

Health and Safety Executive

**Development of a Business Excellence Model
of Safety Culture**

Prepared by **Entec UK Ltd**
for the Health and Safety Executive

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Development of a Business Excellence Model of Safety Culture

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This report gives the results of a study carried out by Entec UK Ltd to provide a comprehensive review of research on how to assess and develop safety culture, and thereafter produce a safety culture improvement matrix (SCIM). Due to the adoption of the Business Excellence Model (BEM) by certain nuclear licensees consideration was given to whether it would be valid and useful to structure the tool according to the BEM framework. Having concluded that the BEM provided a reasonable framework a SCIM was developed. The SCIM was trialed in a series of six desktop applications by NII inspectors, in the context of sites under their inspection. The trials, whilst revealing points requiring refinement, indicated that the BEM framework and our safety culture version was useful and practical.

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EXECUTIVE SUMMARY

Aims and approach

This project aimed to develop a Safety Culture Improvement Matrix based on the Business Excellence Model (BEM) for use by Nuclear Installation Inspectors. The ultimate goal is to develop a tool that helps licencees improve safety culture rather than simply measure safety climate. Therefore, the tool needs to incorporate guidance on progressive improvements and be sufficiently detailed for users to ascertain what is required to improve safety culture.

The study comprised a number of stages, namely:

- identification of the key elements of safety culture and those factors that promote or inhibit achievement in the area of safety
- assessment of whether BEM provides a suitable framework for the assessment and improvement of safety culture;
- drafting of a safety culture improvement matrix (SCIM);
- trialing the SCIM with a group of NII inspectors;
- concluding whether the SCIM is useful and, after responding to trial results, producing a final version for use by inspectors.

The review of previous research and publications, has been used to answer the following questions:

- do the nine elements in the Business Excellence Model capture the critical safety culture factors?
- do the statements contained in the Business Improvement Matrix address, at a micro level, the key safety culture sub-factors?
- what are the advantages and disadvantages of delineating safety culture in this way?

We have used the ACSNI report on Organising for Safety (HSC, 1993) as a starting point of the review as it is based on a comprehensive review of safety culture research completed in the period up to 1993. We then identify and summarise research completed since the publication of the ACSNI report. The more recent work is used to check whether the view of safety culture has changed or the weights attached to various elements have altered, due to either new findings or changes in management structures in the nuclear sector, such as contractisation.

In addition, the study examines:

- the extent to which it is valid to read across from an assessment of the quality of business management to the quality of safety management, and;
- the conditions under which it is likely that there will be a congruent style of business and health and safety management.

The goal here is to examine whether it is “safe” to read across from one area of management performance to another.

Findings from the literature review

There is a broad consensus amongst earlier models that the following factors are important:

- A. Commitment of the organisation, particularly senior management, to the achievement of a high standard of safety, and the demonstration of this commitment through communications, consistent decision making, reward and approval systems, allocation of resources training, a caring management attitude etc.
- B. An effective process of communication between all parts of the organisation, based on trust, openness and mutual respect.
- C. Communication and maintenance of a shared view of risks and standards of acceptable behaviour.
- D. Open-minded learning from experience.
- E. Ownership and acceptance of the need for health and safety controls, typically requiring a participative approach to the development of control and a co-operative non-confrontational approach to securing adherence to agreed procedures and practices.

It is also broadly agreed that it is necessary to reinforce a culture over time by assuring consistent management response to incidents, feedback on unsafe/unacceptable behaviours and consistent decisions on resourcing. Attitudes are, in part, a product of an individual's interpretation of what other people expect of them. Therefore, if individuals perceive that there has been an implicit shift in expectations, perhaps due to changes in (say) management response to incidents, they may believe that the expected standard of behaviour has changed regardless of stated policy.

There are four areas where models either differ or where new research provides a different perspective;

- A. Differences in the emphasis, content and philosophy of earlier models of safety culture.

In particular:

- Many models recommend a participative approach to the development of a safety culture, involving staff in the identification of issues and development of initiatives. However, some models, especially the INSAG4 model, places greater emphasis on the role of management in defining the required norms and thereafter securing acceptance of these norms, viewing the development of a safety culture as a "top-down" process.
- The ACSNI and some other studies appear to presume that an organisation will possess a valid view of what constitutes "strong safety commitment" and that such commitment can be assumed to apply equally to all areas of health and safety performance. There is also something of a presumption that once a set of "good" norms and beliefs have been defined they remain unchanged thereafter, with the only remaining task being the maintenance of these norms. It could be argued that the ACSNI model focuses on internal processes and overlooks the issue of who/how safety norms are formulated and reviewed. This stands in contrast to the NUREG work that places emphasis on external reference points.

Indeed, recent studies suggest that safety culture is a dynamic entity which may need to change due to internal and/or external events. In this context an organisation must be adaptive and flexible, displaying an ability to recognise the need to change norms and attitudes.

B. Developmental versus descriptive models.

The earlier models and research sought to describe the features of an effective safety culture and the attributes of organisations which exhibit effective cultures, rather than trying to explain how an organisation can develop such a culture.

C. Recent changes in organisation and management.

The early models of safety culture were developed in the 1980's and early 1990's before research had been completed on the ramifications of "new ways of working", delayering, downsizing and outsourcing. There has been a shift from larger hierarchical organisations and traditional command and control styles of management towards more decentralised, devolved styles of management and much greater use of contractors. These changes not only create new issues, such as how the use of contractors affects safety culture, but also raise questions about the continued validity of some of the earlier recommendations on safety culture.

D. Recent research on safety culture.

There has been some new research on safety culture that allows some further elaboration of the earlier models.

A development model of safety culture

The SCIM needs to fulfil a number of aims, including:

- Allow users to recognise what is required to improve safety culture.
- Be applied via self-assessment and/or observations of an organisation.
- It must be theoretically sound.
- It must be applicable to a range of organisational types.
- Be sufficiently detailed to allow specific areas of improvement to be pinpointed.
- The model must be progressive, directing progressive improvements.

The review indicates that a developmental model of safety culture should comprise the following main parts, as illustrated in Figure E.1:

- A. A means of defining health and safety cultural ideology, norms and goals which takes account of the opinions, perceptions and expectations of internal and external stakeholders.
- B. A means of communicating and demonstrating the organisation's commitment to these goals and norms, and maintaining this sense of commitment over time.
- C. Processes to facilitate the achievement of stated goals and norms, such as participation, empowerment, staff-management-contractor communications, training, proper resource management etc. These processes must allow for the impact of organisational structure, outsourcing and new ways of working on the means by which an effective culture is developed.

- D. A means of checking that the organisation's cultural goals and norms have been effectively achieved or at least that the behaviour of people is consistent with these norms and/or within the boundaries of agreed acceptable behaviour.
- E. A means of tracking the opinions, perceptions and expectations of stakeholders and assessing whether the organisation's norms need to be adjusted to reflect significant changes in these.

Comparison of BEM with models of safety culture

The correspondence of the BEM, as shown in Figure E.2, with models of safety culture has been assessed by:

- A high level comparison of the main elements of the BEM and the development safety culture model shown in Figure E.1;
- Comparing the questions and issues addressed by BEM and the earlier safety culture models.
- A comparison of the compatibility of the sub-division and ordering of questions, and;
- Back-fitting BEM to the composite safety culture model to test their compatibility.

In addition, the implications of research into the congruency of attitudes for the validity of reading across from one area of performance to another have been examined.

Key points of comparison:

- The earlier safety culture models do not pose questions on "results".
- The majority of matches from earlier models are in the area of leadership, policy and strategy and people management.
- The safety culture models pose questions in areas which are not explicitly noted in BEM such as hazard management.

These differences reflect the origins of the models, namely that:

- the BEM reflects a view that quality and business excellence must be driven by an outward looking attitude, comparing performance with competitors and assessing customer satisfaction;
- the early safety culture models focus on the internal processes of leadership and communication, reflecting the focus of early research in the area of safety culture, and;
- the BEM covers the more formal aspects of resource management and management processes. These processes are generally regarded to fall into the area of safety management systems rather than safety culture.

It is suggested here that the lack of matches to the "results" part of the BEM reflects limitations of the earlier safety culture models rather than a failing on the part of the BEM. This conclusion, in combination with the finding that the first 3 elements of the BEM do match well with the safety culture models, suggests that the BEM may be a reasonable "vehicle" for framing a developmental model of safety culture.

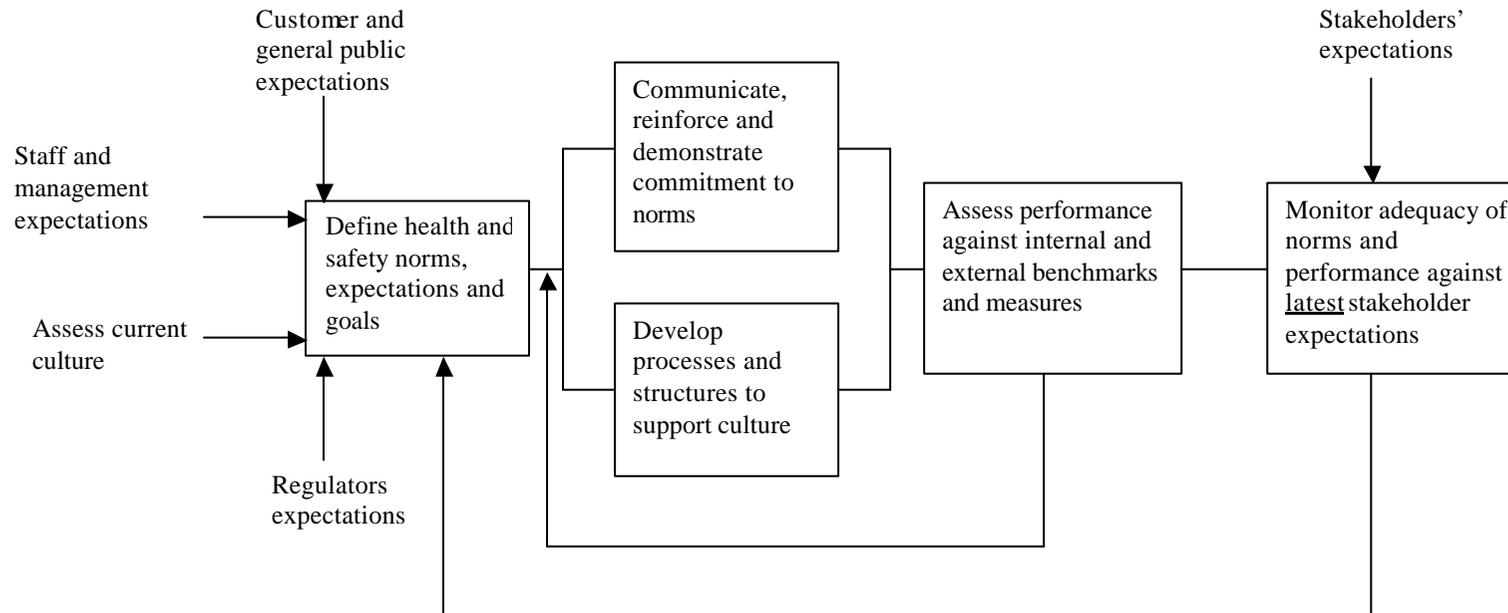


Figure 1
Overview of composite safety culture model

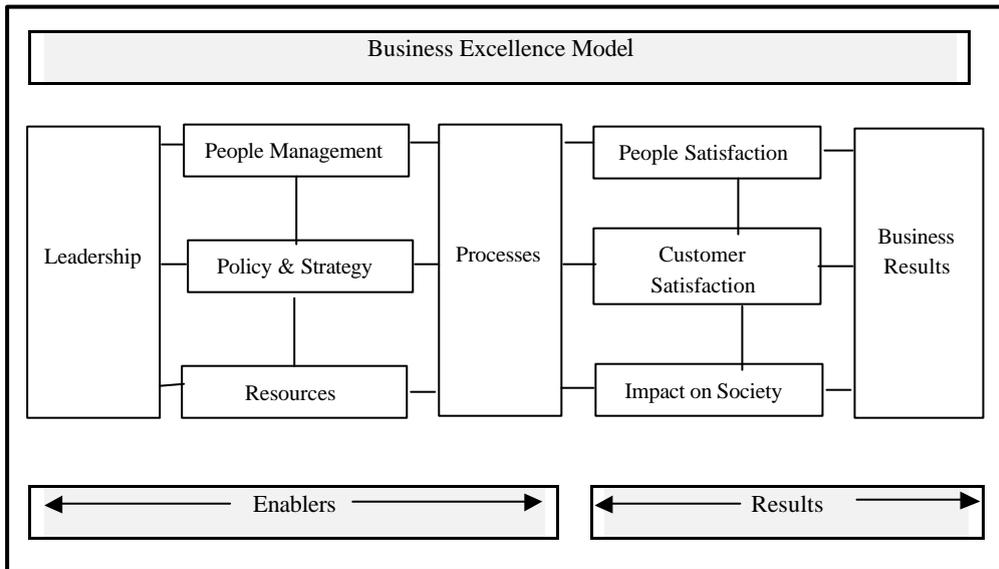


Figure 2
Summary of Business Excellence Model

As a further test of whether the BEM provides a useful “vehicle” for assessing safety culture, we “back-fitted” the BEM onto the developmental model of safety culture in E.1. This entails trying to re-word the BEM question set to be specific to safety culture, i.e. what is the safety culture analogy of each BEM question? This indicates that:

- The wording and intent of some questions in BEM are similar to many questions raised by the developmental safety culture model.
- Many questions posed by BEM are directly analogous to those that might be asked or posed by safety culture but need to be made specific to safety to be of any value, such as questions on “results”.
- The split between leadership, processes and results is similar to the split of factors in the composite safety culture model, although leadership does cover aspects of two parts of the safety culture model.
- The BEM model does broadly cover the whole scope of the composite model, if allowance is made for deletion, addition and re-wording of specific questions.
- Some BEM questions are analogous to safety management system factors rather than safety culture factors – although these could be deleted or re-focussed without degrading the general match of BEM to the safety culture model.

