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**HEALTH & SAFETY
LABORATORY**

Safety Culture: A review of the literature

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Summary

This document reviews the literature on safety culture, focussing particularly on research carried out from 1998 onwards.

Objectives

1. To review the main features of safety culture and safety climate within the existing academic and applied literature

2. To explore the links between safety culture and safety performance.

Main Findings

1. Culture can be seen as a concept that describes the shared corporate values within an organisation which influences the attitudes and behaviours of its members. Safety culture is a part of the overall culture of the organisation and is seen as affecting the attitudes and beliefs of members in terms of health and safety performance (Cooper, 2000). Safety climate is a distinct yet related concept which can be seen as the current surface features of safety culture which are discerned from the employees attitudes and perceptions (Flin et al., 2000). However, in reality the terms are not so clear cut and many writers use the terms safety culture and safety climate interchangeably.

2. From the literature it emerged that management was the key influence of an organisation's safety culture. A review of the safety climate literature revealed that employees' perceptions of management's attitudes and behaviours towards safety, production and issues such as planning, discipline etc. was the most useful measurement of an organisation's safety climate. The research indicated that different levels of management may influence health and safety in different ways, for example managers through communication and supervisors by how fairly they interact with workers (Thompson, 1998). Thus, the key area for any intervention of an organisation's health and safety policy should be management's commitment and actions towards safety. Ultimately management's attitudes and behaviour in terms of safety influence many aspects of safety behaviour including:

   • The success of safety initiatives.
   • The reporting of near-miss occurrences, incidents and accidents.
   • Employees working safety, e.g. nurses compliance with universal precautions.
   • Employees taking work related risks.
   • Influencing production pressures.
   • Implementing safety behaviour interventions.
   • Health interventions.
   • The effectiveness and credibility of safety officers.
   • The effectiveness and credibility of safety committees.

3. Many definitions of safety culture (e.g. ASCNI, 1993) present a view of employees having a shared set of safety values and beliefs. However, a number of studies have found the presence of subcultures within an organisation which suggest an absence of a cohesive safety culture. Subcultures are likely to develop when employees within the same organisation experience different working conditions. Work groups within an organisation are likely to view risk differently depending on the type of work they do. In general, subcultures are not seen as undesirable and it can be argued that they provide useful contextual insight into the different risk and hazards experienced by workgroups.

4. The literature on bonus schemes suggests that financial incentives to improve productivity or to compensate for working in hazardous conditions can lead to safety being compromised. Employees who were eligible for hazard pay were found to be at greater risk of having an accident, and it may be seen as an inducement to take risks (Sawacha et al., 1999). Productivity bonus schemes have been found to act as an incentive to work faster and thus to commit unsafe acts (Sawacha et al., 1999). Collective bonus schemes can lead to workers being pressurised not to report an accident by colleagues unwilling to lose their bonus (Collinson, 1999).

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1.   INTRODUCTION

Historically the concept of organisational climate was first developed in the 1970's and referred to a global concept underlying the events and processes of an organisation (Guldenmund, 2000). During the 1980's this concept began to be referred to as organisational culture, and for some, the term climate has replaced the term culture. In a review of the literature, Guldenmund (2000) concludes that originally organisational climate referred to a global concept. This concept is now referred to as organisational culture while organisational climate is now seen as the manifestation of organisational culture. This mirrors the trend amongst management theorists where the concept of 'organisational culture' appears to be replacing 'organisational climate' (Hale, 2000). As Flin et al., (2000) point out it appears that the long-standing debates regarding culture versus climate are now being repeated within the safety arena. Overall the trend appears to be towards the term 'culture' at the expense of 'climate'.

1.1.   Culture versus climate

Although safety culture and climate definitions tend to be similar, the term safety culture is generally seen as more embracing than that of safety climate. Glendon and McKenna, (1995) suggest that the implication of culture is that of existing within an organisation while climate has more passive connotations of being influenced by the external environment. Thus, safety culture can be described as "the embodiment of a set of principles which loosely define what an organization is like in terms of health and safety" (Glendon and McKenna, 1995). A simpler definition is "the way we do things around here" CBI (1990). Climate is usually regarded as being more superficial than culture in that it involves the current position of a company (Glendon & Stanton, 2000). Guldenmund (2000) suggests that safety climate refers to the attitudes towards safety within an organisation while safety culture concerns the underlying beliefs and convictions of those attitudes, in other words the prevailing values of the social group. Even though people within an organisation will be subject to the same policies and procedures, people will tend to see things very differently according to which part of the organisation they are in (Payne, 1996). Cooper (1998) suggests that this is because sections will be subject to different customs and practices as well as differing levels of risk which will influence the emphasis on compliance to safety and the way safety is managed on a working level. Thus safety climate can be seen as the indicator of the organisation's safety culture as perceived by employees at a point in time (Cox and Flin 1998).

In reality the terms are not so clear cut, with many writers using the terms safety culture and safety climate interchangeably. A related term, safety management, has also emerged in recent years. Again, some researchers have often failed to distinguish between safety management and safety climate/culture. However, Kennedy and Kirwan (1998) suggest that safety management should be regarded as a documented and formalised system of controlling against risk or harm. In HSG65, (HSE 2000) HSE consider that safety should be integrated as part of sound management. Indeed it could be argued that safety should be managed more effectively than other operations, especially by organisations in safety critical domains. However good the safety management system of an organisation is, the way it exists on paper does not necessarily reflect the way it is carried out in practice. It is the safety culture and safety climate of the organisation which will "influence the deployment and effectiveness of the safety management resources, policies, practices and procedures" (Kennedy and Kirwan,

1998). When using the term safety culture it should be remembered that it is only a small part of the organisational culture, which in turn is part of an industrial and ultimately a national culture (e.g. Meshkati, 1999; Ludborzs1995, cited in Guldenmund, 2000).

Traditionally, organisational culture has been studied through qualitative methods by Sociologists, such as observations and interviews, while organisational climate has been studied by Psychologists within a psychometric framework such as self-administered questionnaires (Gildenmund, 2000). Mearns et al., (1997) proposed that the term safety climate is more appropriate for questionnaire surveys as they give a 'snapshot' of the organisation's state of safety discerned through the attitudes and perceptions of the workforce. Cox and Flin, (1998) suggest such measurements enable management to see changes in the atmosphere of the workplace which they see as important indicators for safety management.

1.2.   Defining Safety Culture

The term safety culture was introduced by the International Atomic Energy Agency(IAEA) as a result of their first analysis into the nuclear reactor accident at Chernobyl (Lee, 1998). Investigation into a number of the recent disasters such as Kings Cross, the Piper Alpha Inquiry and the train crash at Clapham junction, led to the conclusion that the safety systems had broken down. This was not because of how safety was managed i.e. the policies and procedures in place, but because of the safety climate and safety culture of the organisation in which the safety management system was in place (ACSNI, 1993).

A number of definitions have been developed since that time but one that is most widely used is that developed by the Advisory Committee on the Safety of Nuclear Installations (ACSNI) (HSE 1993),

The safety culture of an organisation is the product of individual and group values, attitudes, perceptions, competencies and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organisation's health and safety management.

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 preventive measures.

Other definitions include

"those aspects of the organisational culture which will impact on attitudes and behaviour related to increasing or decreasing risk" Guldenmund (2000).

and

"the attitudes, beliefs and perceptions shared by natural groups as defining norms and values, which determine how they act and react in relation to risks and risk control systems" Hale (2000).

Although definitions vary there is a consensus towards safety culture being a *proactive* stance to safety (Lee and Harrison, 2000)

1.3.   Role of safety culture in incident causation

Traditionally, attempts to improve workplace safety concentrated on technical issues and individual human failures. However, a series of major accidents such as the nuclear reactor accident at Chernobyl, the fire at King's Cross, the fire and explosion on Piper Alpha and the train crash at Clapham Junction all highlighted the role that organisational policies and procedures contribute to accidents. Following the Kings Cross Fire, Judge Fennel stated that "..a cultural change in management is required throughout the organisation" (Fennell, 1988, p.127). Similarly during the Piper Alpha Inquiry Lord Cullen said that, "it is essential to create a corporate atmosphere or culture in which safety is understood to be and is accepted as, the number one priority" (Cullen, 1990, p.300). More recently Lord Cullen's inquiry into the Ladbroke Grove rail accident in 1999 (Cullen, 2001) paid much attention to the role of safety management and culture within the rail industry. The inquiry pointed to evidence which suggests that a large proportion of accidents, incidents and near miss occurrences follow from unsafe acts that are a result of underlying deficiencies in safety management. Thus, the inquiry emphasised the link between "good safety and good business". Cullen recognised that a successful safety culture depends on leadership. The inquiry heard that the fragmentation of the rail industry made it difficult to achieve clear safety leadership within the UK rail industry. Within individual companies Cullen stressed the need for the safety commitment of senior management which should be clearly visible to front line workers, the need for effective communication of safety goals and objectives along with regular meetings devoted to safety issues (Dyer, 2001).

Thus, as Pidgeon (1997) suggests, with each disaster that occurs our knowledge of the factors which make organisations vulnerable to failures has grown. It has become clear that such vulnerability does not originate from just 'human error', chance environmental factors or technological failures alone. Rather, it is the ingrained organisational polices and standards which have repeatedly been shown to predate the catastrophe. For example, the train crash at Clapham Junction was a result of both failures at an individual level (e.g. attitudes towards safety) and at a company level (policies and practices relating to safety). Thus, health and safety practitioners now focus on the organisational values that might enhance risk and crisis management and safe performance in complex and hazardous conditions.

