culture within its parent concept of organisational culture. A distinction is drawn between functionalist and interpretive perspectives on organisational culture. The terms 'culture' and 'climate' are clarified as they are typically applied to organisations and to safety. A contrast is drawn between strategic top down and data-driven bottom up approaches to human factors as an illustrative aspect of safety. A safety case study is used to illustrate two measurement approaches. Key issues for future study include valid measurement of safety culture and developing methods to adequately represent mechanisms through which safety culture might influence, and be influenced by, other safety factors.

**Author Keywords: Culture; Climate; Safety**

## 1. Organisational culture and safety culture

Organisational culture, however defined, is widely acknowledged to be critical to an organisation's success or failure, for example in business. Graves (1986) and Williams et al. (1989) consider that the prime function of culture is to contribute to an organisation's success. Analogously, safety culture is frequently identified, for example by disaster inquiries, as being fundamental to an organisation's ability to manage safety-related aspects of its operations — successfully or otherwise. Implicit within both these views is the notion that culture operates at different levels and through various mechanisms. However, the nature of these mechanisms remains problematic.

Because the notion of safety culture arose from the more inclusive concept of organisational culture, some key features characterising debate about this concept are first considered. Broader issues, including derivation of the notion of culture from social, ethnic or other origins, are excluded here.

### *Alternative views of organisational culture*

Waring and Glendon (1998) review approaches to organisational culture from two contrasting perspectives that have dominated the literature, as well as managerial and professional practice within organisations. These two broad perspectives have been described as functionalist and interpretive (Burrell and Smircich).

Waring, 1992; Waring, 1993 and Waring considers that functionalist approaches assume that organisational culture exists as an ideal to which organisations should aspire so that it can, and should be, manipulated to serve corporate interests. The notion that organisational culture has, as its prime function, to support management strategies and systems is premised on the assumption that it can be reduced to relatively simple models of prediction and control. This approach primarily aligns organisational culture in support of managerial ideology, goals and strategy, in extreme cases involving managerial use of 'culture' to coerce and control (Smircich, 1983). Ideological use of culture as a weapon in organisational struggles reveals a powerful unitarist bias. This engineering model of organisational culture is criticised by Sackmann (1990), who regards it as problematic as to whether leaders initiate culture.

Alternative expositions of organisational culture can provide a more complete understanding of this important concept. From this imperative derived interpretive approaches to organisational culture. Interpretive approaches (e.g. Waring, 1992; Waring, 1993 and Waring) assume that organisational culture is an emergent complex phenomenon of social groupings, serving as the prime medium for all members of an organisation to interpret their collective identity, beliefs and behaviours. Organisational culture is not owned by any group but is created by all the organisation's members. Consonant with an interpretive perspective is Schein's (1990) developmental approach to organisational culture, defined as a pattern of assumptions developed by a group as it learns to adapt to its environment. The culture is taught to new members as the framework for cognitions and behaviours in response to problems.

From assumptions characterising interpretive approaches to organisational culture, it follows that managerial attempts to manipulate culture, for example in seeking to drive rapid organisational change, are likely to fail because of the application of an inadequate model of processes that they attempt to manipulate. An analogous point, in respect of organisations seeking to enhance safety culture as the 'philosopher's stone' to improving health and safety, is made by Cox and Flin (1998).

A functionalist perspective is 'top down' in that it serves the strategic imperative of members of the controlling group. An interpretive perspective represents a 'bottom up' approach, and allows for the existence of sub-cultures within an organisation. Most organisations display elements of both approaches. For example, through rigorous adoption of formalised risk management practices, an organisation reveals a functionalist approach to culture. A more interpretive side may be revealed by individual and group commitment to learning from past mistakes, such as those leading to accidents. This

might be achieved through open ended communication and discovery processes, involving a developing identity for the organisation's members.

As Waring and Glendon (1998) observe, from an interpretive standpoint, culture provides a metaphor for understanding how organisations work and why they respond in particular ways to environmental influences. These authors argue that an interpretive perspective on culture is more appropriate than a functional approach as a way of modelling attempts to understand behaviours and cognitions in respect of safety and other aspects of organisational life.

A number of classifications have been suggested for organisational culture, including those of Schein; Deal; Graves; Cooke; Cooke and Williams. A global approach within one organisation was the basis for Hofstede and Hofstede well-known taxonomy - a tradition continued through the current 65-nation GLOBE project (House et al., 1999). Furnham and Gunter's (1993) culture taxonomy is based on theoretical versus empirical origin. The former they identify as being top down approaches that are based on conceptual distinctions from previous work. Empirical approaches are identified as being bottom up and data-driven to produce a set of dimensions for defining culture, but probably theoretically void (Furnham and Gunter, 1993). Considerable emphasis in the literature has been upon seeking appropriate measures, dimensions and taxonomies for organisational culture, in part at least to find a way to an optimum culture. However, this is premised upon a functionalist approach as being the best means of understanding culture.

## 2. Dimensions of organisational culture

A number of attempts have been made to map the main features or levels of organisational culture. A few are summarised in Table 1.