Therefore, at the very least, it would appear that there is a broad match between questions asked of safety culture and those raised by BEM although the range and wording of questions need to be adjusted. Indeed, the progressive improvement matrix in BEM is considered a better framework for providing a safety culture improvement matrix than the descriptive models developed by ACSNI etc. Whilst it is possible to suggest sub-divisions of safety

culture factors different to that within BEM, it is not certain that they offer significant advantages. Therefore, the BEM sub-division may be advocated on the “practical” grounds of allowing a safety culture matrix to be related directly to the business matrix already in place in companies using BEM.

Therefore, as a first step in the development of a SCIM, it was decided to:

- Retain the 9 elements in BEM.
- Modify the question set to be meaningful in the context of safety culture.
- Provide a “statement of intent” regarding the philosophy behind the SCIM.

Trial of the SCIM

The SCIM was trialed by six NSD inspectors, chosen to represent a range of power generation, decommissioning, chemical process and other types of activities. Each inspector was asked to apply the SCIM to a site with which they are very familiar, namely the site they are responsible for inspecting. If necessary they focussed in on one or more units on that site.

Inspectors provided feedback on:

- Usefulness, does it add to their understanding?
- Practicality, can it be applied using inspectors existing knowledge and/or easily acquired information?
- What unit of organisation can it be applied to - the licensee, the site, the unit, the department?
- Time required to complete.
- The virtues of alternative structures, such as using HS (G) 65 as a format.

Suggestions on how to improve the usefulness and/or practicality of the SCIM were elicited.

Trial results

Overall reaction

- The SCIM was felt to be relevant, gets down to the practical level and adds to the understanding of safety culture.
- The ladder version needs revision.
- There were no major concerns with the practicality of the SCIM. An inspector could form a judgement against each question. The benchmarking questions in element 9 would be the most difficult to answer.
- The SCIM could be applied to any size of organisation. Inspectors did not have to alter their viewpoint of their licensee to apply the SCIM.
- Time taken to complete the SCIM was not considered to be a problem.
- Only one of the issues raised, that of how the SCIM handles contractors, could be considered to be a structural problem. Otherwise there were no concerns and no obvious enthusiasm for adopting another structure, such as that of HS(G)65.

Improvement Areas

Only the issue of contractors was brought up by nearly all inspectors. Most other points were raised in only one pilot session.

- Contractors: These are seen to be different from other stakeholders, certainly not in the same bracket as customers. Where questions overlap they should be separated. It is anticipated that elements will need specific questions on contractors.
- Compatibility with nuclear safety philosophy: Some questions, are perceived to hint that staff initiative can take precedence over procedural controls.
- The perspective on risk assessment. The use of risk assessment in the evaluation of nuclear safety risk should be separated, from ‘risk assessment’ used to support other operational and business decisions is probably required.
- Avoid direct compliance questions: It is preferred that the features / sub-points not be binary yes/no compliance with legal requirements.

It was also suggested that the inclusion of some negative points as well as positive ones per issue and sign posting to reference material would be helpful.

Finally, editorial issues such as consistency of the wording of the scales were raised.

The draft SCIM was modified to address these points.

Conclusion

This study set out to develop a tool that would assist NSD inspectors in assessing licensee safety culture and advising licenses on how to improve culture. This has been achieved by structuring a body of guidance covering a process of continuous improvement within the BEM framework. The trial indicates that the SCIM is practical, useful and enhances inspectors work in this area. Some areas that may benefit from further work include:

- Applying the SCIM across a series of sites to (1) acquire benchmarking data and (2) testing correlation of SCIM results with site safety performance.
- Collating “real life” examples and guidance on how to select and implement improvement methods and strategies.
- Researching how alternative types of contractor and staff remuneration and reward schemes influence behaviour.

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APPENDIX B: ACSNI SAFETY CULTURE PROMPT LIST

1. INTRODUCTION

1.1 AIMS OF THIS STUDY

This report summarises the development of a Safety Culture Improvement Matrix based on the Business Excellence Model (BEM). This has been achieved by:

- identification of the key elements of safety culture,
- definition of those factors that promote or inhibit achievement in the area of safety,
- assessment of whether BEM provides a suitable framework for the assessment and improvement of safety culture, and;
- drafting and trialing a SCIM based on the BEM.

Clearly it is important to ensure a theoretically sound and up to date view of safety culture is used in the comparison with the BEM. This is achieved by a review of previous research and publications, which are considered to provide a sufficient empirical base of evidence.

1.2 SCOPE OF THIS REPORT

The overview of safety culture developed in the first 4 sections of this report is used in subsequent sections in a comparison with the Business Excellence Model (BEM), to determine whether BEM provides a suitable framework for the assessment and improvement of safety culture. In particular, it is used to answer the following questions:

- do the nine elements in the Business Excellence Model capture the critical safety culture factors?
- do the statements contained in the Business Improvement Matrix address, at a micro level, the key safety culture sub-factors?
- what are the advantages and disadvantages of delineating safety culture in this way?

As there already exists a number of reviews of safety culture in the nuclear sector a limited review of literature has been completed. We have used the ACSNI report on Organising for Safety (HSC, 1993) as a starting point of the review as it is based on a comprehensive review of safety culture research completed in the period up to 1993. We then seek to identify and summarise research completed since the publication of the ACSNI report. The more recent work is used to check whether the view of safety culture has changed or the weight attached to various elements have altered, due to either new findings or changes in management structures in the nuclear sector, such as contractorisation.

The summary is sufficiently detailed to allow a comparison to be made with the 10 “statements” used in the self-assessment of each of the nine BEM elements. Thus, key safety culture parameters, such as “leadership”, are broken down into sub-factors or characteristics, such as priority awarded safety by managers and management response to reports of unsafe practices etc.

These sections also examine:

- the extent to which it is valid to read across from an assessment of the quality of business management to the quality of safety management, and;
- the conditions under which it is likely that there will be a congruent style of business and health and safety management.

The goal here is to examine whether it is “safe” to read across from one area of management performance to another.

It is important to appreciate that the goal of this project is to develop a tool that helps sites improve safety culture rather than simply measure safety climate. Therefore, the tool needs to incorporate guidance on progressive improvements and be sufficiently detailed for users to ascertain what is required. The review has been scoped to support this objective.

Section 6 summarises the trial of the SCIM and its subsequent modification. Section 7 provides the study’s conclusions.

2. OVERVIEW OF SAFETY CULTURE MODELS

2.1 OVERVIEW

This section of the report provides a summary of the reviews of safety culture and models of safety culture presented in the early to mid 1990's. It commences with a summary of the definitions of safety culture offered at this time, before providing an overview of each key text. The ACSNI report on "Organising for Safety" is used as a starting point as it is recognised as a founding report in this area, based as it is on a review of 147 references. We then consider a series of studies completed in the US Nuclear Sector, funded mostly by the US Nuclear Regulatory Commission, and work by the IAEA. This is followed by a summary of a series of UK research studies that followed on from the ACSNI work and/or sought to develop measurement methods and "operational" models of safety culture. These latter studies have sought to develop tools and models to help apply the types of ideas laid out by ACSNI and other similar reports. Whilst we have not sought to summarise every report or study, the following overview does identify the main bodies of thought in this area presented in the early to mid 1990's.

The research summarised in this section of the report is then critically reviewed in section 3 of this report.

2.2 DEFINITIONS OF SAFETY CULTURE

The idea of culture (especially as used by anthropologists) covers everything learned or otherwise acquired by a social group, organisation or society that is preserved and passed on to future members. A number of definitions of safety culture have been disseminated, as follows. Although the wording and emphasis varies between definitions, they all broadly agree.

The International Nuclear Safety Advisory Group of the IAEA definition of safety culture is:

"That assembly of characteristics and attitudes in organisations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance".

The CBI describes the culture of an organisation as "the mix of shared values, attitudes and patterns of behaviour that give the organisation its particular character. Put simply it is 'the way we do things round here'". They suggest that the "safety culture of an organisation could be described as the ideas and beliefs that all members of the organisation share about risk, accidents and ill health".

The ACSNI Study Group suggests the following as a working definition:

"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."

The ACSNI Study Group also describe safety culture as follows:

“Any group of people develops shared attitudes, beliefs, and ways of behaving. These form a culture that is more than the sum of its parts. In a safe organisation, the pattern of shared assumptions puts safety high in its priorities. Whatever individual they affect then handles new events and decisions in the light of that priority. Thus the commitment to and the style and proficiency of an organisation’s safety programmes matter as much as the formal definition of those programmes. This commitment and style are the product of individual and group values, attitudes, competencies, and patterns of behaviour.”

2.3 ACSNI STUDY GROUP, CBI AND TUC

The ACSNI Study Group report “Organising for safety” (1993) warrants a summary in its own right as it is based on a very extensive review and compilation of research and expert opinion in the period leading up to 1993 and thereby comprises a key source. The factors identified by the study group were “without exception, ... validated against accident patterns”, although the rationale for inclusion of individual items is not explicit. The key factors identified by the ACSNI are summarised in Appendix A whilst the ACSNI prompt list of safety culture factors is given in Appendix B.

These factors can be condensed into the following:

- A. Commitment - The importance attached to safety by the organisation - as demonstrated by its behaviour and decisions at all levels in the organisation, including the trade-off between safety and other priorities, allocation of resources and management time to safety, recognition and reward of good safety behaviour, rejection of unsafe behaviours etc.
- B. Communications - the style, frequency and methods of communication and interaction between different parts of the organisation - including a democratic and participative style of management and ownership of safety by all.
- C. Competence - the quality, frequency and content of formal and informal training, feedback and assessment.
- D. Risk perceptions and attitudes - a shared and accurate view of the risk posed by each hazard, and acceptance of and confidence in corresponding controls - including feedback on unacceptability of unsafe behaviours/violations and open-mindedness about the possibility of failures etc.
- E. Shared expectations about performance standards - clear definition and communication of the organisation’s expectations concerning the standard of safety to be achieved, with each individual (management and staff) accepting their personal role and contribution in meeting these expectations.
- F. Open minded learning from own experience and realising the regulators perception of your own culture may be wrong, and the degree to which organisations are geared to learn from experience and apply the understanding proactively.
- G. External factors, including the financial health of the parent organisation, or the economic climate within which the company is working, and the impact of regulatory bodies including their advice and guidance.

The required features of any programme to improve safety culture are considered to be as follows:

- *commitment from the top through prioritisation of safety*: through safety policy, organising for safety through adequate allocation of resources, and well defined individual responsibilities;
- *demonstration/implementation of a commitment to safety* through the provision of resources and associated support tools and training. Through the day to day management actions a positive and unified attitude toward safety is promoted;
- *communication between management and workforce*, involving the workforce in a continuous dialogue about safety and risks and involving all in the process of recognising problems and finding solutions;
- *openness of communication*, consistently maintaining impartiality and confidentiality, to replace a culture of blame and mistrust;
- *full and enthusiastic support* and involvement of the whole workforce so that they are fully "on board", and can continuously improve, the effectiveness of the Safety Management System.