1.4.   Characteristics of a positive safety culture

Pidgeon and O'Leary (1994, cited in Pidgeon and O'Leary 2000) argue that a "good" safety culture may reflect and be promoted by four factors: "senior management commitment to safety"; realistic and flexible customs and practices for handling both well-defined and ill-defined hazards; continuous organisational learning through practices such as feedback systems, monitoring and analysing; and a care and concern for hazards which is shared across the workforce. Examining worker attitudes towards safety and their perceptions of hazards within the workplace is often used to provide a measure of the organisation's safety climate and ultimately the safety culture which underlies it. Many researchers have assessed safety climate as an indicator of the overall safety culture of an organisation (for a review see Guldenmund, 2000 or Flin et al., 2000). Cox and Cox (1991, cited in Cheyne et al., 1998) have suggested that employee attitudes are one of the most important measures of safety climate and culture because they are often influenced by other features of the working environment. While Lee (1995, cited in Cheyne etal., 1998) proposed that attitudes towards

safety are a basic element of safety culture. Any safety interventions may fail if the attitudes and perceptions of safety are not taken into account (Williamson et al., 1997). Research into the factors which underlie safety climate is discussed in the next section.

2.   SAFETY CLIMATE

There are three main components to safety culture; psychological, situational and behavioural, and there are a number of tools available, qualitative and quantitative, which can be used to measure them (Cooper, 2000). Situational aspects of safety culture can be seen in the structure of the organisation e.g. policies, working procedures, management systems etc.. Behavioural components can be measured through self-report measures, outcome measures and observations. The psychological component is most commonly examined by safety climate questionnaires which are devised to measures people's norms, values, attitudes and perceptions of safety. Over the years a number of questionnaires have been developed by various researchers (e.g. Zohar, 1980; Mearns et al., 1997; Lee, 1998) in an attempt to identify the main factors that comprise safety climate. Although such surveys produce a snapshot of an individual's safety climate the results tend to be aggregated at a group or organisational level to give a view of the overall safety climate of the organisation. Safety climate measures have been widely researched and tend to be used as substitute measures of safety culture.

Recent interest in the measurement of safety culture has resulted in a number of reviews of the area. These reviews demonstrate the wide range of assessment tools, typically self-report questionnaires from large scale surveys, that have been developed. Such assessment tools are often customised to a particular industry, principally the energy industry but also manufacturing and health. In a review of the area, Flin et al. (2000) looked at 19 studies and found that 16 were derived from literature reviews of the safety research; of those 6 studies incorporated interviews and focus groups conducted at the workplace. The other 3 studies used existing questionnaires. Typically factor analysis is then used to identify underlying structures. Again, Flin et al. (2000) found a large range of variation in the number of factors identified: from 2 to 19 in the studies that they reviewed. Whilst Lee and Harrison (2000) extracted 28 factors in their assessment of safety culture in nuclear power stations. As Flin et al. (2000) point out the dimensions of climate measures vary considerably in terms of criteria, statistical analysis, size and composition of workers and industry. Thus drawing comparisons between the measures is difficult not only because of the methodological differences outlined but also because of language and cultural variations.

Consistency amongst safety climate measurements is difficult. For example, Zohar (1980, cited in Glendon & Litherland, 2001) found eight safety climate dimensions amongst Israeli production workers including management attitudes, effects of safe conduct on promotion, work pace and status of safety officer and safety committee. However, when Brown and Holmes (1986, cited in Glendon & Litherland, 2001) used the same questionnaire on a sample of American Production workers they found only three safety climate factors: management concern, management activity and risk perception. Dedobbeleer and Beland (1991, cited Glendon & Litherland, 2001) tried to validate the three safety climate factors on American construction workers but found the two factors of management commitment and worker involvement, more appropriate than the three. Coyle et al. (1995 cited in Glendon &

Litherland, 2001) administered a safety climate questionnaire to two similar organisations and found that while 7 factors emerged for one organisation only three factors emerged for the other. Varonen and Marrila (2000) however, used the same safety climate variables (organisational responsibility, workers safety concerns, workers indifference to safety and level of company safety precautions) as used in two previous Finnish studies and found similar results. They suggested that the results indicated that the safety climate structure is relatively stable among Finnish workers.

2.1. Emergent Themes

Perhaps the main problem with the concept of a safety climate is that there are such a wide range of climate features assessed. Inconsistent labeling and varied item generation have led to problems with reconciling the dimensions reported by different researchers. However, Cox and Flin (1998) identified the following as emergent factors; 'management commitment to safety', 'personal responsibility', 'attitudes to hazards', 'compliance with rules' and 'workplace conditions'. Two years later Flin et al. (2000) attempted to identify the most common themes which have emerged from recent research. They identified 18 published surveys from the years 1991 to 1998 which had a sample size of more than 100, were written in English and included only industrial sectors. They found that 50% of measures came from the energy/petrochemical sector which is currently leading the field in this area. Guldenmund (2000) carried out a similar review of the safety climate literature using 15 studies and found the common safety climate dimensions of management, risk, safety arrangements, procedures, training and work pressure. His analysis included a review of 11 of the research teams reviewed by Flin et al. (2000). Drawing on Guldenmund's (2000) analysis Flin et al. (2000) suggest that there are three core themes namely "management, risk and safety arrangements". Other themes which emerged, though less frequently, include "work pressure, competence and procedures". These themes will be considered in the light of subsequent research from 1998 onwards in an attempt to identify what relevant literature exists to substantiate their inclusion.

2.1.1. Management

Flin et al. (2000) found themes relating to management and supervision in 17 studies, which makes this the main theme. Dedobbeleer and Beland (1998) in a review of safety climate surveys found evidence for two main factors, one of which they identified as management commitment. Aspects of management include perceptions of management attitudes and behaviours in terms of safety and production, along with other issues such as discipline and selection. In some of the studies however, the management label is used ambiguously making it difficult to ascertain the level of management which is being assessed. This is an important issue as each management level has distinct roles within an organisation and the workforce do perceive them differently. Thompson et al. (1998) suggests that senior managers support safety through indirect means such as establishing safety policies and procedures, setting production goals etc.. While supervisors act as the link between management and shop floor, they monitor worker compliance to safety and provide feedback to workers concerning their behaviour.

Clarke (1998) looked at British Rail train drivers, their supervisors and senior managers. She found that although they share a perception of the importance of safety, inter group perceptions of safety were not realistic, for example drivers considered that supervisors and managers would have less awareness of the importance of safety than themselves. Clarke also found that senior management's attitudes and behaviour may be subject to negative stereotyping by other employees including supervisors. Research has also shown that management commitment influences the success of safety initiatives. Marsh et al. (1998) found that the success of behavioural safety interventions implemented in building sites across the UK were strongly influenced by management commitment. Some studies have included a factor which relates to supervisors separately. It is important to distinguish between supervisors and senior management as they are likely to influence the safety culture in different ways. Thompson et al. (1998) found that managers influenced safe behaviours through communication i.e. what is brought to their attention and supervisors by how fairly they interact with workers.

Cox et al. (1998) in a study of the UK manufacturing industry found that the main influence on employees safety commitment was how workers perceived 'management actions for safety'. This scale included quality of near-miss reporting, whether focus was on accident prevention rather than blame, encouragement of safety ideas, effectiveness of safety committees and how safety is prioritised in relation to other issues. Using the same questionnaire as Cox et al. (1998) within organisations in the manufacturing, dairy produce and transport sectors, Cheyne et al. (1999) found the factors underlying employee attitudes to safety to be context dependent. Within the manufacturing and dairy produce sectors they found that how workers act in terms of safety was linked to how their managers act. However, this finding was not confirmed in the transport sector and they suggest that this is due to the autonomy in the working practices of transport workers. Cheyne et al. (1999) suggest that the study confirms management actions for safety should be the key area for intervention.

Cheyne et al. (1998) also found management commitment to be key in their predictive model of safety behaviours. Griffin and Neal (2000) in a study amongst Australian manufacturing companies identified how managers view safety in the workplace as a key factor to the safety climate within an organisation. Grosch et al. (1999) also found that management commitment to safety was one of three safety climate dimensions (along with job hindrances and feedback/training) that was positively associated with nurses compliance with universal precautions. Sawacha et al. (1999) tried to identify factors which influence safety on construction sites. They found "top" management's attitudes towards safety was found to be a significant factor in safety performance as measured by their accident record. The role of management as a factor influencing the under reporting of accidents was identified by Clark (1998a). It was found that incident reporting by train drivers was influenced by managers' reactions to the reports; for example drivers were less likely to report incidents if they felt that managers would 'take no notice' or would not be concerned. Clark (1998a) suggests that incident reporting could be viewed as an objective measure of the level of managers' commitment to safety as perceived by employees.

Lord Cullen's (Cullen, 2001) inquiry into the Ladbroke Grove train crash found that senior management within the rail industry were not visible at the working and operational level and were rarely seen by the workforce unless they were on VIP visits. Lord Cullen suggested that there was "no substitute for personal contacts" and that the organisational policy of rail

companies should ensure that senior management spend adequate time on safety issues with front line employees. He further suggested that senior executives should formally schedule at least one hour per week for concentrating on safety with employees. Middle managers should spend at least one hour per day and first line managers 30% of their time on this issue. A study by O'Dea and Flin (1998, cited in Flin et al., 2000) surveyed 200 offshore oil company managers. They found that the managers felt so overburdened with administration and safety initiatives that they did not feel that they had enough time to maintain visibility and involvement within the workplace, although they felt such behaviours were necessary for workplace safety.