Originator	Level	Intermediate	Deepest
Schein (1985)	Most accessible Behaviours and artefacts	Beliefs and values	Underlying assumptions
Rousseau (1988, 1990)	Observable artefacts (e.g. company logo); observable patterns of behaviour.	Behavioural norms, which can be inferred from observed behaviours; values, as expressed consciously by organisation members	Fundamental assumptions — core values that may not be articulated
Deal and Kennedy (1986); Lundberg (1990)	Manifest level — symbolic artefacts, language, stories, rituals, normative behaviours	Strategic level — strategic beliefs	Core level — ideologies, values assumptions

Table 1 Three models of organisational culture

A large degree of concurrence exists between espoused models. For the content of organisational culture, a three-level classification embodying relatively accessible, intermediate and deep levels, forms the basis for the composite model outlined. The most accessible level refers to observable behaviours and perhaps associated norms. At an intermediate level are attitudes and perceptions, which are not directly observable, but which may either be inferred from behaviours or assessed through questioning. At the deepest level are core values, which are much less amenable to assessment and for whose investigation more ethnographic methods are likely to be required.

Other key dimensions of organisational culture that have been identified include depth, breadth and progression (Eldridge and Crombie, 1974). Depth refers to the way in which culture is reflected in the organisation's policies, programs, procedures, practices, values, strategies, behaviours and other features. Cultural breadth is represented in the lateral coordination of different organisational components. Progression refers to the time dimension, and is similar to the developmental aspect of culture espoused by Schein (1990). Gorman (1989) identifies three further dimensions. Strength is the extent to which organisation members embrace core level meanings. Pervasiveness refers to the extent to which beliefs and values are shared across the organisation. Direction reflects the extent to which organisational culture embodies behaviour that is consistent with espoused strategy.

Waring and Glendon (1998), following Turner's (1988) pluralistic notion of organisations as assemblages of multiple cultures, add localisation, this being the extent to which organisational locations exhibit sub-cultures. Schein (1990) identifies seven dimensions of organisational culture, and considers that critical dimensions of culture - reflecting its strength and degree of internal consistency — are defined by the stability of a group and how long it has existed. Also important is the intensity of group learning experiences, how learning occurred, and the strength and clarity of assumptions held by group founders or leaders.

If organisational culture, or some aspect of it, is to be measured at three levels and across several dimensions, then complex and imaginative methods of assessment and analysis will be required. Questionnaire or similar measures will be inadequate to measure all aspects of organisational culture. Validated questionnaires are acceptable as climate measures. Organisational climate and its derivatives (e.g. safety climate) might be comparable with intermediate levels of culture measured across some of the dimensions already outlined. This issue is explored further later.

### **2.1. Measuring organisational culture**

Rousseau (1990) reviews several instruments supposedly designed to measure organisational culture, and found considerable variation in what was measured and in the extent to which validity and other methodological issues were addressed. Broadfoot and Ashkanasy (1994) reviewed 18 survey instruments designed to measure organisational culture, all of which they found exhibited serious flaws. Contemporary circumstances, within which measurement of all aspects of managerial performance becomes an imperative, means that pressure to assess culture and its derivatives can be difficult to resist. However, exclusively functionalist approaches to the measurement of organisational culture are likely to be inadequate because they are based upon an incomplete model of the concept for which measurement is sought.

To comprehensively assess organisational culture, or some aspect of it - such as safety culture - the measures used must be based upon an adequate model of culture, taking account of its multi-faceted nature. Three methodologies that have been used to assess and analyse organisational culture are:

1. Soft systems methodology (Checkland and Waring) adopts a broad perspective that can incorporate both quantitative and qualitative data.
2. Organisational climate surveys supported by triangulated methods (e.g. Rousseau, 1990; Tucker and Glendon).
3. Grid-group analysis (e.g. Gross; Douglas and Royal).

Locatelli and West (1996) examined three qualitative approaches to measuring organisational culture - repertory grids, the twenty statements test (TST) and group discussions. The criteria used by Locatelli and West to compare the three methods were:

1. Level of cultural information accessed, including specific cultural elements (artefacts, values, underlying beliefs - see Table 1 - about which information was elicited).
2. Quality and usefulness of information generated.
3. Ease of use, including time and cost.

Locatelli and West (1996) showed that TST performed best, being both quickest and producing the most relevant information. However, there was poor overall inter-rater agreement and no one method had

comprehensive coverage for all aspects of the organisational culture framework (Schein, 1990). A combination of methods is indicated, probably comprising as a minimum the TST and a questionnaire - assuming that together these will capture information on values and beliefs as well as underlying assumptions. A more comprehensive analysis might also require checklists (to capture data on artefacts) and activity analysis (for information on behaviour patterns). Although no study has yet reported on the combination of all these approaches in the open literature, a case study combining questionnaires and human factors interventions is discussed later.