This condensed listing of factors overlaps with the view offered by the CBI and TUC, who describe the following characteristics of organisations with a positive safety culture:

- A. The CBI, in their document entitled "Developing a Safety Culture", reported the following themes:
 - a) the crucial importance of leadership and the commitment of the chief executive;
 - b) the executive safety role of line management;
 - c) involvement of all employees;
 - d) openness of communication, and;
 - e) demonstration of care and concern for all those affected by the business.
- B. The TUC in its "Guide to improving health and safety systems" note that "No policy can be effective without the active commitment of the most senior executives. And they must show that the commitment is translated into action lower down the organisation". They also stress the importance of two-way communications and recommend the sparing use of grievance procedures on safety issues.

2.4 USNUREG

The US NRC has commissioned a series of projects aimed at developing measures of organisational influence on safety. The ultimate aim is to identify "leading" indicators of safety in nuclear power plants, i.e. indicators of future safety performance. The published results of this work are summarised here.

An early study completed by Nichols and Marcus of the Minneapolis Strategic Management Research Centre (1990) identified a number of organisational influences correlated with safety performance, including:

- problem recognition, problem solving and organisational learning, and;

- experience, utility level strategic focus and demands on managerial attention, with years of experience, resource availability and diversification of operations all influencing the allocation of management attention.

They contended that the more demands there are on management attention, the less effective would be problem solving and learning, with erratic safety performance resulting.

This was followed by a study, Hemel, Connelly and Haas (1991) of the correlation between audit type and Unsafe Act assessment results and safety indicators. They found that both types of measures were leading indicators of safety performance in the chemical and nuclear sector.

Jacobs and Haber (1994) completed a project aimed at defining and measuring organisational factors related to nuclear power plant safety. Their work commenced with a review of previous studies in high risk industries for common safety related issues, and then developed a set of assessment methods. The categories and sub-dimensions (20 in total) of factors are summarised below in Appendix A, along with the 4 methods.

As shown in Appendix A.2, the US research has produced a similar set of factors to those noted by the ACSNI. However, they place greater emphasis on “organisational learning” and “external factors” than the ACSNI, in that they suggests that safety performance is predicted by:

- a high level of COMMUNICATION between and within levels of the organisation;
- a mechanism by which the ORGANISATION CAN LEARN and improve its own methods;
- a strong FOCUS on safety by the organisation and its members, and;
- some EXTERNAL PRESSURES on the organisation, which may be positive or negative.

The importance of external pressures has been noted in the UK, as exemplified by Ashton’s (1994) view of the introduction of an alcohol ban by British Rail in a society where alcohol consumption (at some level) before driving vehicles is common place and widely accepted. In this context the organisation must recognise the external cultural influences on the behaviour of individuals in the organisation and positively act to counter these where there is a mismatch in cultural norms between the workplace and the domestic environment.

2.5 IAEA

The IAEA developed a model of safety culture (INSAG4), as shown in Figure 1, denoting the characteristics required of an organisation for a good safety culture. In this model, safety culture is construed to have two components; a proper framework determined by organisational policy and management action; and the attitudes of staff at all levels in responding to this framework. In this way, INSAG place a greater emphasis on managerial systems and structure than the ACSNI, indicating that the organisation requires a self-regulating safety management system, which sets safety standards, implements these standards and monitors to ensure their achievement. At the individual level, the management system must promote staff awareness, competency, commitment and effective communications. Thus, the INSAG model also places emphasis on the role of the management system in developing an effective safety culture, as opposed to placing emphasis on the role of individual’s and peer group attitudes.

Indeed, they state that “the manner in which people act is conditioned by requirements set at a high level. The highest level affecting nuclear plant safety is the legislative level, at which the national basis for safety culture is set...national climates are fostered in which attention to safety is a matter of everyday concern...”.

A similar process applies within operating organisations and those organisations, such as manufacturers and researchers, supporting the operator – all of whom need to express their commitment at policy level.

These commitments are then implemented via appropriately resourced management structures, and self-regulatory mechanisms. Similarly, the organisations commitment is realised in individuals by managers moulding the environment and fostering attitudes conducive to safety, this is supported by clear definitions of responsibilities, controls on working practices, training and rewards/sanctions – with audit and review of performance. Individuals respond to this framework and contribute to safety by developing a questioning attitude towards costs, adopting a prudent approach to decisions and communication with others.

Thus, the INSAG-4 model can be characterised as:

- placing greater emphasis on the influence of external bodies on an organisation safety culture, and;
- viewing safety culture as being a mouldable product of the safety management system.

Indeed, they state that “safety culture flows down from actions by the senior management of an organisation” – clearly representing safety culture as a “top-down” process.

INSAG-4 produced a prompt list to demonstrate the tangible features of an effective safety culture.

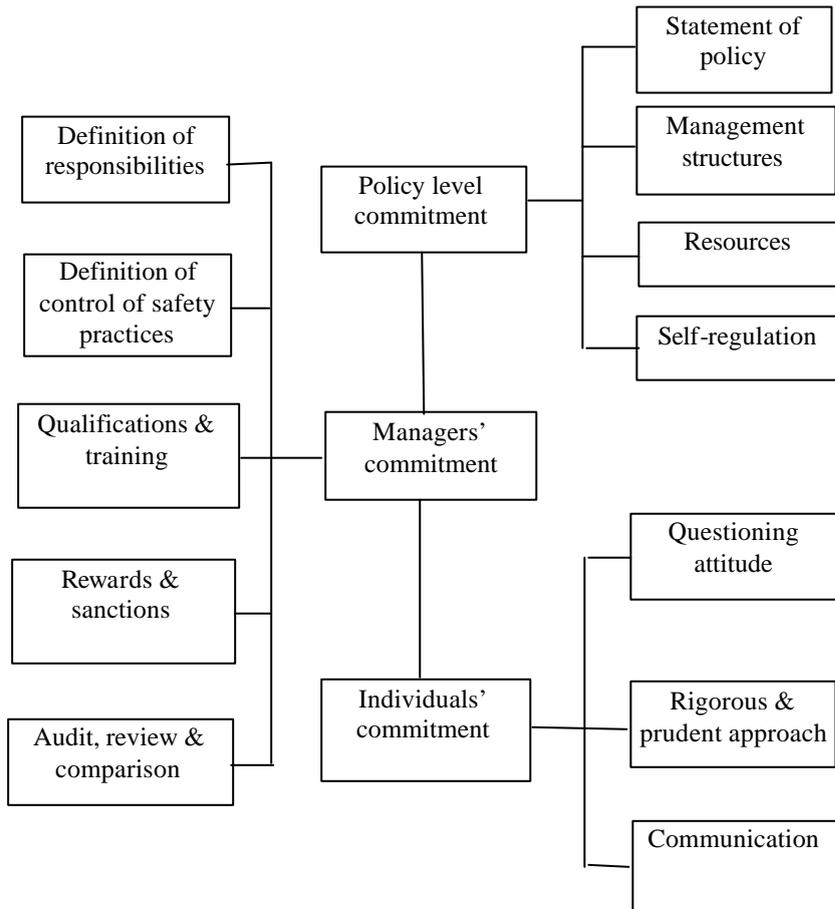


Figure 1
INSAG model of safety culture

2.6 UK NUCLEAR SECTOR ATTITUDINAL MODELS

2.6.1 Introduction

A number of models focus on the perceptions and attitudes of management and employees, such as the work of Lee (1997). These approaches aim to characterise the safety culture (or climate) of an organisation by profiling the attitudes of individuals using questionnaires and interviews. Having correlated attitude profiles with safety performance, the attributes of low accident plants are identified and used as a model for the assessment of other plants. These studies focus on one side of safety culture, namely the attitudes and perceptions being manifested, rather than the organisational antecedents of these attitudes. However, as stated by Cox and Flin they are not fundamentally different from broader models of culture;

“Safety climate measures.. tend to focus on current perceptions and attitudes to management and supervision, risk taking, safety policies and practices, and social aspects of the work situation such as trust...they do not usually claim to assess fundamental value systems or the organisations philosophy of management. Notwithstanding this...,questionnaires claiming to measure safety culture or safety climate are almost indistinguishable in terms of their component factors..” (p 143, Cox & Flin, 1998).

Whilst safety climate questionnaires may not incorporate guidance on how to develop an effective culture, designed as they are to measure climate, they do demonstrate some of the key attitudes required for an effective culture.

2.6.2 Lee and Rycraft

This approach has been applied in the nuclear sector, namely to the Sellafield site in 1991 by Terence Lee (1997), and more recently by BNFL again to Sellafield (Rycraft, 1997). The earlier 1991 survey developed a model of the relationship between expressed attitudes and safety performance using data from a questionnaire survey and self-reported accident rates. The list of attributes developed by Lee is shown in Table 1. The more recent review used an updated version of the survey method applied in 1991, as described in Appendix A. Having profiled the attitudes and behaviours of individuals, inappropriate attitudes are either traced back to underlying factors, such as poor communication by management, or “modified” by Behaviour Change and communication techniques, such as the unsafe act audit method applied by BNFL. The latter audit approach aims to directly change behaviour at the point of carrying out tasks by challenging “unsafe” behaviour in a non-confrontational way, and thereby changing behavioural norms. The former approach presumes that inappropriate behaviour is a learned adjustment to organisational phenomena, such as overly complex safety rules. Therefore, the sources of attitudes are probed as part of the safety culture review and subsequently targeted.

Table 1
Characteristics of low accident plants (Lee, 1997)

Characteristics
<ul style="list-style-type: none"> • A high level of communication between and within levels of the organisation. Exchanges are less formal as well as more frequent. Safety matters are discussed. Managers do more walkabouts, are more ‘visible’. • Good organisational learning, where organisations are tuned to identify and respond to structural change. • A strong focus on safety by the organisation and all its members. • A senior management that is strongly committed to safety, giving it high priority, devoting resources to it and actively promoting it personally. • A management leadership style that is democratic, co-operative, participative and humanistic, as distinct from autocratic and adversarial. • More and better quality training, not only specifically on safety, but also with safety aspects emphasised in skills training. • Clean and comfortable (relative to the task) working conditions, good housekeeping. • High job satisfaction, with favourable perceptions of the fairness of promotion, layoff and employee benefits as well as task satisfaction. • A workforce composition that often includes employees who are recruited or retained because they work safely and have lower turnover and absenteeism, as distinct from yielding higher productivity.

2.7 STRUCTURE AND PROCESS MODELS

Other models focus on the structures and processes within organisations, such as the Systems Model of Safety Culture developed by Cox et al (1997) shown in Figure 2. The “organisational” focus of these models arises from the emphasis awarded “management” factors in disasters such as the sinking of the Herald of Free Enterprise. Accordingly, the starting points of these models are organisational facets such as “corporate leadership” rather than the attitudes of staff. The methods of assessment are similar to those of Lee and Rycraft, namely interviews and questionnaires. However, there is a bias towards selecting management interviewees and on focusing questions on the behaviour of management and the “norms” built into management systems and procedures - although individual attitudes are also examined. One version of this method has been applied in the UK nuclear sector, as reported by Dalling (1997). These models are said to have the advantage of helping to identify the organisational factors that need to be targeted and hence are a better aid to guiding the development of cultures.

2.7.1 Donald and Canter

The principles underlying this approach are illustrated by the work of Donald (1997) in which the organisational context of safety culture is elaborated. Donald argues that it is the formal and informal organisational context in which people work that is critical in guiding behaviour, as follows:

“In working within this context, and drawing on their experience of it, people develop expectations about what is required of them. These expectations are based on their active interpretation of the meaning of events, rules, and instructions. Workers develop scripts for appropriate safety behaviour. So, for example, a safety policy statement which is explicit that safety comes before productivity will be interpreted in terms of what they think that the organisation really means. Subsequent behaviour will be based on the interpretation, rather than the original statement”.

Donald goes on to argue that because people are subject to, and adopt, the attitudes and behaviours of the people with whom they work, their behaviour is only likely to change if the context is changed. Consequently there are three central questions:

- What is the organisational and social framework that supports actions and beliefs?
- How do people interpret and understand their context, i.e. those frameworks?
- How can the context and organisational framework be changed to reduce accidents?