There is some evidence that the importance of health and safety is being realised at boardroom level. Smallman and John (2001) interviewed eight business leaders of FTSE companies and found that they viewed occupational health and safety as an important concept that could potentially impact on corporate reputation and profits. A poor health and safety record could potentially damage the company's reputation in that it could lead one or more stakeholders to view the company less positively. However, there was a view that an excellent safety record does not enhance a company's reputation. In other words there is a balance between the cost of investing in health and safety measures against the potential cost of things going wrong. The research also found that the most senior level managers had little notion of what the ongoing outlay for health and safety was and found the idea of assessing their financial return on such investment 'unpalatable'. Wright (1998) also identified the fear of loss of corporate reputation as a main factor which motivates companies to initiate health and safety improvements. Peterson, (1993) suggested that lack of management commitment was "more a perception than reality". He suggests that top management do want safety to be a key element within their company, but that there are barriers between the senior executive and the workers. Peterson suggests these barriers are created by middle managers being resistant to change. Managers may hear safety rhetoric from upper management but are daily confronted with other, often stronger, messages of cost cutting, downsizing and productivity levels. Thus, according to Peterson (1993) the key to a positive safety culture lies in achieving agreement within the organisation on how to implement a safety element within the company. Such an agreement must have senior management support, supervisors' accountability and the active involvement of middle managers.

Managers also appear to exert an influence over health interventions within the workplace. Torp et al. (1999) looked at coping strategies, such as improving handling techniques, using lifting equipment and discussing health and environmental problems with supervisors and co-workers, for workers with musculoskeletal disorders. They found that workers who perceived their managers as being very involved in health and safety policies and who had regular health and safety meetings with managers were more likely to use the coping strategies than those workers with less involved managers. They suggested that commitment of the senior management is important when attempting to implement health interventions.

There are few studies which try to differentiate between management levels with regard to health and safety. One study by Simard and Marchard (1994) did attempt to study the behaviour of supervisors in accident prevention. They looked at supervisors' involvement in health and safety in terms of whether they were personally involved in safety along with other workers working under their supervision (referred to participatory involvement) or whether the supervisor took care of safety activities themselves without involving the workers

(hierarchical involvement). They found that participatory supervisors were more effective in reducing lost-time accident incidence rate. However, they further found that the supervisors involvement in health and safety was not an independent factor but was linked to the safety programme in place at the plant. The safety programme was measured according to safety activities at the site including, investigation of lost-time incidents and minor injuries, monthly workplace inspections, safety analysis of critical tasks, safety training etc., and can be seen as part of the safety culture of the plant. A well developed safety programme was positively correlated with a participatory style of supervision. Thus this study suggests that it is difficult to examine the role of the supervisor in isolation, rather the organisation's safety culture will impact on a supervisor's effectiveness.

Research by Pearson (1999) also suggests that there are differences between how senior executives and safety managers perceive health and safety is managed within the company. The study indicates that senior executives' involvement in health and safety is not always seen so positively by safety managers. Pearson (1999) questioned senior executives and health and safety managers on the level of senior executive involvement and commitment to health and safety. Results showed that while 85% of senior executives claim they or another director always attend safety meetings, only 59% of health and safety managers claimed that this was the case. Almost a third of managers believed that health and safety is rarely or never a priority of senior management while 24% of health and safety managers were not happy with the support that they received from senior executives. The managers felt senior executives could be more proactive of health and safety in general, more supportive of new procedures and policies introduced by managers and provide more resources, both human and financial. The research also found that 43% of senior executives felt that negative pressures such as a fatality, serious accident or pressure from HSE would persuade them to invest more resources in health and safety.

Collinson (1999) in a case study of an offshore operator found that managers in London and Aberdeen worked extensively to imprint a positive safety culture on to their employees. However, Collinson found that on the offshore rigs the safety culture was not as encompassing as the managers onshore believed and found evidence of accident concealment. This study highlighted how senior executives can be "hierarchically, geographically and culturally separated from local practices" Collinson (1999).

2.1.2. Summary of management commitment

A major problem with the research into management commitment to safety is that in many studies the label "manager" is used ambiguously which makes it difficult to discern which management level is being investigated e.g. supervisor, middle or senior manager. Research has tended to concentrate on the attitudes of employees and Trade Unions however, little research has been conducted to discover what managers (especially senior management) really think about health and safety. Safety managers' attitudes towards health and safety have also been neglected (Smallman, 2001). The major drawback in relying on employees perceptions of management commitment is that they may be subject to negative stereotyping by other staff, perhaps as a result of existing mistrust within the work place such as trade union and management disputes. Therefore, how management's attitudes are transmitted to employees needs to be considered to ensure that management commitment to safety is perceived by them accurately. Thus, although it is well established that positive attitudes towards safety at senior

management level is vital to a positive safety culture it cannot be assumed these will cascade down the organisation (Clarke, 1998). Clarke (1998) suggests the development of a positive safety culture should be within the context of the organisational culture as a whole and not viewed as a separate entity.

The literature points to management as the key influence of an organisation's safety culture. A review of the safety climate literature revealed that employees' perceptions of management's attitudes and behaviours towards safety, production and issues such as planning, discipline etc. was the most useful measurement of an organisation's safety climate. Overall, the research into management influence on safety suggests that the various management layers within an organisation affect health and safety in different ways. Collinson's (1999) study suggests that however encompassing the health and safety policy within a company, if the senior executives are geographically removed from the workers then the policies may have little impact. This may also be the case for other large organisations. However, within small and medium sized companies the senior executive is likely be involved at the operational level as well as influencing health and safety. Within large companies the senior manager on the site is likely to be the major influence on health and safety.

2.1.3. Safety system

Flin et al. (2000) found a second broad theme identified in almost all of the 18 studies surveyed, namely 'safety system'. This label encompasses aspects of the organisation's safety management system, including safety committees, safety officers, safety equipment and safety policies. In general, employees were asked whether they agreed with statements in connection with the organisation's safety performance or to rate their satisfaction with the safety system. The status of the safety advisor and safety committee has been found to affect employee perceptions of the safety climate (e.g. Cooper and Phillips, 1994; Zohar, 1980a), although there has been little research in the area. Cooper (1998) suggests that the status of the safety officer should be of senior level within the organisation's hierarchy and is one of the ways in which senior management can visibly demonstrate their commitment to safety.

In general, the aim of a safety committee is to bring management and workers together in the safety process. To an extent they can be seen as an indirect measure of management commitment towards safety and a measure of the extent to which safety communication flows between workers and management (Cooper, 1998). Overall, there has been little literature on either safety committee or safety officers within the last few years. Sawacha et al. (1999) identified safety committees as an important factor in safety performance, they suggested that organisations with effective safety committees are more likely to try and improve safety performance than those organisations without. Lee and Harrison (2000) found that team briefings which include discussion of safety were correlated with positive attitudes towards safety by staff. However, within their sample of nuclear power personnel, 34% of respondents agreed that safety was "sometimes mentioned" while only 25% agreed that "safety takes equal priority". Rundmo et al. (1998) found that poor management can decrease workers interest in proposing ways to improve safety which they suggested may result in a reduced safety level.

Safety committees are often judged by how well they influence and promote health and safety within a company. If recommendations are implemented and publicised throughout the workplace rapidly, the more the committee will be seen as effective and credible to staff (Cooper, 1998). Lee and Harrison (2000) also examined respondents perceptions of how management deals with safety suggestions. They found that while 50% of respondents claimed to have had suggestions acted upon by management, 22% of respondents either had had suggestions ignored or claimed they did not know how to make suggestions. Many companies also assess safety systems through safety auditing tools which will be discussed in greater detail later in the review.

2.1.4. Risk

The concept of risk is often included in safety climate scales but covers a wide range of issues including self-reported risk taking, perceptions of risks within the workplace as well as attitudes towards risk and safety. In a review of the literature, Dedobbeleer and Beland (1998) considered the importance of risk in safety climate measurements. They examined nine studies from 1980 to 1995 and found that employee risk perception was identified in two of the nine studies, and in others it was associated with employee perception of control. Cox and Cheyne (2000) found "personal appreciation of risk" (how employees view the risk associated with work) and "personal priorities and need for safety" (the employee's health and safety management and their need to feel safe) to be a useful indicator in their 'Safety Climate assessment tool'.

Van Vuren (2000) investigated the cultural influences on risk (i.e. incident causation) and risk management within the Dutch steel industry and medical environment, using a risk management tool called PRISMA (Prevention and Recovery Information System for Monitoring and Analysis). The study showed that in both domains there was a poor attitude towards following safety procedures. Within the steel industry "enormous risks" were taken in order to gain time, e.g. not isolating a system before beginning work. The use of personal protective equipment was not treated seriously and considered to be an unnecessary burden especially as the working conditions were hot. Employees were aware that safety precautions were being ignored, however such violations had been accepted by employees and many team leaders, i.e. they had become custom and practice. Anecdotal evidence from the foundry industry suggested that some foundry workers felt able to take more risks because the advances in the personal protective equipment made them feel safer (Dickety et al., 2002).