### 3. Organisational culture and organisational climate

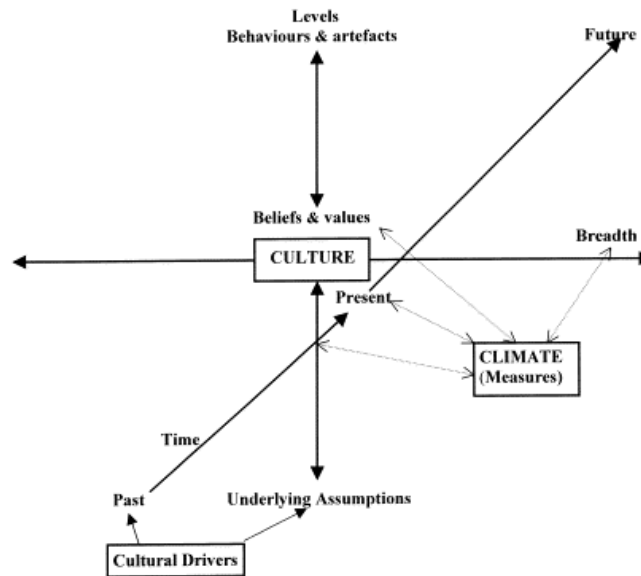
Confusion between the terms 'culture' and 'climate' means that they have been used interchangeably. While there is a relationship and some overlap between these terms, organisational climate refers to the perceived quality of an organisation's internal environment. In a review by Rousseau (1988) of 13 definitions derived over a 21-year period, employee attitudes and perceptions featured prominently. Typical was the definition proffered by James and Jones (1974), of "psychologically meaningful cognitive representation of the situation". Furnham and Gunter (1993) regard organisational climate as being an index of organisational health, but not a causative factor in it.

Typically organisational climate is regarded as a more superficial concept than organisational culture, describing aspects of an organisation's current state. Scaled dimensional measures are the most popular means of measuring organisational climate, of which many have been devised. There is no agreement on the key dimensions to be measured. Furnham and Gunter (1993) identify 35 possible scales, one of which is risk. In reviewing the literature, Koys and De Cotiis (1991) produced a composite eight-dimensional scale with the components shown in Fig. 1. These generic categories essentially relate to human resource aspects of an organisation's environment, and while substantive elements of organisational life, such as safety or risk do not figure, dimensions from Koys and De Cotiis (1991) typically feature on safety climate scales.



Fig 1 Dimensions of organisational climate (after Koys and De Cotiis, 1991).

Methodology might be a good indicator as to whether organisational culture or climate is being measured. If a psychometric scale is the exclusive measurement instrument, then some aspect of organisational climate is being measured. A triangulated methodology might indicate that other aspects of culture were being tapped, although this would depend upon the depth and breadth of the measures used. An attempt to describe the relationship between organisational culture and climate is shown in Fig. 2.



**Fig 2 - Organisational culture and organisational climate.**

Fig. 2 identifies three dimensions for organisational culture. It is represented at three different levels (as per Schein [1985] or similar models), it has breadth (which also represents the extent to which cultural elements are shared or localised as sub-cultures) and it has a past, a present and a future - the progression or time dimension. Other dimensions might be added, but cannot adequately be represented on a two-dimensional figure.

What organisational climate measures may access are some dimensions of organisational culture within a limited range. For example, climate questionnaires might access attitudes, beliefs and perceptions that are located at the mid-range of cultural levels. However, surveys are limited by their methodology and can only report on attitudes at the time that they are undertaken and perhaps also a little in the past. Thus, organisational climate surveys might provide a snapshot of selected aspects of organisational culture. Without validation, climate survey findings may be difficult to interpret within a culture framework.

By imposing a unified mono-culture, a functionalist approach to organisational (or safety) culture or climate renders the notion of sub-cultures largely redundant. Aggregating questionnaire scores across departments or other groupings within organisations predicates a functionalist approach. Acknowledging diversity from such surveys would go some way towards identifying a bottom-up approach to these phenomena. However, the methodology imposes uniformity upon the data. Identifying sub-cultures and the potential diversity that this implies as a basis for improving understanding of the phenomena under study could be a valuable way forward.

### **3.1. From organisational culture to safety culture**

Contrasting perspectives on organisational culture can be used as a framework for appreciating how values, attitudes and beliefs about safety are expressed and how they might influence directions that organisations take in respect of safety culture. The term 'safety culture' arose from the Chernobyl nuclear disaster in 1986, in which cause was attributed to a breakdown in the organisation's safety culture (International Atomic Energy Agency, 1986 and Toft, 1992). Subsequently, the concept was heralded as a substantive issue in official inquiry reports into disasters such as Kings Cross (Fennell, 1988) and Piper Alpha (Cullen, 1990). The term rapidly gained currency within the safety management lexicon.