2.7.2 Cox

A further Systems Model of Safety Culture was developed by Cox et al (1997) as shown in Figure 2. The model suggests that organisational variables, such as safety management and goals, influence the work environment and group processes, such as physical conditions and hazards appraisal, which in turn influence individual precursors to behaviour such as an individual responsibility and level of safety activity. They identify managers, and their actions and commitment as a key group in influencing attitudes, along with structural safety communication systems and employee participation programmes. This general model was broadly supported by empirical research, such as Chegne et al 1998. Clearly Cox recognises that there is not a simple one-way top down process of creating a safety culture or climate. As stated by Chegne et al 1998, a “good” safety culture will be promoted and maintained by a

“good” safety climate and vice versa. In this way, the distinction between organisational antecedents and attitudinal outputs of a good culture becomes blurred.

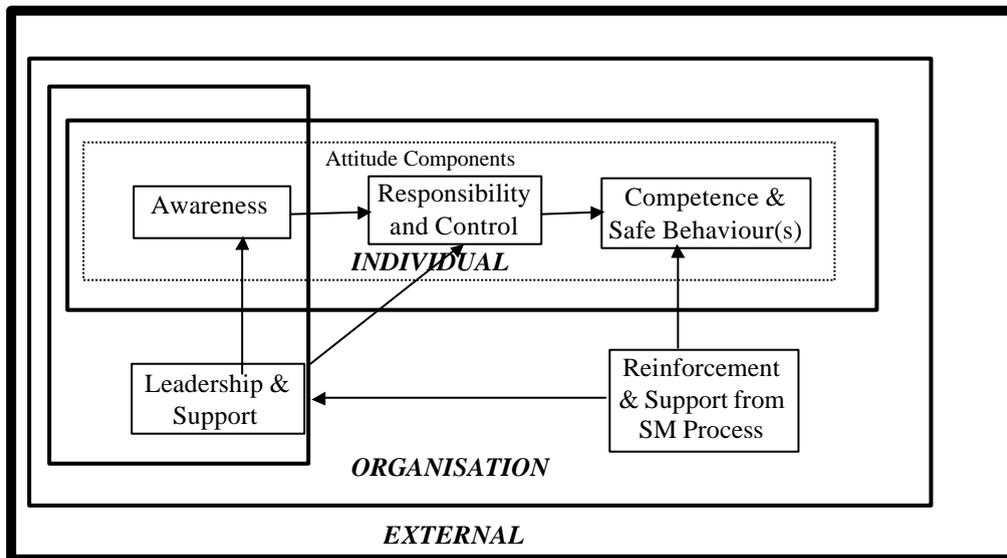


Figure 2
A systems model of safety culture (after Cox et al 1997)

2.7.3 Dalling

Another model which focuses on organisational factors has been developed by the AEAT, as reported by Dalling (1997). The model was developed between 1993 and 1994, at the end of which an assessment methodology named the ‘Safety Culture Assessment Tool’ had been developed and then applied within two divisions of the same nuclear company. Dalling states that the research included:

- a wide ranging technical review of contemporary work on safety culture, organisational and management factors, team aspects, individual attitudes and responses and factors influencing cultural change;
- case histories of safety improvement schemes;
- studies aimed to determine the factors which correlated with good safety performance, and;
- initiatives which claimed to improve not only safety but also safety culture itself.

The model aimed to promote a clearer understanding of the organisational components that are critical to safety, and therefore placed emphasis on organisational and external factors. In addition, it was “intentionally configured using the left to right principal direction of influence in the Business Excellence Model” (Dalling, 1997), as shown in Figure 3. The model defines the following six critical components;

- culture;
- the Management System;
- the Knowledge Base;
- corporate Leadership;
- group and individual Consciousness;
- stake-holders

With the exception of stake-holders, the components are said to interact together in a symbiotic way orchestrating the behaviour of the organisation.

Other factors which it was thought may influence an organisations Safety Culture (other than the components in the model) include:

- education and training;
- turnover of staff;
- initial perceptions (newly formed organisations);
- gender;
- national, religious and racial culture, and;
- age grouping.

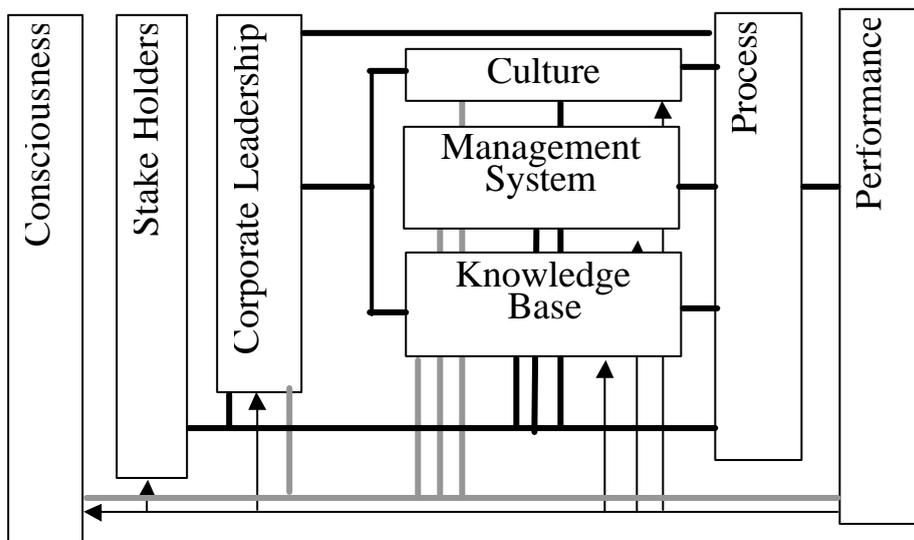


Figure 3
Safety performance model based on the
business excellence model (Dalling, 1997)

The parameters could ultimately be sub-divided into 3 Overall Groups. This resulted in a hierarchically organised 'Safety Culture Framework'. (see Figure 4)

Management & Organisational Factors	Enabling Activities	Individual Factors
are demonstrated by management's awareness of factors under their direct control that have an implication for a positive safety culture.	Determine whether sufficient and suitable initiatives are in place to inform, train & motivate personnel	include individual's attitudes, opinions and perceptions of safety.

Figure 4
AEA Technology Safety Culture Framework

2.7.4 Greenstreet Berman Safety Culture Research

Whilst Greenstreet Berman (1999) may not have set out to define a “structure” or “process” model of safety culture, their research on behalf of public concern at work and the HSE does identify a set of organisational, managerial and process factors that influence the culture of organisations. These features are shown in Table 2. In relation to these factors the research found that:

- Awareness of risks underpins health and safety. Without such awareness risks go unrecognised, unreported and untreated.
- The corporate culture is the major determinant of a good safety culture. A good culture is viewed as one where the “mental attitudes of both workers and management is such that when a risk to health and safety is perceived, it will be reported promptly to the designated people. They, in turn, will investigate it and remove or reduce any unwarranted risk.”
- The health and safety culture does not develop independently of the wider cultureit seems clear that a good culture requires genuine commitment and active, visible leadership from senior management – even where some responsibilities have been devolved.
- Supervisors and management are the critical grades in the promotion of health and safety, encouraging reporting, investigating events and implementing remedial measures.

Thus, whilst people want to be empowered, they also want to be given a vision and sense of direction.

- Availability of diverse channels by which staff can become involved in health and safety, report events and hazards, and a culture in which reporting concerns is a “safe” and acceptable practice.
- The implementation of proactive safety management systems, such as risk assessment and auditing, can provide opportunities for staff involvement as well as demonstrating management commitment to an effective well managed safety programme (and hence commitment to their safety). In this respect auditing should be seen as “reality checks” rather than “policing”. When audits are seen as “reality checks” they offer benefits of raising awareness and stimulating reporting of hazards etc.

Table 2
Summary of good practices
(Berman, 1999)

Culture
<ul style="list-style-type: none"> • Corporate culture is the major determinant of safety. A good SHE culture requires genuine commitment and active, visible leadership from senior management. • An open, empowered culture that promotes ‘constructive intolerance’ of risk is the objective. Fairness and ‘enlightened response’ is necessary. ‘No blame’ policies are rarely appropriate. • Sufficient resources must be allocated to SHE management, and to the functions such as maintenance, which keep the working environment safe and respond to concerns. • Empowerment does not do away with the need for supervision. High caliber, conscientious and safety aware supervisors are essential. • Look for sustainable, continuous improvement. Do not expect quick fixes from initiatives that fail to address the real drivers of culture within the organisation. Support people through the change process.
Organisation & Management
<ul style="list-style-type: none"> • Appoint a corporate SHE Advisor, skilled in culture change and SHE management, to coach and monitor senior company management and monitor site SHE performance. • Set up SHE policy teams of senior managers at corporate and site level, to review performance and strategy, and to ensure site management are held to account. • Set out clear corporate expectations of SHE performance and the general approach to be used, but leave the detail to the sites. • Use indicators to monitor performance and benchmarks, but be wary of links to bonuses. • Integrate SHE targets into business plans and individual action plans.
Operational Sites
<ul style="list-style-type: none"> • Site SHE Managers are key individuals. They should be able to advise with authority and competence and be able to persuade all parties to get behind and allocate resources to any proactive safety programs whilst still being willing to challenge unsafe behaviour at any level. • OSH Advisors and volunteer hazards have a valuable part to play in the SHE team. • Good site HSCs are working parties, not confrontational talking shops. A co-operative HSC can develop and drive forward improvements and culture change. Involve as many people as possible in SHE initiatives and improvement project teams. • Prepare regular site SHE reports. • Maintain a database that supports trending and root cause analysis. • Don’t ignore the hazards of the car park and shared facilities.

Hazard & Event Reporting

- Reporting schemes must be simple to use and provide diverse routes for raising concerns.
 - Near miss and hazard reporting is essential, but effective screening and prioritisation is needed.
 - Local teams can take responsibility for identifying, assessing and responding to concerns in most situations.
 - There must be a confidential option for reporting concerns, although open reporting should be the objective. Anonymity should not be encouraged.
 - Fast and effective response to reports of hazards is a powerful motivation for improved reporting, and makes the workplace safe more quickly. Fast maintenance was frequently mentioned as one of the keys to safe working.
 - Attention needs to be paid to keeping awareness of reporting schemes high, to providing quick feedback to originators, and to disseminating the lessons from events.
-

SHE Training

- Put in place a formal SHE training matrix, covering induction, safety management and workplace safety and reporting routes for concerns.
 - Develop HSC members and supervisors as informed SHE champions.
 - Pay attention to the development needs of the SHE team, and the SHE awareness needs of the management team.
 - Site induction is important, and has to re-orient contractors to the client's expectations and safety management systems.
-

Against this background they suggested that cultures can be categorised into 3 types:

- A. Compliance driven, where regulatory frameworks are translated into internal procedures and compliance is assured by close supervision.
- B. Managed safety, where formal safety management systems are implemented to set its own targets and standards and achieve these through management processes.
- C. Constructive intolerance. Here responsibility is devolved to the team level with greater emphasis on ownership of health and safety, and developing risk awareness. The aim is to encourage "constructive intolerance" of unsafe or potentially unsafe conditions, completed with a commitment to taking responsibility for dealing with a hazard. This is often tied in with a commitment to continuous improvement.

Thus, this research reinforces and elaborates on the view that individual behaviour and attitudes are, at least in part, a product of the manner in which the organisation is managed and led. This does not infer that peer attitudes or sub-cultures are unimportant. Indeed, the research highlights the role that local peer pressure can play in inhibiting behaviour, such as reporting a colleague's unsafe practices. However, it does imply that these individual and peer processes are just one among many wider organisational influences on culture, where senior managers in particular are crucial in shaping and promoting the culture.

This “composite” view of culture being a product of organisational and personal factors is illustrated in the recent study by Ball and Scotney (1998) who present the overview of safety culture influences shown in Figure 5. As noted, if briefly, in their report there may be “differences in the view about the health of the safety culture either within an organisation, or a discrete part of an organisation...”. Presumably the differences may occur in discrete parts of an organisation due to “local” factors, reflecting the role of individual and peer group factors alongside more general management and organisational factors. Finally, Bayliss (1998) presents a list of the features of a “good” safety culture that again encompass organisational and individual features, as shown in Table 3.