Rundmo (1995) studied risk perception and safety amongst offshore workers in 1990 and 1994. They found that offshore personnel perceived themselves to be safer in 1994 when compared to 1990; from catastrophes and major disasters as well as occupational accidents such as slips and trips. He suggests that improvements in the working environment, management and safety measures during this period influenced the change in the workers perception of risk. The number of reported accidents had also decreased, thus he suggests that the workers assessment of risk probably mirrored the improvements. If the probability of having an accident appears to decrease then it is likely that the perception of risk will also decrease.

Research into risk perception of offshore workers has shown that workers appraise the risks they face fairly accurately (e.g. Rundmo, 1992; Flin et al, 1996 cited in Flin et al., 2000),

although this may not impact on workers' behaviour. For example Cheyne et al. (1998) in a study of manufacturing industries found no direct relationship between appraisal of workplace hazards and level of safety activity. Risk perception and behaviour have been found to be associated with attitudes towards safety and the safety climate (Rundmo, 1995,1997) although the cause and effect relationship between attitudes, risk perception and behaviour remains unclear (Rundmo, 2000). In an attempt to examine the relationship between safety climate, safety attitudes, risk perception and how they relate to risk behaviour, Rundmo (2000) differentiated between the cognitive aspect of risk perception (level of probability of accidents for selves and others by respondents) and emotive aspect (how worried or safe they felt when thinking about risks) in a questionnaire survey. Rundmo (2000) found that the emotional perception of risk along with safety attitudes, assessment of the safety climate and perceived 'safety status' (e.g. employee influence on and communication with management, availability of personal protective equipment, training etc.) appeared to influence employees' judgements of risk. Management priorities of safety over production was an indirect effect on risk behaviour, whilst acceptability of rule violations was found to be the strongest predictor of behaviour.

Research has indicated that within the workforce of the same organisation there will be differing levels of risk perception. Alexander, (1994 cited in Cox and Cheyne, 2000) found that offshore subcontractors had a greater appreciation of risk and a greater need for safety than organisation employees. Also offshore workers in general had a greater appreciation of risk than onshore workers. Cox and Cheyne (2000) found that drilling teams had significantly lower "personal appreciation of risk" than managers, which they suggested may be because drilling teams are often employed by another organisation which may have its own safety subculture. It appears that within the offshore environment at least, some employees work in groups which have their own 'worlds of risk', which develop as a result of demographic factors such as age, experience, occupation and situational factors such as physical working conditions, work pressures and peer pressure (Mearns et al., 2001).

2.1.5. Work Pressure

Flin et al. (2000) labelled work pace and work load factors as work pressure. They suggest that the balance between pressure for production and safety is a related theme which is recognised as a key component of safety culture (ACSNI, 1993). Mearns et al. (2001) found that perceptions of management commitment to safety were, in general, positive amongst offshore workers. However, less than 50% of those surveyed agreed that production would be stopped because of safety concerns at the expense of profit. Lee and Harrison (2000) studied nuclear power workers' perceptions of the priority of production over safety. The research was carried out over three sites, all of which had a workforce of over 350. They found that pressure to put production before safety was perceived to come from management rather than peers or safety representatives. When the data was examined in terms of the respondents accident history they found that respondents had a better accident rate if they perceived the pressure for production came from top management rather than if they perceived it to be from team leaders or middle management. These findings support the general view that supervisors play a more important role in influencing the work environment than senior management (Flin et al., 2000). Thus, future research would benefit by differentiating between senior managers and supervisors/ team leaders.

Excessive workload of managers can also affect safety. The Nuclear Installations Inspectorate (NII) investigating a rise in the number of reported accidents at Sellafield noted a number of safety management failures (Dyer, 2000). The NII found that excessive workloads for many of the managers affected their ability to monitor safety, with the result that important safety management tasks such as investigating occurrences and reviewing logs etc. did not take place.

Dickety et al. (2002) found that work pressures within the foundry industry led to some workers cutting corners and committing unsafe acts. One of the more common practices was to lift heavy castings manually and thereby risk strain injuries as some workers felt that using the mechanical lifting devices took too long and slowed down production.

2.1.6. Competence

The competence factor includes workers perception of employees' qualifications, knowledge and skills and relates to selection, training and competence standards.

Part of the NII report into safety management failings at BNFL found that the procedures for ensuring competence and training was flawed. Records of competence were not kept up to date and for some personnel it was unclear what their competencies were. BNFL were recommended to implement a consistent and effective method for employing competent people and for controlling and recording safety training (Dyer, 2000).

Within some organisations managers appear to receive little health and safety training. The advisory committee on the safety of nuclear installations (ACSNI, 1993) commented on the lack of safety training amongst business and management schools, as well as the absence of safety in management texts. Fuller (1999) found that managers of a UK water utility had limited understanding of health and safety, in terms of both their legal and corporate responsibilities. The found that whilst operators and supervisors received a great deal of training in health and safety issues, managers did not. Pearson (1999) found that around 57% of company executives surveyed had received basic management health and safety training, while 18% admitted to "very basic" training and 11% to no safety training at all. Only 7% of senior executives had a NEBOSH Certificate and 4% the NEBOSH Diploma.

2.1.7. Summary of safety climate research

Lee and Harrison (2000) have argued that to comprehensively assess safety culture, methods such as audit, peer reviews and performance indicator measures should be adopted, however this is rarely done. Many of the safety culture definitions tend to focus on the way employees think or behave. However, most research has tended to concentrate on the way people think (i.e. attitudes, perceptions, beliefs) about facets of safety, through measures of safety climate, rather than their actual behaviour. The drawback to using attitudes to measure safety culture is that attitudes can have a poor relation with behaviour. This may be because social pressures such as laws or organisational pressures prevent people behaving in a consistent way to their attitudes. Another drawback is that often behaviour is measured by accident rates which can be unreliable, rather than actual behaviours. Where behaviours have been sampled these have only been taken once or over a short time period. Longer term assessments of behaviour over a number of occasions would be a preferable way to see whether attitudes towards safety

reflect behaviour. Attitude measures may also tap into other issues such as pay disputes within the organisation; such issues may impact on the data especially when comparing two or more organisations. Greater reliability would be gained by using the measure on the same organisation two or three times. A final point is that measures of safety climate tend to be used as a substitute for measures of safety culture because of the difficulties in measuring safety culture per se. However there has been no research as yet which examines how the safety climate of individuals interacts with the safety culture of the whole organisation (Cooper, 2000).

Overall, there has been little agreement concerning which dimensions should be incorporated into a safety climate model. Researchers have noted that attitude scales are context dependent and vary across industrial sectors (Cox et al., 1998; Cheyne et al., 1999). If common features across sectors cannot be identified it may be necessary to examine what other factors such as nationality or industry type influence the distinctive nature of such safety cultures (Cox and Flin, 1998). As Guldenmund (2000) suggests a number of the safety climate dimensions from different studies are comparable and if they are renamed according to a common classification system the total number of dimensions will be reduced. Flin et al. (2000) attempted to identify a set of core features in their review and identified five emerging themes; management, safety system, risk, work pressure and competence, although the areas are very broad.

3.   SUBCULTURES

Within an organisation there are often different groups who have their own style of management and have different levels of concern for safety issues; in effect, they have their own safety subculture. Mearns et al. (1998) found evidence of subcultures in their survey of 10 offshore installations. The subcultures varied mainly by occupation, age, shift pattern, prior accident involvement and grade. Further support for the existence of onshore safety subcultures has been found within the road construction industry. Glendon and Litherland (2001) found differences in the safety climate between occupation subgroups, however no difference was found between two regional areas of the same organisation. However, Clarke (1998) did find significant differences between areas in terms of train drivers intentions to report incidents.

Harvey et al. (1999) found evidence of two distinct safety cultures within the nuclear industry; a management safety culture which also included professional and technical staff and an industrial employee safety culture. They suggested that the differences between managers and workers could potentially cause problems for communication and risk taking behaviour as well as other safety issues. However, Harvey et al. (1999) did not see the existence of two different cultures as undesirable, and felt that improved communication between the two groups would help to bridge the gap between groups. McDonald at al. (2000) found a 'professional subculture' within aircraft maintenance organisations which spanned four companies and differentiated between technicians and management. Technicians believed that they were responsible for the safety of the aircraft and should exercise their professional skill and knowledge to carry out this responsibility. In contrast management believed technicians should follow the set task procedures explicitly, however, they did acknowledge that if all technicians did this then production would be delayed. Such a difference in job perception results in the technicians carrying out their tasks differently to how the company prescribes.

Research suggests that groups view safety through their own subcultures, rather than sharing an overall view of safety (e.g. Collinson, 1999). The presence of subcultures within an organisation can lead to misunderstandings and ultimately conflict between groups. The investigation into the Piper Alpha disaster highlighted the lack of communication between the day and night shifts, despite there being shift hand-over and permit to work systems (Mearns et al., 2001). However, subcultures can be a positive influence on safety, by bringing different perspectives and a diversity of views to safety problems. Mearns et al., (2001) suggest that an emphasis on 'good risk communication' may be one way to bring subcultures together in order to share understanding of other groups' risks. Subcultures may develop when employees working in the same organisation experience different working conditions. Collinson (1999) found that the terms and conditions of contract workers working on offshore installations were "markedly inferior" to those workers employed by the company, for example, they did not receive holiday or sick pay. They were employed to do the most dangerous and physical work. Their working experience resulted in them becoming distanced from the operating company and its safety culture, viewing safety as something that was subordinated for the demands of production; unsurprisingly they experienced more accidents than company employees.