As with the concept of organisational culture, a range of meanings has been attached to safety culture, three of which are reviewed by the Institution of Occupational Safety and Health (1994). The first meaning includes those aspects of culture that affect safety (Waring, 1992). The second refers to shared

attitudes, values, beliefs and practices concerning safety and the necessity for effective controls. The third relates to the product of individual and group values, attitudes, competencies and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organisation's safety programs (Health and Safety Commission, 1993). The latter two definitions are premised upon a functionalist perspective - also seen in Confederation of British Industry, 1990; Ryan, 1991; Pidgeon et al., 1992; Booth, 1996; Clarke, 1998 and Cooper. Booth (1996) proposes an audit approach, while Cooper's (1998) methodology for changing safety culture incorporates risk assessments, audits, training, climate surveys and behaviour change. The approach taken by these authors implies that safety culture is conflict-free and aligned with the objectives of a controlling function.

### 3.2 Safety climate

Contemporaneous with the derivation of safety culture from organisational culture was the associated term 'safety climate', which came from a more empirical tradition associated with such researchers as Zohar; Brown; Cooper and Phillips, 1994; Guest et al., 1994 and Williamson. Some researchers distinguish between safety culture and safety climate (e.g. Cooper and Mearns et al., 1998), while attempts have also been made to derive composite models (e.g. Guldenmund, 2000). The prime research method for investigating safety climate is the questionnaire, typically completed by sufficient numbers of employees to enable statistical analysis to reduce a large number of items to a small number of dimensions (e.g. Williamson and Mearns et al., 1998). These dimensions are intended to represent the essence of safety climate for the organisation. Table 2, from Litherland (1997) summarises dimensions obtained from six safety climate studies.

Zohar (1980)		Brown and Holmes (1986)	Glendon et al. (1994)	Coyle et al. (1995)	Coyle et al. (1995)	De-dobbeleer and Belan (1991)
Country/industry	Israel/Production	USA/Production	UK/Electricity	Australia/Medical 1	Australia/Medical 2	USA/Com
Factor	Management attitudes towards safety	Employee perceptions of management concern with their well being Employee perception of management response to this concern	Relationships	Maintenance and management issues		Management commitment to safety
Training	Importance and effectiveness of safety training		Communication and training	Training and management attitudes	Personal authority, training and enforcement of policy.	
Procedures			Incident investigation and development of procedures Adequacy of Procedures	Policy/procedures Company policy		
Risk perception	Level of risk at work places	Employee physical risk perception	Safety	Work environment	Work environment	
Work pace	Effects of work pace on safety		Work pressure			
Worker involvement	Status of safety-committee					Workers involvement in safety
Other	Effects of safe conduct on social status Effects of safe conduct on promotion Status of safety officer		Personal protective equipment Spares		Accountability	

Table 2 Summary of safety climate dimensions from six studies (after Litherland, 1997)

This empirical tradition has elements of both functionalist and interpretive perspectives. The methodology presumes that, much as in trait-based approaches to personality, organisations have safety climates that are waiting to be ‘discovered’. The measurement and inference that, once ‘revealed’ the perceptions that comprise safety climate dimensions will be associated with measurable safety behaviours, with the implied targeting by management of these perceptions and behaviours, suggests a functionalist approach. However, the notion that safety climate derives essentially from aggregate employee perceptions, that it is multi-dimensional and that it can potentially influence safety-related behaviours, means that the concept belongs more in the interpretive school. Notwithstanding this conceptual position, finding an empirical association between safety climate dimensions and safety behaviour measures has so far proved elusive, although this could be due to methodological and analytical difficulties as much as to the presence or absence of such an association.

### 3.3. Psychometric assessment over time

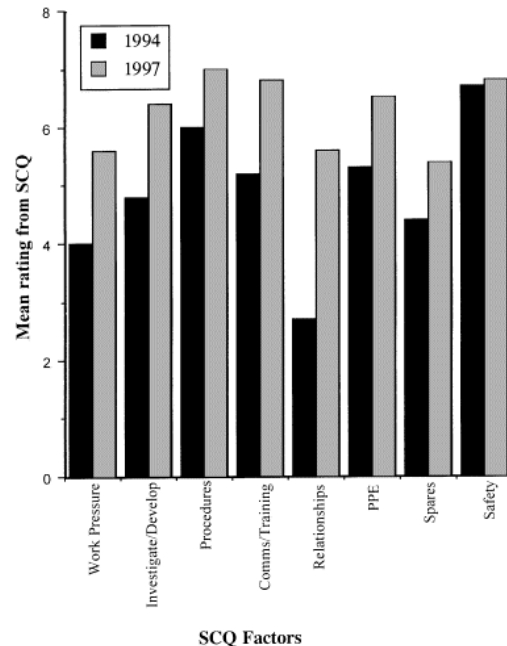
An alternative to seeking correlations between safety climate scores and behavioural measures is to use a psychometric approach to measure changes over time, for example to test for possible effects of an intervention. The case study described involved comparing safety features in an industrial organisation on two occasions over a three-year period and is an example of a functionalist approach to safety culture. Two methods were used: the Safety Climate Questionnaire (SCQ) and predictive human error analysis (HEA). HEA is based upon Hierarchical Task Analysis (HTA) and is designed to identify the error potential of any aspect of work. It is more fully described in Stanton (1995). Development of the SCQ is described in Glendon et al. (1994). The SCQ is a 58-item measure that was originally derived from over 300 generic items with the potential to influence safety performance. It measures employee attitudes to each item on a nine-point scale, and has been factor analysed for a number of samples to produce a reasonably consistent eight-factor structure. The eight SCQ factors are shown in Table 3.