Figure 5
Safety Culture Influences

Table 3
Characteristics of a good safety culture

Is capable of:	<ul style="list-style-type: none"> - Understanding the risks it faces - Prioritising the risks for treatment - Identifying a number of practicable ways of treating the risks - Having a discussible mechanism for enhancing the best treatment
Has individuals who:	<ul style="list-style-type: none"> - Are alert to safety-related issues, aware of their personal contribution to the identification and control of hazards, and know they “own” the safety regime - Have thoroughgoing and conscientious attitude to safety matters - Know that unsafe situations and unsafe acts are for open and honestly report with fair follow-on actions - Are capable of noticing the potential impact on safety of change and of learning from it
Has good safety information flows:	<ul style="list-style-type: none"> - Throughout its own staff (at all levels and all locations) - With national government views, and with international standards and perspectives on permissible practices and best practices - With the latest reliable evidence from internaional technical scientific, medical, personnel, managerial, sociological and other relevant communities - Throughout the public domain

3. CRITIQUE OF MODELS

3.1 OVERVIEW

This section of the report provides a critique of the earlier research on safety culture. There are four areas of critique, namely;

- A. Differences in the emphasis, content and philosophy of earlier models of safety culture.
- B. Developmental versus descriptive models.

It is reasonable to argue that the earlier models and research sought to describe what an effective safety culture looked like and the attributes of organisations which exhibit effective cultures, rather than trying to explain how an organisation can develop such a culture. In the context of this study which aims to develop a tool to aid the development of safety culture, this is an important difference in purpose. Fortunately, there is now a reasonable body of research and experience to provide guidance of how to approach the development of an effective culture.

- C. Recent changes in organisation and management.

The early models of safety culture were developed in the 1980's and early 1990's before research had been completed on the ramifications of "new ways of working", delayering, downsizing and outsourcing. It is reasonable to suggest that there has been a shift from larger hierarchical organisations along with traditional command and control styles of management towards more decentralised, devolved styles of management and much greater use of contractors.

These changes not only create new issues, such as how the use of contractors affects safety culture, but also raise questions about the continued validity of some of the earlier recommendations on safety culture.

- D. Recent research on safety culture.

There has been some new research on safety culture that allows some further elaboration of the earlier models.

These points are discussed in the remainder of this section. However, before moving to these points, the areas of commonality between the earlier models are highlighted.

3.2 COMPARISON OF EARLIER MODELS

3.2.1 Areas Of Commonality

There is a broad consensus amongst earlier models that the following factors have an important role in achievement of an effective safety culture:

- A. Commitment of the organisation, particularly senior management, to the achievement of a high standard of safety, and the demonstration of this commitment through communications, consistent decision making, reward and approval systems allocation of resources training, a caring management attitude etc.
- B. An effective process of communication between all parts of the organisation, based on trust, openness and mutual respect.

- C. Communication and maintenance of a shared view of risks and standards of acceptable behaviour.
- D. Open-minded learning from experience.
- E. Ownership and acceptance of the need for health and safety controls, typically requiring a participative approach to the development of control and a co-operative non-confrontational approach to securing adherence to agreed procedures and practices.

It is also broadly agreed that it is necessary to reinforce a culture over time by assuring consistent response to incidents, feedback on unsafe/unacceptable behaviours and consistent decisions on resourcing. Attitudes are, in part, a product of an individual's interpretation of what other people expect of them. Therefore, if individuals perceive that there has been an implicit shift in expectations, perhaps due to changes in (say) management response to incidents, they may believe that the expected standard of behaviour has changed regardless of stated policy.

The apparent consensus on these points is supported by a recent review of 34 strands of research by Hale and Hovden (1998), who report the following features of safety culture:

- A. The availability of resources, a problem-solving approach, a stable workforce, safety training systems, good communication channels.
- B. Learning systems in design, maintenance and construction and operations.
- C. Good quality communication and a leadership style which demonstrates concern for the group and its dynamics.
- D. Openness to criticism, good labour relations, low stress and low grievance rates.
- E. Top management commitment, along with supervisors and individual commitment, safety attitudes of co-workers.

Thus, to a large extent Hale and Hovden's review supports the conclusions of earlier reviews. Their review also usefully elaborates on a number of issues. As part of their review they identified inconsistencies in research findings, which upon further review highlighted underlying factors, as follows:

- On the subject of rules, they found some studies showing a positive correlation between quality and quantity of rules and good performance, whilst other studies found no correlation. They concluded that the difference would appear to be related to the type of risk management or state of development of its system of rules, or the type of study. In particular, on-line management which requires groups to evolve and constantly revise and reconfirm their own rules are more likely to be effective than off-line centrally imposed rules.
- Some studies reject the idea of "deviation control" and instead advocate giving employees freedom to operate within defined and agreed boundaries.

- On the issue of union involvement in safety committees, studies again offer contradictory results with some reporting positive relationships, others no relationship and others a negative relationship. Again it is thought that the affect of union involvement depends on the quality of labour relations and company history, with poor labour relations being reflected in a negative affect of union involvement and vice versa.
- Finally, on the matter of communications, Hale and Hovden emphasise that it is the quality of communications which matter not the presence of communication channels.

Clearly the apparent broad consensus between the different studies and between the earlier ACSNI and more recent Hale and Hovden review increases the confidence that can be placed in these conclusions. In addition, Hale and Hovden considered the extent to which there was empirical proof of links between topics and company performance. Whilst it was thought that many studies were atheoretical, the vast majority of topics were linked to company performance by empirical research. This further strengthens the level of confidence that can be placed in these findings.

In summary, the factors on which there is a broad consensus may be titled as:

- commitment/leadership;
- communications;
- shared norms and expectations;
- learning, and;
- ownership

3.2.2 Areas Of Difference

There are three principal points of difference, the first of which is elaborated here.

Top-down versus bottom-up processes

Many models suggest that it is necessary to adopt a participative approach to the development of a safety culture, involving staff in the identification of issues and development of initiatives. It is argued that you can only secure ownership of safety, and hence acceptance of a common ideology, by involving staff in the development process. However, some models, especially the INSAG4 model, places greater emphasis on the role of management in defining the required norms and thereafter securing acceptance of these norms, viewing the development of a safety culture as a “top-down” process.

The difference in emphasis on top-down versus bottom-up processes partly reflects differences in philosophies and partly reflects differences in the origins of the models. Some models, such as that of Dalling, cite the predominant role of management and organisation factors in major incidents. These incidents suggest that individuals and staff as a whole are unlikely to adopt “safe “ behaviours in an organisation which is not committed to safety or which does not effectively support or encourage safe behaviours. This view is clearly supported by research on the role of leadership in engendering an effective safety culture, and recent work on how changes in attitudes and behaviours can come about from organisational changes, especially where supported by changes in management behaviour. In addition, the recommendation of communication of norms, reinforcement of safe behaviours by feedback appraisal and reward, and consistent management behaviours all point to an important role of management in supporting an effective culture.

However, there is an equal body of work indicating that the participation of staff is also required to secure ownership and acceptance of new safety ideology. Indeed, many recent changes in organisation and management have been designed with the explicit goal of increasing the level of staff involvement in health and safety and creating a two-way dialogue. Also, there is a body of research that indicates that sub-groups can hold a different set of attitudes and beliefs than the organisation as a whole, and that these attitudes can be a product of peer group pressure and are accordingly resistant to wider organisational initiatives. For example, Sinclair and Haines (1993) and Gherardi et al (1996) found that social subgroupings might exist in their studies of workplace accidents and the construction section.

Thus, it would appear that there is a place for both “top-down” and “bottom-up” processes. Such an approach might include developing appropriate organisational structures and processes of communication etc, combined with clear expression of management commitment reinforced by consistent management behaviour and reward of correct behaviours by staff – along with staff participation and involvement in the development and implementation of safety controls.

The two other areas of difference comprise the **emphasis awarded to external pressures** and the **definition of organisational learning**. These points are elaborated in sections 3.4 and 3.5 in light of more recent research.

3.3 DEFINING GOALS AND NORMS

The ACSNI and some other studies appear to presume that an organisation will possess a valid view of what constitutes “strong safety commitment” and that such commitment can be assumed to apply equally to all areas of health and safety performance. Indeed, as expressed by Hale and Hovden “some writers only talk of a ‘safety culture’ if the achievement of safety is a high priority...”. There is also something of a presumption that once a set of “good” norms and beliefs have been defined they remain unchanged thereafter, with the only remaining task being the maintenance of these norms. It could be argued that the ACSNI model focuses on internal processes and overlooks the issue of who/how safety norms are formulated and reviewed. In this way the ACSNI prompt list presents an organisation which stands in isolation of wider society and in isolation of what others conceive to be an appropriate set of norms, ideology and standard of behaviour. This stands in contrast to the NUREG work that places emphasis on external reference points, and to the recent employee consultation regulations.

The importance of the issue of how “commitment” is defined and translated into a set of expected behaviours is highlighted by a number of studies, as follows.

Congruency of management attitudes

The first set of studies, as summarised by Wright (1998) found that:

- Organisations may pursue an award winning proactive outward looking approach to quality management and a reactive minimalist approach to health and safety.
- Organisations with a commitment to achieving high standards in one area of health and safety may overlook other hazards – i.e. organisations can display a very incongruent attitudes towards individual hazards.
- The incongruent attitudes of an organisation can be repeated by individual employees.
- It cannot be assumed that a general and genuine commitment to safety will apply to all areas of health and safety responsibility.

The organisation's attitude towards individual hazards is influenced by a number of factors. One of the most important factors, especially in the major hazard sector, is the organisation's perception of which hazards pose a significant threat to the business. The threat is usually defined in terms such as the potential for adverse publicity, regulatory intervention, and loss of consumer confidence and so on. The reaction and perceptions of third parties attenuate the level of perceived threat to the business posed by a hazard. Consequently the concern for those hazards that are of little concern to third parties may not be in proportion to the objective level of risk.

The second key factor is the organisation's view of society's moral and social expectations, as many organisations seek to satisfy society's expectations as a matter of policy. In this respect, organisations will often use regulations as an indication of society's moral expectations and hence measure "social" performance in terms of the level of compliance with these regulations. However, as the ultimate goal is to satisfy moral and social duties, the organisation will only seek to comply with those regulations that it views as valid, proportionate to the risk and applicable to the organisation. Also, where it is felt that the risk is low, or that there is no expectation on the part of society to comply with a specific regulation, the organisation may again decide not to use the regulation as a benchmark of society's expectations.

Clearly, the role played by third parties in shaping organisations attitudes demonstrates the need to include the issue of "goal and norm definition" in the model of safety culture. The previous research has also shown that these processes are influenced by factors such as the level of professional training in health and safety and the awareness of risk posed by specific hazards. Also, those organisations that adopt a policy of managing all hazards are more likely to apply a consistent approach and appropriate set of standards to each hazard. Thus, those organisations which take account of the objective level of risk posed by hazards tend to have a more balanced approach to those hazards which third parties are unconcerned about.

The organisational construction of acceptable risk

A series of studies have developed the notion that what is to be regarded as an acceptable risk becomes a question of social negotiation (Vaughon 1996, Short and Clark 1993, Pidgeon 1991, Turner, 1991). Turner observed that all organisations operate with a variety of cultural beliefs and norms with respect to hazards and their management. This culture is created and recreated as people behave and communicate with each other. Over time certain hazards may be less or more tolerated depending on internal and external influences. The basis of disasters arise when unsafe behaviours and conditions become "normalised" and accepted. This in turn leads organisations to ignore or down play signs or warnings of problems, with the risk accepted according to the new norm – termed "cultural denial" by Turner.

Clearly, as demonstrated by the research summarised in Wright (1998), the opposite may also occur, with an increased awareness of risks and heightened safety standards, reducing the accepted level of risk. Either way though, this work further highlights the issue of how organisations define and redefine norms surrounding what is and is not an acceptable standard of behaviour. This view of "acceptable risk" being a product of social negotiation is reflected in the findings of Wright (1998), in particular, the finding that organisations view regulations to be an expression of social and moral duties and expectations. Where these regulations are thought to be valid and applicable to the organisation, they would be used as a guide to the standards society expect to be achieved. In this way, the development and issue of regulations, their communication and acceptance by organisations comprises a process of social negotiation, and are a key influence on the norms adopted by organisations.

Management vs workforce norms

A similar question can be raised about the role of staff and safety representatives in the formulation of behavioural norms. Indeed, some researchers have characterised the traditional safety culture approach as a management driven initiative to impose a management-defined culture onto the workforce. Back and Woolfson articulated this view in their statement that the CBI view of safety culture reflects:

“the belief of a group – usually at the top of the industrial hierarchy – that it had already taken ‘ownership’ of a desirable culture of safety. It also reflected the belief that safety culture was a managerial prerogative, something management could dictate ...” (p14, 1999).