Many of the definitions of safety culture (e.g. ASCNI, 1993) present a view of workers having a shared set of values and beliefs regarding safety. However, the presence of subcultures within an organisation suggests an absence of a cohesive safety culture. Therefore, it is questionable whether a culture change program can be designed for any large organisation without taking into account the subcultures in place, how they interact and the power relations between them (Pidgeon, 1998).

In general, safety climate measures survey a range of staff in an organisation. However, this ignores the contribution that subcultures make to workers' perceptions of safety. Thus surveys will not bring out the competing agendas between supervisors, contractors and workers employed in different areas of the organisation. Safety climate measures may be more meaningful if the different sections are surveyed separately or just the workforce are measured rather than including supervisors as well. Another issue is that the term subculture is value laden in that it suggests social deviance which is misleading. Work groups within an organisation are likely to view risk differently as they will be influenced by the type of work they do. It can be argued that subcultures provide useful contextual insight of different risk and hazards experienced within work groups.

4.   COMMUNICATION

Glendon and Mckenna (1995) suggest that organisations with a positive safety culture are characterised by effective communication. Such communication is founded on shared beliefs of the importance of safety and mutual trust as well as confidence in effectiveness of preventive measures. While Ryan (1991, cited in Glendon and McKenna, 1995) identified effective communication which leads to collective goals and the means to achieve them as a critical indicator of safety culture. HS(G)65 (HSE, 2000) suggests that managers can communicate to employees in three main ways:
1.   Through visible behaviour managers can communicate the importance of health and safety. Employees soon recognise what senior managers regard as important and will adapt

their own behaviour accordingly. Thus, through negative behaviour managers can undermine the health and safety culture of the organisation. Managers can show their commitment to health and safety by:
- Taking regular health and safety tours.
- Regular attendance of health and safety committees.
- Through active involvement in investigations of accidents, incidents and ill-health.

2.   Written communication of:
- Health and safety policy statements.
- Statements concerning health and safety roles and responsibilitie.
- Performance standards.
- Findings from risk assessments.
- Risk control information and practice.

3.   Face to face discussions between employees and managers enable employees to make a personal contribution and helps employees feel involved in the health and safety of the organisation. Ideally employees should be able to talk to managers during safety tours, but other opportunities include:
- during planned meetings or briefings from which information is cascaded through the workforce.
- management meetings should include health and safety issues on the agenda. Discussing health and safety issues as the first item also helps to show managers commitment to safety.
- through regular 'tool-box talks' where team leaders/supervisors can discuss health and safety issues, remind workers of safe ways of working. Such meetings should provide opportunities for employees to raise safety issues and suggest ways of improving health and safety.

The Cullen inquiry into Ladbroke Grove (Cullen, 2001) also emphasised communications as a key task for management. The inquiry found that within the railway industry the quality and standard of safety meetings varied considerably. The inquiry stressed the importance of safety meetings and how they assist the two-way communication process between management and the workforce. The inquiry also recognised that effective communications make employees feel valued as well as fostering trust and respect between management and employees.

5.   MEASURING PERFORMANCE

HSE, in their publication "Successful health and safety management" (HS(G)65) (HSE, 2000) emphasise the need for measuring performance in order to maintain and improve the health and safety operation of a company. Measuring management performance can be done either actively or reactively. Active monitoring is where an organisation monitors its performance before an incident, accident or case of ill health occurs, and includes measures such as audits, site inspections of premises, plant and equipment, environmental monitoring and health surveillance. Reactive monitoring is triggered after an event and includes identification and reporting of accidents resulting in injury or property damage, investigation of near miss occurrences and cases of occupational ill health.

5.1.   Near miss occurrences

Investigation of near miss occurrences is a very useful measure of health and safety performance as well as enabling organisations to learn from such errors. However, such data is rarely forthcoming except in a handful of industries, for example civil aviation. The process involves the analysis of events which *may* have led to accidents with a view to preventing more serious outcomes in the future. Within the aviation industry, monitoring of near miss occurrences, especially in the air, makes a positive contribution to organisational learning and ultimately leads to safety improvements (e.g. Pidgeon, 1998). In order to promote reporting of near miss occurrences the organisation requires openness with a "no-blame culture". This is more difficult for organisations in safety critical industries such as aviation and the nuclear industry to accomplish. Madsen (2001) studied Danish and Swedish Air Traffic Control and found that Swedish ATC has an effective reporting culture while Denmark ATC does not. They suggested this was due to the fact that in Denmark acts of negligence are punished, while in Sweden they are not. This can be seen as the "dilemma of blame" Pidgeon (1998). Following a disaster there is often a desire to identify a culprit. Although blame can be a positive aspect to safety in that having responsibility without accountability for excessive safety violations can lead to organisational members bypassing management systems. However, identifying the culprit of an error is likely to promote blame avoidance rather than openness. Pidgeon (1998) suggests that a "no-blame culture" is not the answer, instead boundaries need to be established between culpable and tolerable mistakes as some degree of responsibility and accountability is needed. Madsen (2001) also suggests that boundaries need to be established and propose the idea of a 'just culture', which should distinguish what is acceptable and unacceptable behaviour, and discriminate between intent and non-intent as well as simple and gross negligence.

Lord Cullen's inquiry into the Ladbroke Grove train crash (Cullen, 2001) suggested that the rail industry needs to develop into a learning organisation through identifying and effectively dealing with unsafe acts and conditions and learning from incidents and near misses. However, the inquiry found evidence of a "blame culture" within the industry which inhibited the reporting of incidents and thus prevented a thorough investigation of the occurrences. The inquiry concluded that the use of the Confidential Incident Reporting and Analysis System (CIRAS) used within the railway industry, while yielding useful information highlighted the deficiency of open communication within the industry.

5.2.   Accident data collection

Many safety climate dimensions are measured against safety related outcomes such as accident / injury data (for a review see Glendon and Litherland, 2001). Varonen and Mattila, (2000) in a study of the Finnish Wood finishing industry found that two factors that described the company's attitudes to safety and its safety precautions (e.g. Safety training and housekeeping) correlated with the accident rate. A higher rating of safety climate resulted in a lower accident rate. Sawacha et al. (1999) categorised respondents into high, moderate and low performing groups based on the number of injuries they had experienced as a measure of safety performance. They found bonus payments and danger money were correlated with a lower level of safety performance. While a higher level of safety performance was linked to top management's attitudes to safety, individual concerns for personal safety and a tidy and well planned workplace. However, it has been argued by Glendon & Mckenna, 1995 that

accident data are poor measures of safety performance mainly because such data ignore the different exposures to risk inherent in occupations, can be of dubious accuracy due to under reporting by some organisations and over reporting by others and are not very sensitive as any safety changes take time to show up in the data which makes it a poor short term measure. At best, it can be seen as a measure of outcome rather than risk. Any reduction of accident rates may not be due to the safety culture per se, for example the introduction of bonus schemes may lead to under reporting (Cooper, 2000).

5.3. Measuring Behaviour

Glendon and Litherland (2001) used behavioural sampling to measure safety performance. This method involves randomly sampling employee behaviour such as manual handling and personal protective equipment practice and using trained observers to evaluate the proportion of unsafe working behaviours. However, they found no relationship between safety climate and safety performance. Safety behaviour may be a useful complement to measures of safety climate rather than an accurate indicator per se. Cox and Cheyne (2000) incorporated behavioural indicators in their 'Safety Assessment Toolkit' along with employee interviews and attitude assessment. They suggest that direct observation of employees is one way of identifying the number and nature of minor accidents and near miss occurrences. A behavioural checklist can be developed which lists those behaviours associated with preventing incidents and accidents for example "wears eye protection when working with chemicals". Behavioural indicators can help to build up a global picture of the organisations prevailing climate for safety (Cox and Cheyne, 2000), although finding an empirical association between safety climate dimensions and measures of safety behaviour remains elusive (Glendon & Stanton, 2000).

5.4. Self-report methods

Safety performance is often measured using self-report methods. Mearns et al. (2001) attempted to benchmark and monitor safety climate across nine offshore oil and gas installations over two consecutive years. They examined the relationship between employee perceptions, attitudes and behaviour from the first study year with self-reported accidents rates from the second year. They found that employee's perception of management commitment was positively correlated with willingess to report incidents and their perception of the supervisor's competence.

5.5. Summary

Overall, there has been little research that has tried to validate safety climate results from an organisation with actual safety behaviour(s). In general, research tends to use self-reported measures of behaviour (e.g. Cheyne et al., 1998; Griffin & Neal, 2000; Hayes, et al., 1998; Mearns et al., 1997; Neal et al., 2000) a major draw back of which is that they are subject to social desirability biases (Cooper, 2000). This occurs when people feel pressurised to respond as they "should" rather than as they actually would behave. Thus, surveying people's beliefs may not predict their actual behaviour.

6. FACTORS AFFECTING SAFETY PERFORMANCE

Some organisations have introduced financial incentives to either improve productivity or to compensate employees for working in hazardous conditions. However, this may not be conducive to promote safety, Sawacha et al. 1999 found that construction employees who were eligible for hazard pay were at greater risk of having an accident. They suggest that hazard pay went against the on site safety promotion and was an inducement for employees to take risks.