Factor	Description
Work pressure	Degree to which employees feel under pressure to complete work, amount of time to plan and carry out work, balance of workload
Incident investigation and development of procedures	Degree to which staff are involved in development of procedures, extent to which incident investigations get to underlying causes of incidents, effectiveness of procedures
Adequacy of procedures	Accuracy, completeness, comprehensiveness, clarity and appropriateness of procedures, ease of selection and use procedures
Communication and training	Degree of openness and extent to which communication reaches all levels in the organisation, extent to which training incorporates all aspects of the job, relevance and effectiveness of training
Relationships	Degree of trust and support within the organisation, confidence that people have in the organisation's future, working relationships with others and general morale
Personal protective equipment (PPE)	Degree to which the organisation is concerned with the design, issue, use, and enforcement and monitoring of PP
Spares and back up equipment	
Safety policy and procedures	Degree to which safety is a priority, extent to which people are consulted on safety matters, practicality of implementing safety policy and procedures

**Table 3 Safety Climate Questionnaire factors (Glendon et al., 1994)**

Comparison of the two SCQ samples from 1994 and 1997 using the Mann-Whitney U test revealed seven statistically significant differences. Improvements were recorded on the SCQ factors of ‘Work pressure’, ‘Incident investigation and development of procedures’, ‘Adequacy of procedures’, ‘Communication and training’, ‘Relationships’, ‘PPE’ and ‘Spares’. This is further illustrated in Fig. 3, which shows a general improvement in ratings from 1994 to 1997. This is particularly noticeable for ‘Relationships’, which suggests that there have been great improvements in the degree of trust and confidence that staff have in the organisation and in their own future. It may be seen that ratings for ‘Adequacy of procedures’, ‘Communications and training’, and ‘Safety policy and procedures’ remain high. Ratings for ‘Incident investigation and development of procedures’ and ‘PPE’ are just over the scale mid-point.



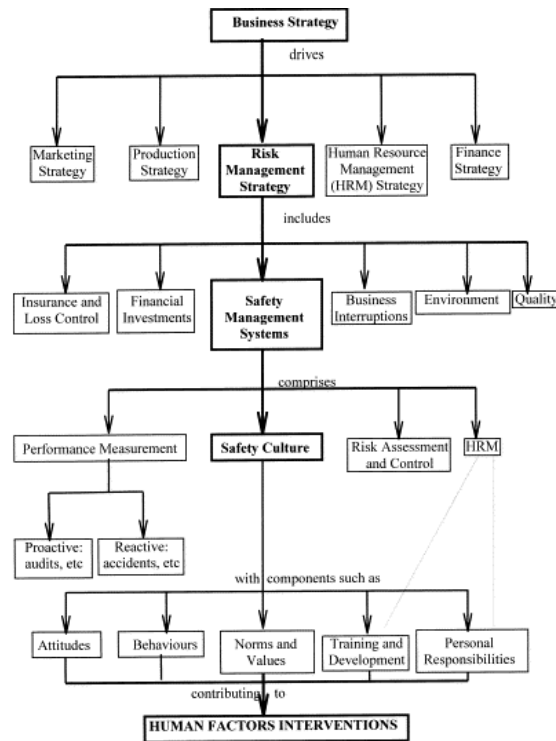


**Fig 3 Comparison of SCQ Factors - 1994 and 1997**

From the data in Table 3 and from contemporaneous observations, some tentative conclusions about safety in this organisation may be drawn. 'Work pressure' is a continuing problem for staff. There is a widespread perception that there is inadequate time for tasks, insufficient staff numbers and that work pressures are generally high. Planned organisational changes improved the degree of trust and support within the organisation. In 1997 staff had more confidence in their future with the organisation and there was a corresponding improvement in working relationships and morale. However, this remained an area of some concern. The 'Spares' factor had the lowest overall mean. Staff are generally critical about the availability and general efficiency with which spares and back-up equipment are provided. There is a need to develop appropriate strategies to tackle this problem.

#### **4. Contrasting approaches: strategic safety and human reliability assessment**

This section contrasts idealised elements typical of top down and bottom up approaches to one aspect of safety culture, human factors. Senior management develops a top-down driven strategy on safety as part of an organisation's overall strategy for business or other mission. This includes risk management strategy, including all aspects of risk - pure and speculative, including insurance and loss control, financial investments and business interruptions. A key aspect is a safety management system, which includes safety performance measurement - both proactive and reactive, risk assessment and control, human resource management (HRM) and safety culture. Safety culture comprises attitudes, behaviours, norms and values, personal responsibilities as well as such HR features as training and development. Human factors in this example provides the interface with a bottom up approach to safety. Fig. 4 is a stylised illustration of a strategic approach to safety.