Whilst it is not for this study to ascertain the validity of this claim, it does highlight the issue of the extent to which staff should be involved in setting behavioural norms and standards, especially with the recent issue of Employee Consultation regulations.

Initiatives, such as the Step Change in Safety initiative in the offshore sector, seek to involve the workforce. This clearly demonstrates a recognition of the need to include the workforce in the definition of goals – notwithstanding the criticism levelled at the Step Change initiative of excluding trade unions. However, it is probably inappropriate to suppose that the workforce can take the lead in defining the safety culture ideology for at least two reasons, namely:

- The “directing mind” of the organisation holds ultimate responsibility and accountability for performance.
- The cultural ideology should have regard to the expectations of external stakeholders, particularly the regulator and society at large, which may be at odds (or at least focus on a different set of issues) with the workforces ideology.

Thus, workforce participation in defining and developing a cultural ideology will be “bounded” by the locus of legal responsibilities and expectations of external “stakeholders” as interpreted by the organisation, in the same way that the management’s view of safety should be bounded by regulations and societal norms.

Clearly, it is concluded from this work that it is important to focus on the process of setting and revising behavioural norms, including the involvement of internal and external “stakeholders”, as an issue in its own right.

3.4 ORGANISATIONAL LEARNING

The view of Turner that norms change over time leads into the issue of organisational learning. A key feature of disasters is that they often challenge existing beliefs and norms about hazards, i.e., the event demonstrates that prevailing assumptions about the level of risk and its acceptable are wrong. The ACSNI report did recognise the importance of organisational learning. Indeed, the ACSNI report stated, in reference to the Piper Alpha Inquiry Report, that:

“one characteristic of organisations with a poor safety culture may be an unquestioning attitude; a tendency to believe that shortcomings observed in other organisations “couldn’t happen here”, and that they have little to learn from the experiences of other industries or other countries”.

However, this was not fully reflected in its prompt list. In particular, the ACSNI safety culture prompt list focuses on how organisations learn from their own incidents whilst the other models, particularly the NUREG work places more emphasis on external reference points, learning from the experience of others. Indeed, the work of Clarke (1998) on safety culture in the UK railway industry highlighted the importance of communicating information sharing and learning from organisations across the industry – especially in a fragmented industry where different organisations operate on or share the same facilities. Given the trend towards outsourcing in the UK nuclear sector, this further highlights the need for a broad outward looking view of organisational learning.

Similarly, latter day practices of outsourcing, delayering and downsizing with the attendant risk of loss of staff and organisational memory and continuity, further increases the importance of organisational learning. On the other hand, Parker (1997) in a study of clinical disasters in the NHS found that the risk of a disaster is strongly associated with hierarchical management and poor internal and external communication. This collection of features is the opposite of a learning organisation, as stated:

“Disasters are seen as more likely where positional authority overrides individual knowledge, the individual sees themselves as responsible only for themselves and not for the performance of the organisation as a whole, and where the organisation is seen as a closed system” (Parker, 1997)

It is pertinent to note that the need to ensure individual knowledge overrides positional authority was also cited by La Porte (1996) in the context of “loosely couple” organisations as well as “tightly coupled” organisations. This work highlights the need to consider the affect of organisational structure and management styles on their ability to learn.

The different forms of organisational learning can be delineated in terms of first, second and third order learning. In terms of an organisation, first order learning is considered to be at the level of technicians, operators and supervisors. Second order learning takes place at the level of management systems and procedures. Third order learning is at the level of policy and interaction with the external environment.

Whilst all organisations are thought to have the opportunity for first order learning, second and third order learning require specific systems to be present. Third order learning organisations will go further than having standard review systems, such as auditing, and will:

- have mechanisms for recording and analysing organisational behaviour;
- have means of benchmarking performance against other organisations and learning lessons from other organisations and sectors;
- pay particular attention to the amount and distribution of experience it retains;
- take care not to shed core knowledge and so deplete its organisational ‘memory’ and;
- ensure that political and social factors, such as a culture of blame and positional authority, do not inhibit the acceptance and application of lessons learnt.

3.5 ACHIEVING EFFECTIVE SAFETY CULTURE: RECENT FINDINGS

3.5.1 Organisational Structure And “New Ways Of Working”

The ACSNI model and the models put forward by INSAG and NUREG were developed on the basis of research completed before the era of delayered “flatter” organisations. Indeed, many industries, including the nuclear sector, have placed great emphasis on the need to change the organisational structure in order to facilitate the development of an effective safety culture. This stands in contrast to the earlier work that makes little reference to the role of organisational structure in the development of safety culture. Not only does this suggest that the earlier work may have overlooked a key factor, it also raises the question of whether the earlier work recommended solutions to problems associated with traditional “command and control” bureaucracies. Consequently, it is possible that some of the features recommended by earlier work may no longer be required in those organisations which have eliminated or greatly reduced a source of cultural and communication problems. The concern here is that the models may present a set of requirements that may otherwise be unnecessary if the root causes of dysfunctional cultures were eliminated. For example the need for multiple means of communication and multiple means of demonstrating management commitment to safety might be unnecessary if there were fewer organisational barriers to communication and interaction in the first place!

The work by AEAT did recognise the importance of organisational and management factors, but it did not go so far as to explain how one or another organisational structure may provide better support for an effective safety culture. In addition, the AEAT model appears to assume that staff attitudes are a product of management attitudes and behaviours whilst the true picture is somewhat more complex.

The importance of organisational structure is illustrated by the study on Business Process Re-engineering commissioned by the HSE (Wright, 1996), the work of Nuclear Electric and contingency theory, as discussed below.

BPR research

The BPR research found that, for example,

- whilst the role of management and supervisors has traditionally been described as one of interpreting, communicating and implementing organisational goals, it is feared that they actually distort and block communication. Also, it is feared that supervisors rather than facilitating two way communication act as a block on upwards communication. Thus, the recent move towards delayering explicitly aims to reduce the number of layers of management in an organisation, layers which it is thought only served to filter and distort executive policy;
- with a simpler flatter structure there may be less need for multiple means of communication to counter the filtering affect of a multi-layered hierarchy, and;
- the delegation of responsibility from senior management to line management and staff is viewed as placing responsibility back with those people whom should have always retained such responsibilities. By placing responsibility with line management and staff, there may be less need to implement initiatives to win ownership of company wide safety programmes, as line management and staff should already own such systems.

Nuclear Electric

The importance of “new ways of working” and new flatter organisational structures, is illustrated by the work of Nuclear Electric. As described by Low et al (1995) Nuclear Electric first identified, through a review of the cultural issues underlying audit reports and inspections, 3 key factors relating to people, processes and organisational issues, being:

- A. individuals awareness of the reasons for specific rules and safety limits;
- B. the importance of a No Blame culture, and;
- C. the need for ownership of procedures by those who use them.

They went on to identify approaches to overcoming these barriers, including:

- flattening the organisational structure;
- broadening individuals span of control;
- simplifying the company’s safety management processes to build upon the skills of individuals, and;
- enhancing the awareness and competence of staff.

Whilst some of these measures are common to previous work, such as the role of staff competence, they place greater emphasis on the role of structural changes in the achievement of an effective safety culture. They also argue that attempts to tackle barriers in isolation are unlikely to be successful. They cite an example where, “if the skills and motivation of staff were developed, but the process and organisation remained the same, the staff would probably be unable to utilise their new skills and their motivation would be lost” (p81, Low et al 1995).

Low illustrates one example of the role of organisational factors in the explanation of how to promote effective communication and ownership of safety. Low argued that it was important to minimise the number of managerial layers to promote effective communication - in that a flatter organisation improves upward communication and promotes better communication between staff within an organisational level through the development of team working and teams. Accordingly they adopted a four layer structure of station manager, section or function managers, team leaders and staff. The flatter structure also promoted ownership of safety by facilitating the empowerment of staff and providing clearer definition of responsibilities.

A similar trend can be noted in the USA where cost pressures have led to downsizing. As reported by Carroll (1998), the US nuclear power industry has sought to use resources more efficiently. This entails changing the roles and behaviours of both staff and management. Employees are expected to be proactively aware of problems rather than just “do as they are told”. Managers are expected to be communicators, facilitators and motivators rather than controllers. Organisations are shifting from enforcing rules to creating open dialogue so as to encourage collective learning. In this way it is again possible that some of the features mentioned in earlier research on safety culture may be less important in organisations designed to facilitate participation rather than to enforce conformity to management directives.

Thus, whilst the work of Nuclear Electric does reinforce and follow many of the ideas described by ACSNI, such as competent staff and two way communications, it does exemplify the recent increase in emphasis placed on organisational restructuring as a part of the process of creating an effective safety culture.

However, it would be wrong to assume that organisational factors have only recently come to light. Indeed a series of studies in the 1980's and 1990's have examined the influence of organisational structure on behaviour. For example, La Porte (1996) reports from a study of "high reliability organisations" the following features:

- structural flexibility and redundancy;
- dynamic patterns of authority, and;
- decentralised decision-making and negotiation over local goals.

These structural features were required to facilitate decision-making based upon expertise and knowledge rather than formal rank or authority.

Contingency theory

The role of organisational structure in facilitating or inhibiting appropriate behaviour is further exemplified by contingency theory, of which a corollary is that the type of organisational structure required varies from one type of task to another. For example, there may be a requirement for task sub-division and hierarchy for routine tasks, especially if they are safety critical. However, there is equally a requirement for personal freedom to act in emergencies where the authority to act should depend on the individuals' ability rather than their position in the hierarchy.

This view is again reflected in the work of La Porte who observed that the success of high reliability organisations, such as military bodies, was partly due to their ability to "modify the prevailing social arrangements as unforeseen hazards arise". This suggests that there may be a need for more than one unitary culture in an organisation. Rather the social arrangements should change as a response to the task demands.

The adverse impact of a dysfunctional structure is best exemplified by examples of people failing to react in emergencies because they do not believe they have proper authority to make decisions or enact them. For example, it is reported that the stewards of the aircraft which crashed at Kegworth would not have informed the pilot of an engine fire because of the perceived hierarchy.

These examples demonstrate that there is a need to ensure:

- the "normal" organisational structures are not so rigid and inflexible that they inhibit behaviour in abnormal conditions, and;
- there is an appropriate locus of decision making in normal tasks where persons in authority may not be technical experts – this is especially true where new ways of working break down functional specialisms and create "process" based multitasking teams.

This work demonstrates that it is important to avoid prescribing, implicitly or explicitly a single organisational model as the degree of hierarchy, task sub-division, spans of control etc will vary according to the task in hand. However, it is important in all cases to demonstrate that the chosen form of organisational structure promotes and facilitates (rather than prohibit or hinder) ownership of health and safety, communication and participation – striking the right degree of personal freedom within the necessary management structures.

It could be argued that the recent delayering of organisations has sought to redress an imbalance between control and ownership associated with traditional hierarchies. The goal being to reduce the level of structure to the minimum required to avoid role overload whilst

increasing participation to more appropriate levels without eliminating management control in its entirety. Clearly there will always be a requirement for some level of organisational structure and hierarchy, particularly where complex safety critical systems are concerned. Therefore, the recent move towards delayering can be seen as an attempt to provide an appropriate level of “freedom within the necessary management structure” - stripping away the unnecessary elements of management and redefining the new wider limits of freedom. In this way the principles underlying the design of organisational structures can be presented as an attempt to strike a balance between what can be conflicting goals of maintaining “control” whilst simultaneously facilitating ownership, participation and communication.

3.5.2 Contractors

As with flatter organisations, the earlier work makes little if any mention of the use of contractors. This is an important omission given the trend towards outsourcing and its potential effects on safety culture. Indeed, the use of contractors has emerged as a key safety issue in the 1990’s, as highlighted by the HSE/SEPA 1998 Safety Audit of Dounreay, and is thought to have the potential to affect the performance of organisations and import safety problems into the host organisation. In considering this point it needs to be recognised that contractors are being used for a wider range of tasks, such as management and operations, rather than simply being used more regularly on tasks traditionally outsourced, such as maintenance and engineering. Moreover, the concern lies as much with how contractors may affect the safety performance of the host organisation as it does with how the host organisation can assure the contractors safeguard their own health and safety. As such contractors are an issue in their own right who may require special measures.