Productivity bonus schemes can also lead to compromising safety. Sawacha et al. (1999) found that such schemes were an incentive to work faster and to commit unsafe acts because they had been rewarded previously for doing so. Collective bonus schemes can lead to workers being pressured not to report an accident by colleagues unwilling to lose their bonus. This can result in colleagues becoming 'hostile' to workers who do report accidents which results in them all losing their bonus (Collinson, 1999).

In interviews conducted with offshore oilrig workers Collinson (1999) found that workers were critical of the company's attempts to link safety with the performance assessments which ultimately affected pay. Interviewees reported instances of managment/supervisors blaming and penalising individuals for accidents. This linking of safety to assessment had resulted in a 'blame culture' which resulted in making workers reluctant to report accidents, injuries or near-misses. This was despite the company having a positive and 'all-embracing' safety culture. Overall their safety record was good and they had received various safety achievement awards. Managers were confident that '99.9 percent' of accidents and near-misses were reported. However, the interviews revealed that this was not the case, with around 50 percent of interviewees admitting to concealing accidents and/or near-misses in order to safeguard their appraisal. Thus, Collinson (1999) suggests the employees' perception of a blame culture had a greater effect on their behaviour than the safety culture promoted by the organisation. Collinson's study highlighted a number of issues concerning the working conditions of the employees on the installation, many of which impacted on safety. The company did introduce many changes to conditions following Collinson's report. However, the link between safety and performance assessment remained despite it leading to the concealment of accidents and the system being at odds with the safety culture espoused by the organisation.

Paying employees on a piece work basis may also undermine safety. Dickety et al. (2002) found that foundry workers who were on piece work were reluctant to wear safety gloves as they lost some of their manual dexterity and the gloves slowed their work pace down. Many workers preferred to risk the consequences of working without gloves in order to generate as much work, and therefore pay, as possible.

7. SAFETY AUDITS

Other techniques exist which attempt to assess safety management and safety culture. Qualitative approaches try to identify those areas of the safety management system which affect the level of risk and include analysis frameworks which assess the safety culture of an organisation by measuring whether safety performance indicators are present or not (e.g. TRIPOD,

OSTI, NOMAC; Kennedy and Kirwan, 1998). Safety audit tools also take a qualitative approach and can help identify hazards. Items from the audit are scored and usually weighted to provide an assessment of risk (e.g. ISRS, MORT, CHASE, PRISM, ASCOT; Kennedy and Kirwan, 1998).

Audits are useful to gauge the extent to which the organisation's policies and procedures are being followed and how they might be improved. They provide the organisation with feedback which enables organisation to maintain, reinforce and develop its ability to manage and reduce risks. To be effective audits should be carried out by competent people, who have received relevant training, either working individually or as part of a team. Those doing the audit should be independent of the area being audited. The auditing process involves: collating information about the health and safety management system and judging whether it is adequate. Ideally the audit should follow the key elements highlighted in the Health and Safety Executive's guidance "Successful Health and Safety Management" (HS(G)65) (HSE, 2000). These elements consist of Policy, Organising, Planning and implementation, Measuring, Auditing and Review (POPMAR). The safety culture of an organisation can influence the effectiveness of a safety audit in the following ways (Glendon and McKenna, 1995):
1.   The willingness of management to undertake a safety audit in the first place;
2.   Adequate resources devoted to the auditing process, for example auditor training and time;
3.   The involvement of both employee representatives and line managers in the audit;
4.   Findings from the audit are acted upon;
5.   Commitment by the organisation to auditing over the long term.
Fuller (1999) audited a UK water utility using the POPMAR criteria and found that in general, employees found the approach to be a realistic measure of the organisation's health and safety operations.

In addition to examining a company's policies and procedures, audits can also be used to look at the human factor element within a company's safety system. By incorporating human factors in the working environment an organisation can improve efficiency, productivity and reduce workplace risks to health and safety. This is achieved by reducing or eliminating opportunities for workers to make errors within the work system. There are factors which increase or decrease the chance of human errors occurring and are sometimes referred to as "performance influencing factors". These factors include:
• Corporate factors - these include financial pressure, management and safety audits.
• Process factors - these include workplace hazards and technology.
• Human and machine interface factors - these include design of control system, displays etc.
• Environmental factors - such as work and shift patterns.
• Equipment factor - these include PPE, tools etc.
• Individual factors - including workers previous experience, training, health etc.,

The TRIPOD system places much of the emphasis on safety on management. It is based on the premise that increased safety in the workplace comes from management who wants it, originates it and keeps it going through supporting it. The system monitors general failure types (GFT's) which Wagenaar (1998) suggests are a type of latent error which are created by management decisions. As such, GFT's are more under the control of management than attitudes or motivation of employees. Wagenaar (1998) suggests that to change attitudes and

arguably the behaviour that follows from them is not cost effective, instead it is more practical to remove general failure types. Thus the purpose of the TRIPOD system is to show management what actions they must take to reduce or remove GFT's.

The ISRS (International Safety Rating Scheme) is used by Railtrack as part of their effort to ensure compliance with the safety cases. However, criticism has been levelled at the ISRS audit tool because of its emphasis on whether the safety procedures are in place rather examining their effectiveness. Another drawback is that it does not include human factor elements in the audit (Clarke, 1998).

The 'management safety behaviour audit' attempts to measure management's commitment to safety (e.g. Cameron and Duff, 2000). This audit, developed for the construction industry, identifies the fact that safety is an important management role and recognises that some managers do not acknowledge this (Cameron and Duff, 2000). The audit is based on the assumption that employees learn from the behaviour of others, it is therefore designed to measure the ways in which managers communicate safety to workers. Thus, the framework includes questions on induction training, toolbox training, safety committees and records of safety procedures e.g. risk assessments. The audit also incorporates an 'operative safety behaviour inventory' which measures workplace hazards. (Cameron and Duff, 2000) suggest that this model, which combines management audit and operative inventory scores, approximates a 'measure of safety culture'.

8. BEHAVIOUR-BASED SAFETY

Some organisations have introduced behaviour-based safety (BBS) methods in a bid to reduce work-related incidents and accidents. Behavioural theory focuses on the main behaviours that lead to accidents rather than the accidents themselves, which are relatively infrequent and difficult to investigate objectively, or attitudes which are difficult to change. Behavioural methods are proactive and focus on potential risky behaviour. BBS involves identifying, through observation, behaviours which are safe and those which involve risk of injury. Through the observation a baseline figure is produced which reflects the current safety performance of each work group. Work groups then get together to suggest where improvements could be made through hard but achievable targets. The targets are prominently displayed within the working area to remind employees of them. Employees are trained in safe behaviours and given encouragement to employ them in the work place. Employees are encouraged to practise safe behaviours through motivation, which can take the form of feedback on improvements in observed performance, and goal-setting. Goal-setting is thought to affect performance by focusing the attention and action of the individual or group, generating effort and increasing motivation. Some BBS methods arrange for co-workers to observe and give feedback on fellow employees, or can be provided visually on charts etc. which are kept on display within the workplace. Reinforcement of the safe behaviour can also be given through praise from supervisors (e.g. Chhokar, 1987).

A study by Zohar et al. (1980) looked at increasing use of ear protectors through information feedback. Workers in a metal fabrication plant were given hearing tests before and at the end of their shifts. Hearing levels were found to be poorer at the end of the shift in relation to the shift start due to workers not using ear plugs. This information was fed back to individual

workers as a means of promoting the use of ear protectors. Over a period of five months ear plug usage in the department increased to 85-90%. In a control group within the same plant over the same five month period workers were given stand lectures on hearing conservation which were later augmented by disciplinary threats. No more than 10% of the workers in the control group wore earplugs over the five month period.

Safety climate research has highlighted the major role played by management in promoting a positive health and safety culture. The role of management is also important in BBS techniques. Marsh et al. (1998) implemented behaviour safety interventions across UK building sites. They found that a high level of management commitment played a vital role in implementing the behavioural safety intervention. Depasquale and Geller (1999) interviewed staff from a number of organisations involved in BBS in order to discover reasons for the success of failure of the programme. One of the main factors which emerged was the need for continuous management support. Employees suggested management commitment in the form of visible appreciation of BBS methods by management and providing the necessary time for employees to undertake behavioural observations and analyse the results. Further emphasis was put on management implementing training procedures and changes to the workplace quickly and effectively when the need for such changes was highlighted through the BBS process.

Behavioural based interventions appear to be a useful tool to improve safety behaviour within an organisation. However, BBS can put the emphasis on safety behaviour on the worker rather than addressing the safety culture of the organisation. Although the employee is trained on safe behaviours, for example what to do if a machine gets stuck, if the safety culture of the company puts production pressures over safety that employee may still try to fix the machine themselves rather than following procedures and waiting for maintenance to fix it (Atkinson, 2000). Having said that, companies may find this technique of more use in getting workers to adhere to health and safety procedures than bonus schemes.

9.   SUMMARY

The main findings from the review can be summarised as follows:

- Culture can be seen as a concept that describes the shared corporate values within an organisation which influences the attitudes and behaviours of its members. Safety culture is a part of the overall culture of the organisation and is seen as affecting the attitudes and beliefs of members in terms of health and safety performance (Cooper, 2000). Safety climate is a distinct yet related concept which can be seen as the current surface features of safety culture which are discerned from the employees attitudes and perceptions (Flin et al., 2000). However, in reality the terms are not so clear cut and many writers use the terms safety culture and safety climate interchangeably.