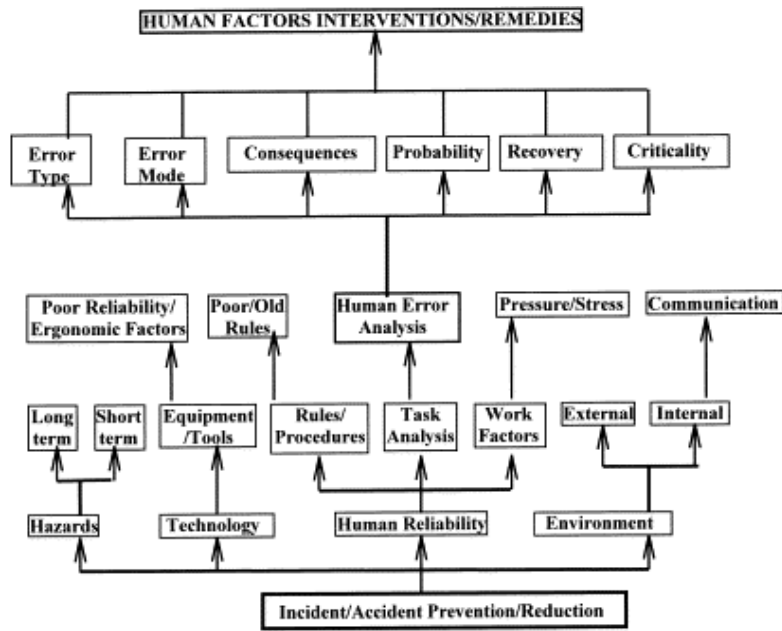


**Fig 4 A strategic (top down) approach to safety**

In a bottom up approach the driver may be a safety target or specific objective, such as accident prevention. Other possible starting points include reducing losses through fire, theft or damage. Whatever risk is being considered, a number of aspects need to be addressed, including relevant hazards, associated technology, the environment within which the activity takes place and human reliability associated with the activity.

In this accident or incident prevention example, associated human reliability is a function of work factors, together with rules and procedures governing work and the tasks involved. A generally accepted way of assessing and evaluating the nature of the tasks undertaken is by some form of task analysis, for example HTA. To understand better how human interaction with tasks might lead to incidents or accidents, some form of HEA is required. For each step in the task analysis this could involve identifying values for the HEA components. Finally, interfacing with and involving human factors solutions are the required remedies. This example illustrates the data-driven nature of a bottom-up approach applied to a particular case.

This example of a bottom-up or operational approach to safety is shown in Fig. 5, which incorporates further illustrative components relating to other features, such as technology and environment. This approach mirrors the top-down example with human factors at the interface.



**Fig. 5. An operational (bottom up) approach to safety.**

Various forms of HEA have been developed. HEA can identify routine human-system interactions that could give rise to errors with potentially serious consequences. The analysis systematically progresses through a sequence of steps. HEA's main advantage over incident analysis is that it can detect possible errors without waiting for them to be transformed into incidents. It can, therefore, be a relatively cost effective approach to incident reduction and risk management. The HEA used in the case study here has the components shown in Fig. 5, which are expanded below.

*Task step* - is the task analysis of the task performed. Each task step is described at the lowest level at which it has meaning for the operational sequence.

*Error type* - slip/lapse, mistake or violation (Reason, 1990).

*Probability* - of error occurrence for each task step. If the error had never been known to occur then a low probability was assigned; if the error had been known to occur then a medium probability was assigned; if the error occurred frequently, then a high probability was assigned.

*Criticality* - If the error leads to, or could reasonably lead to, a serious incident then it is labelled as critical.

*Error mode* - using the task analysis as a basis for determining the types of error that could occur at each step, errors are assigned to the categories: action, checking, retrieval, communication/information transmission, planning and selection. From a range of possible errors, all those that are credible for the task under consideration are identified.

*Description* - the error is described as it relates to the task in question.

*Consequences* - any serious consequences of the error are described, for example in terms of possible injury, damage or major cost-incurring events. Where consequences are negligible, analysis of the step can be terminated, but where they are unacceptable then the information feeds forward to the next stage.

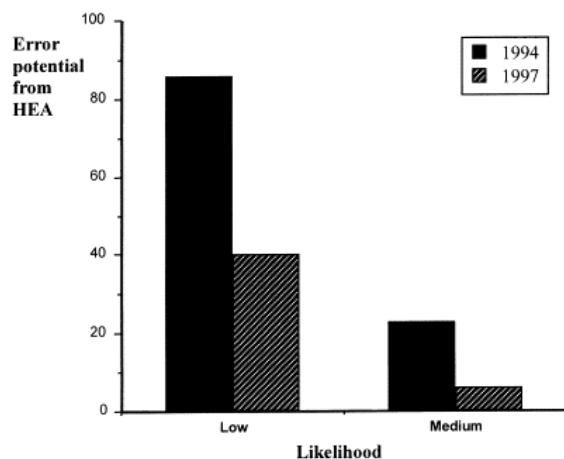
*Recovery* - any future task steps at which the error is recoverable are identified.