Indeed, it has been suggested that the trend towards outsourcing renders the proposition of a single culture redundant, as expressed by Bock and Woolfson:

“In a world of sub-contracting, out-sourcing, high turnover, short-term contracts and ‘flexible’ periphery workforces, the notion of a stable organisational ethos is at best questionable”.

Woolfson and Bock proceed to cite the offshore sector as an example of a highly fragmented industry with 30 operating companies employing more than 300 contracting and service companies – with up to 90% of persons at a location being contractors.

Some potential impacts of outsourcing on safety culture have been summarised by Horbury (1999), these are:

- Dual commitment: this concerns the splitting of loyalties between the host company or client and the contractors organisation. The adequacy of supervision, the provision of equipment and operational requirements are areas where dual commitment may impact negatively.
- Responsibility for training: since much of training takes place on-the-job, the question of responsibility for training in contracting is often unclear.
- Quantity or quality of training: the level of training of contractors may be restricted where it relies on specialised equipment and plant only available through the client.
- Role ambiguity: the contractor and client may have different views of what a job entails.
- Loss of corporate memory of health and safety issues; as experienced staff are let go and/or contractors change, the understanding of problems held by staff will be lost.

- No ownership of problems.
- Diffusion of responsibility: responsibility for successful completion of tasks may become unclear.
- Contractor payment and schedule schemes: contractor payments are often linked to achievement of specified deadlines, and may have penalty schemes for early/late completion. This may cause conflict between safety and production.
- Loss of commitment to training: Workforce training is regarded as a long-term investment, which contractors may not feel able to accept in a situation of short term contracts and uncertain future workloads.
- Externalisation of risks: where the host organisation presumes that it has shed responsibility for risks to the contractor and no longer needs to ensure necessary health and safety precautions are taken.

Horbury presents a typology of four contracting factors developed by Mayhew and Quinlan, as follows:

- economic reward pressures;
- disorganisation;
- inadequate regulation, and;
- inability of sub contractors to band together to improve their situation.

It is also thought that these pressures can be “passed-down” from principal contractors to sub-contractors.

However, there has been little, if any research into the impact of contractors on the host organisation’s safety culture or whether current models of safety culture can simply be applied to contractors in the same way as they are applied to sub-divisions of the host organisation.

In addition, many of the problems noted in the context of contracting have also been noted in the context of in-house management. For example, the safety-production trade-off noted by Horbury is a recognised issue within "host" companies. This suggests that the types of problems, and hence the solutions, associated with contracting may be the same as those in host organisations. Indeed, Horbury quoted research which suggests that the source of many of the contracting related problems is ultimately the client and their demands on contractors and sub-contractors, suggesting that the contracting related problems are simply another manifestation of poor safety management on the part of the host organisation.

Clearly though the creation of a client-contractor (and sub-contractor) interface introduces a new dimension to the implementation of solutions. The host organisation must recognise its role in assuring contractor performance and clearly communicate requirements. The host organisation should also consider how the form of contractual relationships may impact attitudes and commitment to training etc. On the contractors part, they need to accept the need to develop an understanding of the host organisations standards and to endeavour to meet these.

One study has examined the safety culture of contractors, namely a study by Mearns et al of offshore workers (1998). This study found few differences in attitudes and perceptions between operator and contractor staff. However, it was considered that this was due to the formation of a single safety culture, in particular the Step-Change in safety initiative, in the offshore industry. In particular:

- The contractor workforce may have worked in the industry long enough to absorb the general culture, and/or;
- The prevailing “climate” on any given installation over rides individual attitudes – with contractor personnel quickly learning the current views on an installation and working within these boundaries.

This work would suggest that it is important to ensure the host organisation's culture is effectively disseminated to contractors, as contractors can absorb and respond to the norms and expectations of the host organisation. It also suggests that the problems associated with contracting may not be inevitable and can be mitigated by taking counter measures, such as developing industry wide initiatives.

Also, Lardner and Miles report (1998) in a study of off-shore self-managed teams, including those using contractors, report favourable experience in both high and low hazard industries. Self managed teams have freedom to allocate tasks and roles and are not directly supervised or controlled by management. They found that self-managed teams enhanced the ownership of safety and performance provided that:

- Safety is a goal.
- The team is trained as a team.
- Boundaries are clear.
- Motivational climate is right.
- Safety roles are assigned to individuals.

This work again suggests that new ways of working and use of contractors create new but not unsolvable issues. Whilst the process of safety management may need to be changed, the results can be positive. Indeed, self-managed teams have been proposed as a solution to the loss of corporate identity incurred by the increased use of contractors. In this context, self managed teams play a role in creating and maintaining site specific solutions and resolving inter-organisation culture differences, i.e. the team becomes the unit of allegiance rather than the host organisation.

3.6 A SINGLE STATIC CULTURE?

Some recent discussion has suggested that the development of a single unitary safety culture may not be desirable. The concern here is that the development of a single culture may lead to an insular culture resistant to new ideas and alternative views, including resistance to signs of failure (it could not happen here) and a “not invented here syndrome”. Accordingly, it is suggested that there is some value in an organisation encompassing a range of beliefs and norms, as well as creating features necessary for “organisational learning”, such as self-doubt and open-mindedness.

However, it could be argued that this merely reflects the need to ensure an organisation has the capacity for reflection and can learn and change from experiences – a feature recognised as a key element of an effective culture. This reflexivity requires an ability to challenge accepted norms and beliefs about hazards and their management. Accordingly, the strive for a single culture should not be detrimental if it is simultaneously ensured that the organisation can challenge its own beliefs.

Other researchers have indicated that it is unrealistic to suppose a single set of beliefs and norms can be generated amongst all persons in an organisation, especially with the advent of out-sourcing and the frequency of re-organisation, as previously noted. However, the research, limited though it is, does suggest that people will quickly learn what the norms and expectations are in a new organisation. This leads to the view that the aim of safety culture is to communicate and secure acceptance of a set of behavioural norms and expectations, thereby providing a framework in which people can understand what actions and decisions are expected of them. Given that these norms and expectations may evolve over time, perhaps due to changes in societal expectations, it is perhaps inappropriate to seek to create the impression that the current norms are “the be all and end all” of safety culture. Rather, safety culture should be viewed as a dynamic process where the organisation seeks to keep its culture in line with latest expectations and standards. Individuals and sub-groups in the organisation can hold differing personal views of safety, but they should accept that their actions must be framed and bounded by the norms and expectations of their organisation, regulator and society. During periods of change, it is important to ensure that required standards of behaviour are clearly communicated and that staff do not wrongly perceive a change in norms.

The increase in the rate of organisational change is also relevant here, including:

- uncertainty about norms and expectations;
- a less stable workforce;
- more fluid organisation means less time to form and maintain relationships, and;
- change in company goals.

It is reasonable to suggest that where the organisation’s norms have changed, the new norms must be communicated and reinforced in the same way that the original norms have to be communicated.

This again reflects the view that safety culture is a dynamic entity which may need to change due to internal and/or external events, and that the organisation needs to be able to effectively respond to such events particularly where they require a change in safety norms. In this context an organisation must be adaptive and flexible, displaying an ability to recognise the need to change norms and subsequently bring about change in attitudes.

3.7 PERFORMANCE REVIEW

INSAG and other models view the review of performance to be part of the process of developing and maintaining a safety culture, whilst ACSNI presents this as a one-off exercise. Indeed, work by Lee and Rycraft of BNFL and Low of Nuclear Electric demonstrates the role played by attitude surveys in the development of a safety culture. Similarly, Booth has highlighted the role of leading indicators of safety performance, particularly safety culture, as vital aspects of the improvement process, providing early warnings of problems. This is

particularly so in case of low frequency events/hazards where the absence of events does not provide a true measure of risk or performance.

In the context of developing an effective safety culture, measurement and review can be viewed as playing the following roles.

Internal Assessments

- provision of feedback on safety culture issues, to help identify improvements;
- communication and demonstration of organisational commitment – “what is measured is important”;
- facilitation of workforce participation in the identification of safety issues and improvements, and;
- challenge of beliefs regarding safety performance, satisfaction with safety management, risk perceptions etc.

Thus, the internal review of safety culture, using methods such as safety climate questionnaires, focus groups, incident reporting etc, is an integral part of the process of communicating commitment, securing workforce participation, challenging beliefs about performance and defining a way forward.

External

Externally focused review, through methods such as performance and attitude measures, stakeholder opinion surveys and application of safety culture audits perform the following roles:

- challenging beliefs held by staff and management about the adequacy of their safety standards, and;
- checking whether the norms and standards pursued by the organisation match societal, regulatory and industrial expectations.

Risk Assessment

This plays the role of:

- checking whether the subjective view of risk and associated weight assigned to control of each hazard by the organisation is in proportion to the risk, and;
- checking whether the perceptions of risk held by the workforce are in accordance with the actual risk.

Thus, there is a role for a battery of measures and methods to help challenge and test norms and beliefs, facilitate communication of views and help identify areas for improvement.

3.8 CONCLUSIONS

3.8.1 Key Features Of Safety Culture

It is concluded that:

- A. There is a reasonable consensus on the types of attitudes and processes exhibited by organisations with an effective safety culture, such as clear demonstration of management commitment, staff participation in decision-making, open communications etc.

- B. It is vital to have an effective means of defining a health and safety ideology and associated behavioural norms – including a means of dialogue with stakeholders to define goals and a means of tracking changes in expectations.
- C. It is equally important to have a means of measuring safety culture for the purpose of guiding the development of a culture and thereafter maintaining the culture.
- D. In order to develop an effective culture it is important to recognise the impact of organisational structure, outsourcing and new ways of working on the means by which an effective culture is developed and maintained.
- E. Safety culture should not be viewed as a static entity. Rather culture will and should be a dynamic entity reflecting and responding to changes in health and safety ideology, lessons learnt and changes in expectations of parties within and outside of the organisation.

3.8.2 Areas Of Uncertainty

Whilst there is a large body of research and many areas of consensus, a number of uncertainties remain.

Firstly, the issues of organisational learning, organisational change, use of contractors and layering have been only partly researched.

Secondly, few studies have successfully assessed the relative importance of factors. Moreover, it is possible that the affect of specific factors may vary between organisations depending on the state of development of their safety systems. In particular, Hale and Hovden suggest that there is some evidence that “structural factors” such as availability of resources, co-ordination of safety and good communications distinguish a poor organisation from a mediocre one. However, other factors, such as labour relations and management/staff commitment, may distinguish good from mediocre companies.

This leads to the conclusion that there has been little research on the order in which improvements are required and/or how the interaction of factors vary between organisations. Indeed, Hale and Hovden point out that most studies have been completed in the context of large, bureaucratic organisations operating in high technology sectors. This raises the question of whether the features recommended by these studies are equally valid in the context of other types of organisations, such as professional organisations, information technology companies, project organisations and so on who do not fit the traditional bureaucratic model.

Similarly, past models have viewed organisational learning as occurring in an essentially static organisation that incrementally learns from its own and others mistakes. In a situation of constant organisational change, this model may no longer apply or could be construed as a brake on change.

It is also possible to suggest that, even in the context of large bureaucracies, the traditional view of safety management relying on imposed rules is inappropriate and counter-productive. Indeed, it would appear that there has been a shift away from centralised hierarchical bureaucracies in recent years for this very reason. Thus, it is possible that a single model of effective safety culture does apply to all organisational types, but that traditional bureaucracies are simply inherently counter-productive. This preferred model was paraphrased by Rasmussen (1993) as comprising:

“delegation of control to working groups as on-line managers intensively communicating with each other with experiential knowledge and stored, internalised rules, linked to a good understanding of the acceptable boundaries within which the system can function safely...”

In the context of organisational change, the concept of organisational learning may need to be expanded to include the issues of corporate memory (ensuring retention of knowledge) and flexibility (rapidly learning and adapting to new demands). As previously stated, culture should not be viewed as a static entity regardless of the rate of organisational change. Rather all organisations need to keep track of change in cultural expectations and be able to respond appropriately. This has to be achieved in both a static or changing organisation.

Thus, whilst the earlier models of safety culture provide a reasonable description of the attributes of an effective culture, they do not provide a model of the type sought by this study to aid the improvement of culture. Fortunately, recent research and industry experience does throw some light on how to approach the development of an effective culture.

These conclusions are elaborated in section 4 into a composite developmental model of safety culture.