- Within the UK there has been a move away from measuring safety using retrospective data such as lost time incidents towards predictive assessments of the safety climate of the organisation or worksite. To date a number of scales have been developed. In a review of the literature Flin et al. (2000) found the that there were five common dimensions amongst the surveys of which there were three main dimensions relating to management, the safety system and risk:

    1. From the literature it emerged that management was the key influence of an organisation's safety culture. A review of the safety climate literature revealed that employees' perceptions of management's attitudes and behaviours towards safety, production and issues such as planning, discipline etc. was the most useful measurement of an organisation's safety climate. The research indicated that different levels of management may influence health and safety in different ways, for example managers through communication and supervisors by how fairly they interact with workers (Thompson, 1998). Thus, the key area for any intervention of an organisation's health and safety policy should be management's commitment and actions towards safety. Ultimately management's attitudes and behaviour in terms of safety influence many aspects of safety behaviour including:

        - The success of safety initiatives.
        - The reporting of near-miss occurrences, incidents and accidents.
        - Employees working safety, e.g. nurses compliance with universal precautions.
        - Employees taking work related risks.
        - Influencing production pressures.
        - Implementing safety behaviour interventions.
        - Health interventions.
        - The effectiveness and credibility of safety officers.
        - The effectiveness and credibility of safety committees.

    2. Safety systems encompasses aspects of the organisation's safety management system, including safety committee, safety officers, safety equipment and policies. Overall, there has been little research into how the status of the safety officer and safety committee influence employees safety behaviour. HS(G)65 (HSE, 2000) suggests that safety advisors should have status and competence within the organisation in order to advise management and employees. It is likely, as Cooper (1998) suggests, that the status of the safety officers is a reflection of management's commitment to safety. If a

senior manager does not see the importance of safety it is unlikely that the safety officer will be given management status. The effectiveness of safety committees is also likely to be influenced by management commitment. If the senior executive sees safety as less important than other aspects of the organisation e.g. production he/she is unlikely to support the committee through attending meetings and implementing suggestions for change.

3. The concept of risk is often included in safety climate scales under the guise of self-reported risk taking, perceptions of risks within the workplace as well as attitudes towards risk and safety. Research has shown that offshore workers appraise the risks they face fairly accurately (e.g. Rundmo, 1992), although this may not impact on workers behaviour. Rundmo (2000) found that management priorities of safety over production was an indirect effect on risk behaviour, whilst acceptability of rule violations was found to be the strongest predictor of behaviour. This research again highlights the role of management attitudes towards safety upon employees behaviour.

- Many definitions of safety culture (e.g. ASCNI, 1993) present a view of employees having a shared set of safety values and beliefs. However, a number of studies have found the presence of subcultures within an organisation which suggest an absence of a cohesive safety culture. Subcultures are likely to develop when employees within the same organisation experience different working conditions. Work groups within an organisation are likely to view risk differently depending on the type of work they do. In general, subcultures are not seen as undesirable and it can be argued that they provide useful contextual insight into the different risks and hazards experienced by workgroups.

- Measuring performance has been identified as being important in maintaining and improving the health and safety operation of a company (HSE, 2000). Performance can be measured in a number of ways:

1. Measuring near miss occurrences - Investigation of incidents or near miss occurrences provide useful lessons for organisations. However, if they are conducted with the intention of apportioning blame this may lead to employees failing to report accidents or near misses. Thus, investigations should concentrate on the fundamental causes of incidents rather than a procedure to allocate blame. Mearns et al. (2001) found that employees willingness to report accidents was also correlated with how committed they perceived management to be to safety.

2. Accident data collection - Many safety climate dimensions are measured against the accident / injury data of a company (e.g. see Glendon and Litherland, 2001). However, Glendon and McKenna (1995) have argued that accident data are poor measures of safety performance because it ignores the different levels of occupational risk, can be of dubious accuracy due to underreporting in some companies and over-reporting in others and is a poor short term measure as any safety changes implemented take time to show up in the data.

3. Measuring behaviour - Behaviour can be measured using behavioural sampling which involves randomly sampling employee behaviour such as manual handling and personal protective equipment practice.

4. Self-report methods - Safety performance is often measured using employee self-report methods. However, a major drawback of these methods are that they are subject to social desirability biases (Cooper, 2000). This occurs when people feel pressurised to respond as they "should" rather than as they actually would behave.

- The literature on bonus schemes suggests that financial incentives to improve productivity or to compensate for working in hazardous conditions can lead to safety being compromised. Employees who were eligible for hazard pay were found to be at greater risk of having an accident, and it may be seen as an inducement to take risks (Sawacha et al. 1999). Productivity bonus schemes have been found to act as an incentive to work faster and thus to commit unsafe acts (Sawacha et al., 1999). Collective bonus schemes can lead to workers being pressurised not to report an accident by colleagues unwilling to lose their bonus (Collinson, 1999).

- Safety audits are used to gauge the extent to which the organisation's policies and procedures are being followed and how they might be improved. Audits should not be confused with inspections; although they may include workplace inspections they operate at a higher level. To be effective audits should be carried out by competent people either working individually or as part have a team and who have received relevant training. Those carrying out the audit should be independent of the area being audited. The effectiveness of a safety audit can be influenced by the safety culture of the organisation in the following ways (Glendon and McKenna, 1995): the willingness of management to undertake the safety audit; the adequate provision of resources for the process; involvement of employee representatives and line managers; whether the findings from the audit are acted upon.

10.   DISCUSSION

Ultimately it is senior management's commitment to safety that influences employees' safety behaviours. However, this is not to say that all management is at fault or that managers deliberately act to undermine safety issues. It may be that that senior managers do not realise that they have to support the safety officer to influence the employees to work safely. Fuller's (1999) study indicated that managers had little health and safety training which left them with limited understanding of their legal and corporate responsibilities within the area. Often the safety officers do not have the power and influence within the organisation to improve health and safety on their own. Therefore managers may need to be made aware of how they can undermine any health and safety initiative through their behaviour. A study by Pearson (1999) indicated that the stick rather than the carrot may be most effective for persuading senior managers to invest more in health and safety. 43% of managers said they would invest more resources if forced to do so by HSE, whilst 43% said they would increase investment if they had a serious accident or fatality. Research carried out by the author in the foundry sector (Collins, 2001) revealed that for one health and safety officer an Improvement Notice issued by an inspector was a catalyst in gaining greater support for health and safety from the executive manager. This suggests that firmer action from the Inspectorate may help to convince senior management that their full commitment to safety is needed.

The main influence in an organisation is likely to be the most senior manager on site. Senior executives who are based elsewhere may have developed the safety policy of the organisation but as Collinson (1999) found they may be too remote to influence the way it is carried out. Thus, to gain a more accurate picture of the safety culture of that particular site Inspectors should aim to see the most senior manager. In small to medium companies the senior manager may be the Chief Executive Officer or owner of the company.

The following can be seen as indicators of a positive safety culture:

- Managers planning work effectively

Part of the managerial commitment to health and safety involves managing production pressures so as not to pressurise employees into cutting corners and committing unsafe acts. Dickety et al. (2002) identified production pressures as being a strong influence on foundry operations. Some respondents commented that management were imposing "unrealistic" production pressures on workers leading to them making mistakes while rushing resulting in workers injuring themselves.

Production pressures can reinforce employees unsafe behaviour because it is the only way to ensure a job is done. Heinrich (1959, cited in Cooper, 1998) suggested that for every 330 unsafe acts, 229 will lead to a serious injury and one in a major incident. Thus, the absence of any injuries for those who consistently engage in unsafe behaviours is reinforcing that behaviour which may eventually result in a serious injury. During times of intense production managers may turn a blind eye or indeed, actively encourage the use of short cuts in order to meet deadlines which will further reinforce the unsafe behaviour. The manager's behaviour in these circumstances transmits conflicting messages which serve to undermine employees' confidence in the whole of management's commitment to safety.

Managing production pressures is part of the overall managerial commitment to safety. Inspectors could approach managers who initiate intense production pressures by pointing out the potential costs of an incident or accident in terms of their reputation, lost production time, finding staff to cover for injured person etc.. Research suggests that companies' commitment to health and safety is partly due to the fear of the impact an accident will do to their reputation.

- Managers getting actively involved in active monitoring.

One way that managers can get actively involved in the assessment of safety performance is through conducting safety tours. Tours are not detailed inspections but are a way of demonstrating leadership and commitment to safety. Toellner (2001) suggests that management tours are most effective when only the most significant hazards are focussed on and time is spent talking with employees and asking for their input on hazards and solutions. Lord Cullen (Cullen, 2001) suggested that rail companies should decide for themselves the amount of time their leaders spend in the field, however, best practice indicated that senior executives should spend one hour per week, middle managers one hour per day and first line managers should spend at least 30% of their time.

Inspectors may wish to point out to managers the benefits of carrying out safety tours as a sign of their commitment to safety. Safety tours can be informal and carried out on an ad-hoc basis or be more formalised and become more of a site inspection. Formal tours are more useful if the results are linked to other issues such as identifying training needs or maintenance programmes.

- Managers getting actively involved in reactive monitoring.

Reactive monitoring includes investigations of accidents which caused injury or damage to property, near miss occurrences and cases of occupational ill health. Measuring and analysing near miss data is a more proactive approach to measuring health and safety in which events that have lead to accidents or incidents are evaluated with a view to prevent more serious outcomes (Van de Schaaf et al., 1991, cited in Glendon and McKenna, 1995). Managerial involvement in this process helps to underline its importance. Dickety et al. (2002) found that one foundry had a procedure which ensured that every lost time investigation was signed off by the Chief Executive Officer. This level of accountability was observed to positively contribute to the overall safety focus of the site.