*Remedy* - strategies that might have prevented the error, or which could be implemented to prevent or reduce the likelihood of that error, are indicated. These could be design alterations, further training or changes to existing training, changes in procedures, changes in management or organisational policy.

A draft HEA is carefully scrutinised by experts in the domain to confirm its accuracy and completeness. Of particular concern are those task steps that can produce errors from which no recovery is possible, which are of at least medium probability of occurrence and where severe consequences are possible. In such cases particular attention needs to be paid to the possibility of an error (high, medium or low) and classification of the error as critical or non-critical. Only a small proportion of errors in any sequence is likely to be labelled as critical. Critical errors with a high or medium probability of occurrence require high priority remedies.

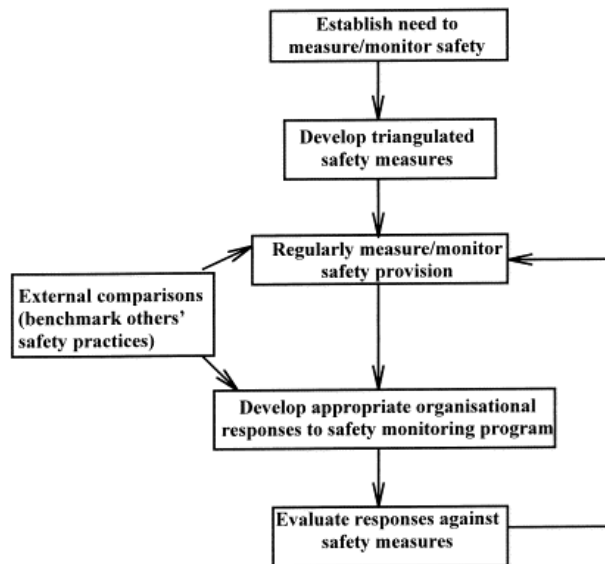
Results from the HEA are a resource to assist in risk-related decision making - i.e. in managing risks involving human factors. From the completed HEA, the identified possible errors that need to be addressed may be ranked, taking account of their likelihood and potential consequences - i.e. a traditional risk assessment. Criteria such as cost-benefit, practicability and user acceptability can then be used to determine the desirability and time scale of implementation of any necessary changes.

In the same case study organisation described above, comparison of current activities with the baseline established in 1994 showed a general reduction in error potential in both critical and non-critical errors. Statistical analyses, using the Binomial test, were conducted to determine differences between error rates in 1994 and 1997. All comparisons between critical (low and medium likelihood) errors were statistically significant. Differences between predicted error potential for critical errors in 1994 and 1997 are illustrated in Fig. 6, which shows a reduction in the error potential by over 50% for critical errors. This suggests that system operation is likely to be generally safer.



**Fig. 6. Comparison of Human Error Analyses — 1994 and 1997.**

Key safety features should be regularly monitored and possible stages are summarised in Fig. 7. A strategic need to monitor safety drives development of triangulated safety measures, for example including staff questionnaires and quasi-ethnographic approaches. Safety should be measured regularly and appropriate responses to findings developed. For example, if it were found that communication was a problem then this issue would be addressed. The success or otherwise of responses to revealed problems would then be evaluated, perhaps by replicated measures or through action research. The cycle would be regularly repeated as a means of evaluating continuous improvements in safety provision. Also important is external feedback, for example in the form of benchmarking others' practices to determine how improvements might be made.



**Fig. 7. Monitoring safety.**

## **5. Measuring safety culture**

### **5.1. An ethnographic alternative**

Comprehensive ethnographic studies of safety within contemporary organisations are awaited, although an early example of this genre is Gouldner (1955), while Powell et al. (1971) carried out a detailed workplace observational study of accidents. In this section we first address some shortcomings of other methods in measuring safety culture or climate, before considering an alternative methodology that represents an attempt at measurement from an interpretive perspective. It is clear from the safety climate and culture literature that the use of survey questionnaires dominates measurement. Many of the studies involved selected employee samples, often at a time of organisational change. It is possible that many of the employee samples were surveyed under conditions of employment uncertainty, which would reflect a particular response bias.

Observational studies, while superficially offering ecological validity, are often of too short a duration to be able to provide sufficiently large samples of behaviour. Social psychologists distinguish between acts and actions in an observational context. Acts refer to behaviours observed by an outsider, and actions to the layers of meaning that surround an act from a participant's viewpoint. Unless an outsider is fully conversant with the studied group's history, purposes, beliefs and values, only acts are available for observation.

Laboratory studies, while offering relatively high control, usually involve only selected samples of behaviour that are removed from any sense of employment or personal significance for participants. It is known that after extensive operations at work, workers develop many subtle adaptations during interactions with work interfaces and establish idiosyncratic patterns and habits that cannot be captured in brief simulations. In searching for an alternative approach that yields veridical data, ecological validity and experimental control appear to be at odds. Without appropriate controls it is very hard to plot true causal paths (Stanton and Gale, 1996). This proposal offers a research approach that combines ecological validity with control in a dynamic and developmental way. It is based on Gale's (1984) methodology, which seeks to preserve the main benefits of traditional approaches, whilst overcoming the principal disadvantages.

Following an initial proposal by Gale (1984) for a new research strategy for assessing the impact of new technology and for guiding design, Gale and Christie (1987) set out a blueprint for a new approach,

called CAFE OF EVE (Controlled Adaptive and Flexible Experimental Office of the Future in an Ecologically Valid Environment). Whilst originally conceived as the methodology for a project to investigate human behaviour with office technology, the CAFE OF EVE approach could be applied to safety culture investigations. It requires the researcher to apply an action research approach to investigating human activity.

The CAFE OF EVE approach seeks to combine the advantages of laboratory and field studies, whilst minimising the disadvantages of each. It involves taking over a department within an organisation in a way that allows day-to-day operations to continue, but to be combined with a parallel set of research studies. Staff within the selected department are included in the research function. However, for the duration of the research, job descriptions are officially altered to include reflection on their work situation and upon task demands. Participants' expert roles are recognised and they are invited into a partnership of equals within the research team, thereby diffusing some of the suspicion that generally attaches to 'clever' outsiders.

In turn, the full-time researchers share some of the departmental functions with the aim of understanding the meaning of events and activities for participants. At the same time, through daily exchanges with permanent employees, typical barriers between participant and experimenter would break down. As a conscious act, the researchers gently move conversation and interaction beyond the work context to issues of family and other non-work concerns, thereby cementing affiliate relationships. By addressing issues beyond the work barrier, the researcher, who also adopts a willingness for self-disclosure, lowers within-work barriers to free communication.

Thus the researchers take on the participant observer role as developed in anthropology (Vetere and Gale, 1987), living and working within the human system studied and recording daily events. Researchers and participants share a social world so that the barriers become more permeable and participants feel freer to express their opinions and reactions about their working environment. In daily debriefing sessions, participants interact with researchers, with the aim of identifying problems from participants' perspectives. End of day briefings are part of the extended job description of the worker and the employer formalises the use of the final half hour of the working day for workers to reflect on safety culture issues during the day, their reactions to these issues, and any other thoughts that come to mind. Because of the relationship that has built up with the researcher, the end of day briefing is more akin to an after work report to the worker's spouse or partner, than to a distant researcher. Within this context it is expected that worker reactions will be less abridged than would be the case in typical research interviews. The research questions generated are not dictated by existing theories but by recounted experiences of people at work.

As far as possible, video observation and analysis, diary keeping and interactive recording of subjective responses would be carried out in the department and integrated with everyday tasks. The CAFE OF EVE approach is a longitudinal and developmental technique that captures real experiences and that can be used to shape new developments (Stanton and Gale, 1996). Research questions are not imposed by prior conceptions but emerge from the work context and participants' views and analyses. Thus, it involves a partnership in exploration in which researcher and participant have equal status. Objectivity can be retained because the researcher remains apart, but ecological validity is ensured by drawing on participants' day to day experiences (Stanton and Gale, 1996). Key features of the approach are outlined in Table 4.

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**Ecological validity is approximated**

**All psychologically significant variables are likely to be identified**

**Participants and researchers develop a partnership of exploration**

**Sampling is flexible and by mutual consent**

**Participants reveal and are able to reflect upon coping strategies developed over time**

**Research studies emerge naturally**

**Participants themselves suggest studies or identify salient variables**

**Participant loss is minimal, thereby allowing longitudinal studies**

**Cooperation affects broader organisational structures, such as new ways of working**

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**Table 4. Key features of the CAFE OF EVE (Controlled Adaptive and Flexible Experimental Office of the Future in an Ecologically Valid Environment) methodology**

The CAFE OF EVE methodology is an action research approach within the ethnographic tradition. The risk of investing in such a long-term project would need to be set against the quality of the data obtained and the insights gained through research of this nature.

## **6. Conclusions**

Debate on organisational culture and climate and their derivatives, safety culture and safety climate, remains at an early developmental stage. Within organisational practices, there are signs of some convergence between theoretically distinct functionalist and interpretive approaches. It is appropriate to maintain a distinction between the overlapping concepts of safety culture and safety climate.

Most studies, mainly using questionnaires, have measured safety climate dimensions. Only a few studies using triangulated methodologies to investigate broader, deeper and historically derived safety culture features, have appeared. Advances are most required in this area.

Measurement of safety culture depends on how it is defined, which in turn reflects the perspective adopted. Measurement is not merely empirical but rests upon a value decision. Ethnographic approaches, while possibly the most valid from an interpretive perspective, are often costly and time consuming. They tend to produce 'discovery data' rather than hard data that can be readily incorporated within management action strategies. A triangulated methodology is most likely to be required.

Case study data reported here showed that two independent measures revealed safety improvements over time as reflected in patterns of behaviour and working practices (from the HEA), as well as values, attitudes and beliefs (from the SCQ). While convergence of data from different methods is likely to improve both accuracy and breadth in the picture of safety culture derived, the direction of cause and effect cannot necessarily be established from such analysis. It may be surmised that observed changes in both measures reflect corresponding changes in underlying aspects of safety culture.

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