During a visit, an inspector could suggest that a senior manager takes a more active interest in the investigation of accidents and near miss occurrences if it appears that management involvement is minimal. At the very least the findings of the accident analysis should be reported to senior management as well as the workforce in general. Ideally the results of any reactive monitoring should be fed into risk assessments, as well as being used to identify any training requirements or working practices which require changing.

- Managers sitting on health and safety committee meetings.

An effective safety committee is likely to be part of an overall positive safety culture within the organisation. In order to be effective the Health and Safety committees must have management commitment, without it the committee will lack standing and credibility amongst staff. Ideally, safety meetings should acknowledge people performing safely rather than concentrating on unsafe behaviour. The Cullen inquiry into Ladbroke grove (Cullen, 2001) stressed the need for a "strategic management process for safety" which should hold regular meetings where only health and safety issues are discussed. Lord Cullen suggested the group would meet at least bi-monthly otherwise it is unlikely to meet its obligations, and the outcomes from the meeting should be communicated throughout the organisation. The following are features of an effective safety committee (after Coyle and Leopold, 1981; Beaumont et al., 1982, cited in Glendon and McKenna, 1995)

- the presence of a senior manager to approve decisions and to show that priority is give to health and safety.
- safety officers role should be recognised and all members to have equal opportunity to raise issues.
- feedback should be regular from and to workers.
- regular meetings at pre-arranged times.
- committee membership should reflect representation within the company e.g. if more than one trade union all should be present.
- regular attendance from all members is important in order to build solid relationships.
- all members to have effective health and safety training.
- compact but manageable size.

Other elements include (Dickety et al., 2002):
- minutes from each meeting to be recorded and circulated to the workforce.
- health and safety actions were assigned to individuals with time frames for review.
- used as an opportunity to follow up actions from previous incident investigations as well as discussing accident trends and near miss incidents.

Inspectors may wish to stress the need for senior management involvement in the safety committee if it appears that managers are not taking an active interest as this will undermine confidence in the committee. The meeting does not have to be chaired by the Chief Executive officer to be effective but the meetings do need to be supported through regular attendance of a senior manager (board level) who has the status to implement actions. The more effective committee meetings will follow up any actions suggested during the meeting within a set time frame.

- In general, human beings are extremely flexible and are able to adapt to and endure extreme working conditions. However, working under such conditions can result in either long term or short term health and safety problems. During an audit the inspector may wish to consider the following factors: (from Glendon and Mckenna, 1995):
  - Environmental factors - lighting, noise, ventilation and relative humidity should be at levels for maximum worker comfort. Excess noise, vibration and extremes of temperature etc. can result in physical stress.
  - Workplace layout - the layout of the working area should ensure that people and traffic are kept separate, there should be adequate space for movement between operating positions, access to and egress from the area should be safe and unhindered.
  - Design of controls - Are controls within reach and dials easily seen. Can systems be close down easily for example are isolation valves easily accessible in an emergency. Cooper (1998) describes a situation where a maintenance valve was situated 10 feet above the ground and operators would stand on a handrail which had a 30 foot drop on one side to reach it. This action was performed many times during the day which made this unsafe behaviour soon become a normal part of the group's behaviour.
  - Workrate - workrates which are too fast, or indeed too slow, can result in fatigue. Repetitive movements can result in adverse physical affects such as work related upper limb disorder (WRULD). Working to unrealistic deadlines can result in psychological stress and injury for example workers can be pressurised to cut corners by lifting objects themselves instead of using mechanical lifting devices.
  - Posture - work systems and processes should be designed to minimise strain and to allow postures to remain comfortable.
  - Influences on performance:
    - Fatigue - work schedules that require workers to work long hours or at night can result in fatigue which ultimately can result in greater errors and accidents. Evidence suggests that successive night shifts increases the likelihood of industrial accident risk and should be kept to a minimum (no more than four nights) (e.g. Folkard, 1999). Recovery time between shifts should be at least 48 hours while time at work should be limited to 12 hours as human performance tends to deteriorate beyond that limit (HSE,1999).

- Time pressure - Is there pressure on employees to meet production demands? Dickety et al. (2002) found that accident rates within the foundry industry varied over the year. Anecdotal evidence from people associated with the industry suggested that the accident rates mirrored annual production pressures. During the times of increased production, overtime levels also rose which led to one foundry worker reporting that he regularly worked 12-14 hour shifts and that 60-70 hour weeks were not uncommon. Errors are more likely to occur when workers have high levels of fatigue or during times of inflexible or over demanding work schedules (HSG48, 1999).

The management of production pressures (including overtime) can be seen as a key factor influencing safety performance. It needs to be managed effectively in order to limit the likelihood of workers working unsafely or committing procedural violations. By checking the hours worked by staff, inspectors may monitor whether the overtime worked by staff is acceptable. Excessive overtime over a period of time would indicate that work planning and levels of resource may need to be investigated Some organisations may need reminding that fatigue from working long hours can affect productivity as well as having implications for safety.

- Training and experience - are workers adequately trained for the job? Do employees get refresher training? Dickety et al. (2002) found that established workers can be the worst offenders in terms of short cutting safe work systems, therefore refresher training may help to modify unsafe behaviours that have evolved out of custom.

The literature review highlighted the fact that most managers (including senior managers) had received little in the way of health and safety training. Results from risk assessments are a good way of highlighting any training needs. Inspectors could recommend more training, however, the amount companies can afford to spend on training depends very much which industry they are in. With the decline of many manufacturing industries within the UK, many organisations have little money to spend on training.

- Housekeeping - Some companies use the prevailing housekeeping standards as an indirect measure of safety. Cooper (1998) suggests that poor housekeeping can result from extreme production pressures in combination with limited storage facilities. These factors then lead employees to believe that housekeeping is unimportant mainly because they are used to working in areas with poor housekeeping standards and do not see accidents occurring as a result. In Japan housekeeping has evolved into a productivity tool referred to as the 5S (Sort, Systematise, Sweep, Standardise, Self-discipline) technique. It is based on the premise that a clean and organised workplace will be more efficient and productive, will improve employee morale and reduce hazards. Research into the 5S technique suggests efficient housekeeping results in a lower injury rate (e.g.McCon, 1997). Companies may be more interested in keeping the workplace tidy if they realise that housekeeping can positively impact on the production process through such activities as maintaining work areas clean and tidy, regularly collecting waste and scrap, storing raw materials and finished products properly (Hilder, 1991).

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One way of encouraging good housekeeping practices to management is to emphasise the positive effect on production within an organisation. The best way to good housekeeping management is through a formalised approach, such as the 5S technique, which aims to make housekeeping an integral part of everyday activity. This can be done actively through developing a monitoring system such as a housekeeping 'checklist' that can be completed at the start of each shift by a nominated person such as the supervisor, the safety officer or safety representative. Positive reinforcement can be given to workers through information feedback on a section basis and praise. The benefits to workers include improved working conditions, improved morale, and reduced accidents especially slips, trips and falls.

- Communications - Are there systems for communication to come from employees or is management based on one-way communications only? Vassie and Lucas (2001) found that organisations who used supervisors within the work environment had little employee involvement in safety activities, had greater reliability on a recognised safety group and showed a lack of specific health and safety communication to staff. In contrast organisations using team leaders showed greater management and employee involvement in safety as well as more open communication. They also found that 5 out of the 35 companies involved in the study did not have any system in place for communicating the results of risk assessments to employees, which is cause for concern.

Communication can be improved by organisations making sure employees are kept informed of health and safety objectives through channels such as safety briefings, safety forums, tool-box talks, through notice or bulletin boards, e-mail etc.. Often companies are good at cascading information from management downwards but less effective in establishing two way communication. One way in which an organisation can improve communication from employees is through establishing boards within the workplace in which employees can highlight safety and production issues and can suggest solutions to other workers problems. The board should be reviewed by a supervisor on a daily basis. This form of communication needs to be carefully controlled as it can be abused, however, managed correctly it can be an effective way of including employees in the safety process.

Information on noticeboards can be improved by organising the board space therefore companies may wish to colour code and label sections of the board by function e.g. Safety productivity and quality. Important information is best conveyed through verbal face-to-face meetings first and then posted on the noticeboard (Cooper, 1998).

- Bonus Schemes - The literature on bonus schemes suggests that financial incentives to improve productivity can lead to safety being compromised. Financial incentives to improve productivity or to reward zero accidents or no lost-time injuries can lead to employees not reporting incidents and accidents. Other approaches to safety management which rely on authority and punishment, for example disciplinary action for not wearing PPE, also can lead to people not reporting incidents or near misses. The use of punishment does not often work because for it to be effective it has to happen immediately and every time the unsafe behaviour occurs. This is difficult to achieve because the person in authority may not be present every time the unsafe act occurs.

An inspector could suggest using feedback as an alternative to either punishment or financial incentives. Providing feedback on improvements in observed performance and reinforcing safe behaviours through praise from supervisors and managers does improve safety performance, because it explicitly links the safe behaviour to the praise (Cooper, 1998). While Krause (2001) suggests that reinforcing behaviour through feedback engages the worker in a positive way making the employee recognise that the performance itself is important and has some significance within the work area. Using tangible reinforcement such as money, prizes, tokens etc. the employee is motivated to gain something rather than to change their behaviour.

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