4. KEY ELEMENTS OF A COMPOSITE MODEL OF SAFETY CULTURE

4.1 REQUIREMENT FOR A DEVELOPMENTAL MODEL OF SAFETY CULTURE

This study must develop a model of safety culture that fulfil a number of aims, including:

- A. It must allow users to be able to recognise what is required to develop or improve an organisation's health and safety culture. This implies the model must, implicitly or explicitly, incorporate guidance on how to develop an effective culture, as well as describing the features of an effective culture.
- B. The model should be able to be applied on the basis of self-assessment and/or observations of an organisation – as per the BEM model, rather than requiring or relying on the use of attitude surveys.
- C. It must be theoretically sound.
- D. It must be applicable to a range of organisational types.
- E. The model must be sufficiently detailed to allow specific areas of improvement to be pinpointed.
- F. The model must be progressive, allowing and directing progressive improvements.

In the context of these aims it is suggested that a “developmental” model of safety culture is required rather than a descriptive model. A descriptive model, as exemplified by the ACNSI prompt list, describes what a “good” safety culture is thought to comprise and the processes required to sustain a “good” culture. A developmental model also provides guidance on those processes and steps required to develop a “good” safety culture. The work on safety climate and the descriptions of “good” safety culture do serve an important role in a developmental model. In particular, they provide a basis on which to assess the manifestations of an organisation's culture. Such assessment is a critical part of developing an effective culture as information is required on the current culture to guide its future development. Also, the review of culture is required to track whether an organisation has been successful in achieving its cultural goals.

The work on defining norms, redesigning the organisation and styles of management, removing organisational obstacles to participation, introducing empowerment, all form part of the process of creating a setting in which a safety culture can develop. Processes such as communications and training are part of the process of developing, disseminating and maintaining the culture. In this way, all of the facets of safety culture discussed in sections 2 and 3 need to be brought together to form a composite “developmental” model of safety culture. Such a model is elaborated below.

4.2 A COMPOSITE DEVELOPMENTAL MODEL OF SAFETY CULTURE

4.2.1 Overview

The review of safety culture models, research and latest industry experience indicates that a developmental model of safety culture should comprise the following main parts, as illustrated in Figure 6:

- A. A means of defining health and safety cultural ideology, norms and goals which takes account the opinions, perceptions and expectations of internal and external stakeholders.
- B. A means of communicating and demonstrating the organisation's commitment to these goals and norms, and maintaining this sense of commitment over time.
- C. Processes to facilitate the achievement of—stated goals and norms, such as participation, empowerment, staff-management-contractor communications, training, proper resource management etc.
- D. A means of checking that the organisations cultural goals and norms have been effectively achieved or at least that the behaviour of people is consistent with these norms and/or within the boundaries of agreed acceptable behaviour.
- E. A means of tracking the opinions, perceptions and expectations of stakeholders and assessing whether the organisations norms need to be adjusted to reflect significant changes in these.

These elements could be further sub-divided, particularly the second and third points. However, care should be taken in trying to achieve a simple delineation between sub-elements as it has been suggested that organisational culture is an emergent property of the organisation. It has “gestalt-like properties, being resident in the whole - in the interaction of the parts - and not in any individual part” (Cox and Cox, 1996). For example, good communications is required to encourage a good safety culture but is also a product of a good safety culture. Thus by developing better communications you are helping to improve culture and having improved culture the quality of communication is likely to increase further. Similarly, it should not be assumed that a culture should be developed by moving linearly through points A to E. Rather, some sub-parts of each point may need to be carried out simultaneously, such as introducing empowerment at the same time as communicating company commitment, so that stated goals do not conflict with incompatible structures and processes.

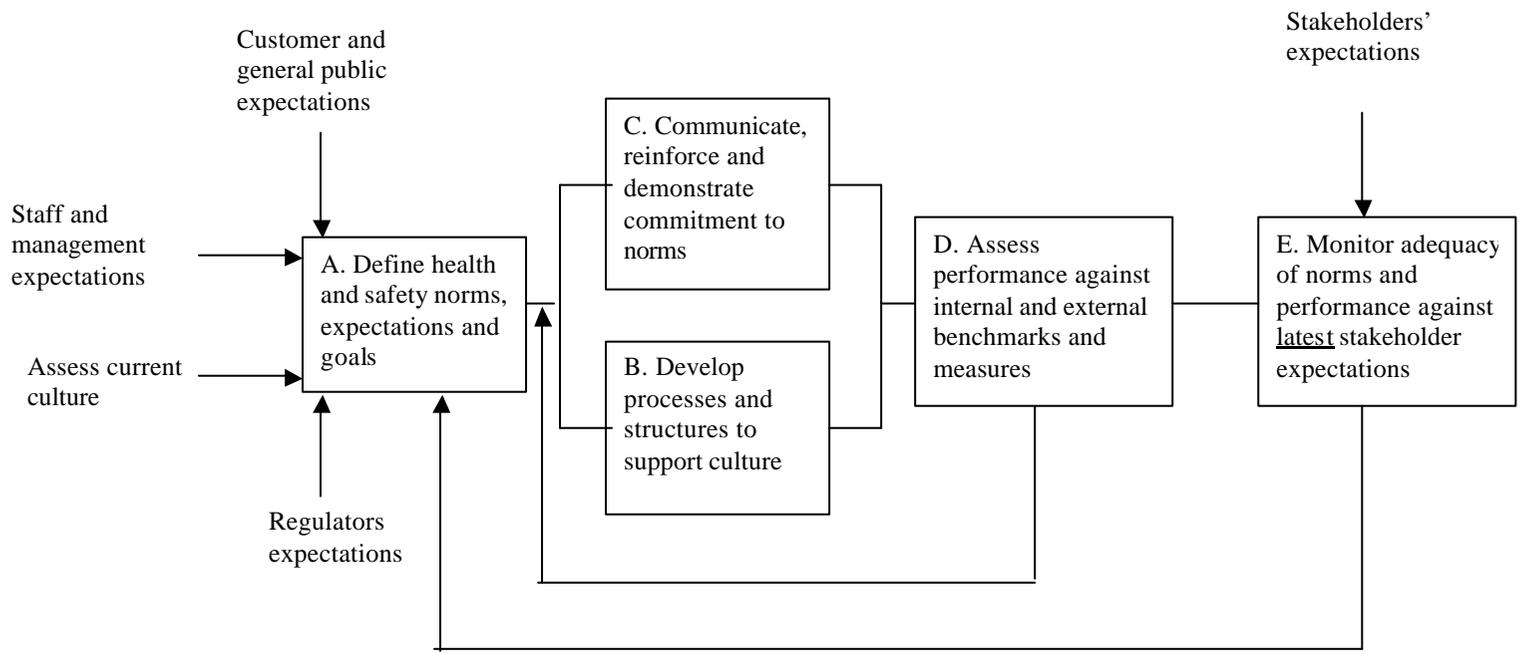


Figure 6
Overview of composite safety culture model

Indeed, Ball and Scotney (IMC, 1998) developed a similar model of the stages involved in developing a safety culture to the one presented in Figure 6 and summarised in Figure 9. They argue that:

“Safety culture enhancement should follow a process which is consistent with good management practices.” (p6)

Their proposed process is shown in Figure 7 and 8. Figure 7 shows the steps in assessing and improving a culture and Figure 8 indicates the role that each method, reviewed by Ball and Scotney, may play. As with Figure 6, they suggest that the process of improvement should commence with analysis and assessment, followed by implementation of improvements and ongoing review. The one key difference concerns the emphasis placed on consultation with internal and external stakeholders, and defining norms in our model laid out in Figure 6, which does not have a direct analogy in the IMC model. The IMC model appears to assume, if implicitly, that the behavioural norms and goals are known and are unvarying between organisations or across time, ie: it is a closed loop system. The model in Figure 6 presents a more open system in which the sought after norms may vary across time and organisations in accordance with stakeholders expectations and requirements. However, and notwithstanding this point of difference, both models present a similar “developmental” process in which safety climate surveys etc fulfil a diagnostic/monitoring role within a broader planning and review process.

The model in Figure 6 can also be compared with the six element management model in HS(G)65, as follows:

- the element “Defining health and safety norms, expectations and goals” is analogous to the “planning” element of HS(G)65;
- the elements on “Communicate, reinforce and”, and “Develop processes and structures” are analogous to the Organising element of HS(G)65;
- the element “Assess performance against internal and external benchmarks, and measures” is analogous to the measuring performance element of HS(G)65;
- the element “Monitor adequacy of norms” Is analogous to the Reviewing Performance element of HS(G)65.
- the expectations emanating from customers, the public, staff regulators etc. would form part of “Policy” in HS(G)65. Thus, it is again apparent that the model shown in Figure 6 is similar to other recommended approaches to the improvement of safety performance. The absence of an auditing element in Figure 6 is not considered critical here. The model aims to show the stages of development rather than the control mechanisms over this process. Thus, auditing of the process could be added as another element such as a “management control” process.

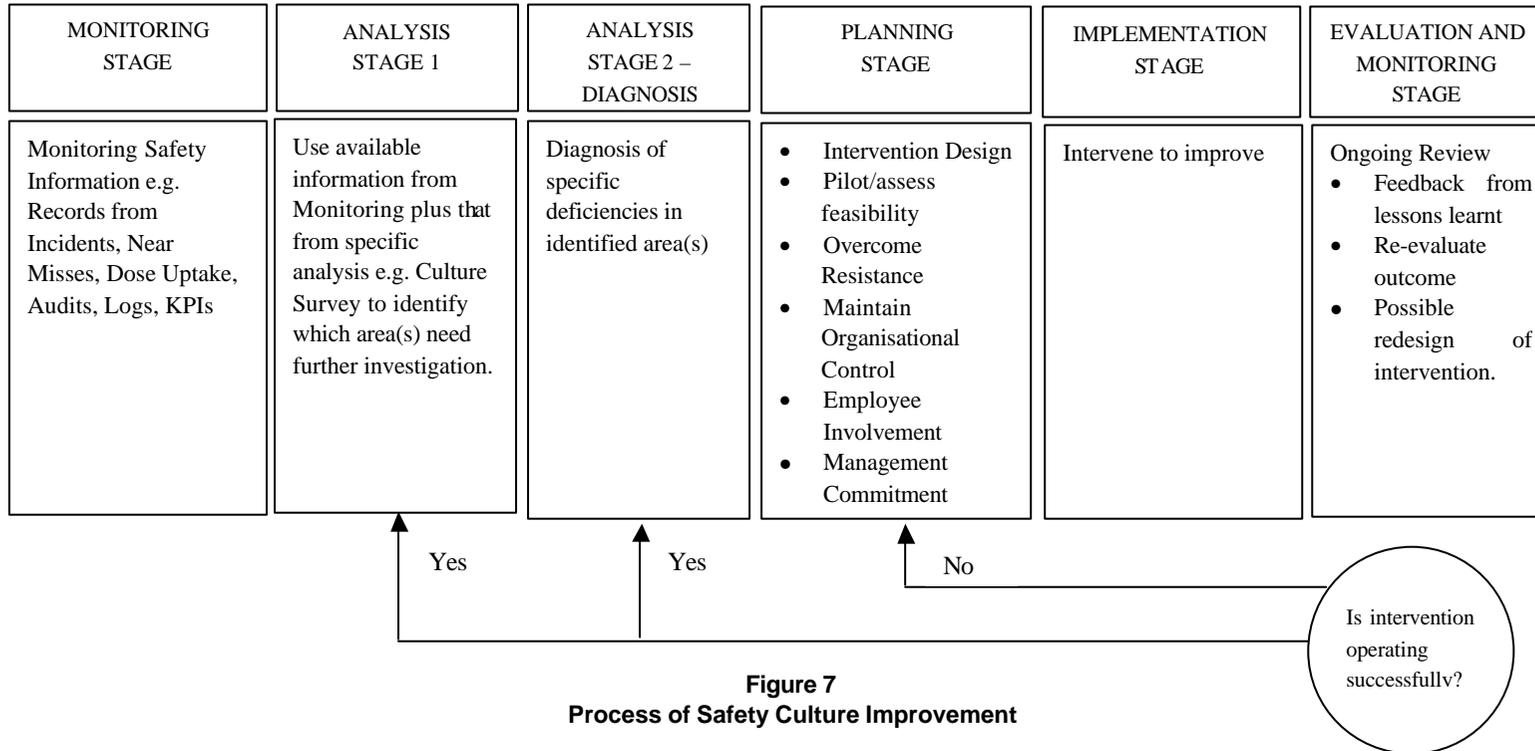


Figure 7
Process of Safety Culture Improvement

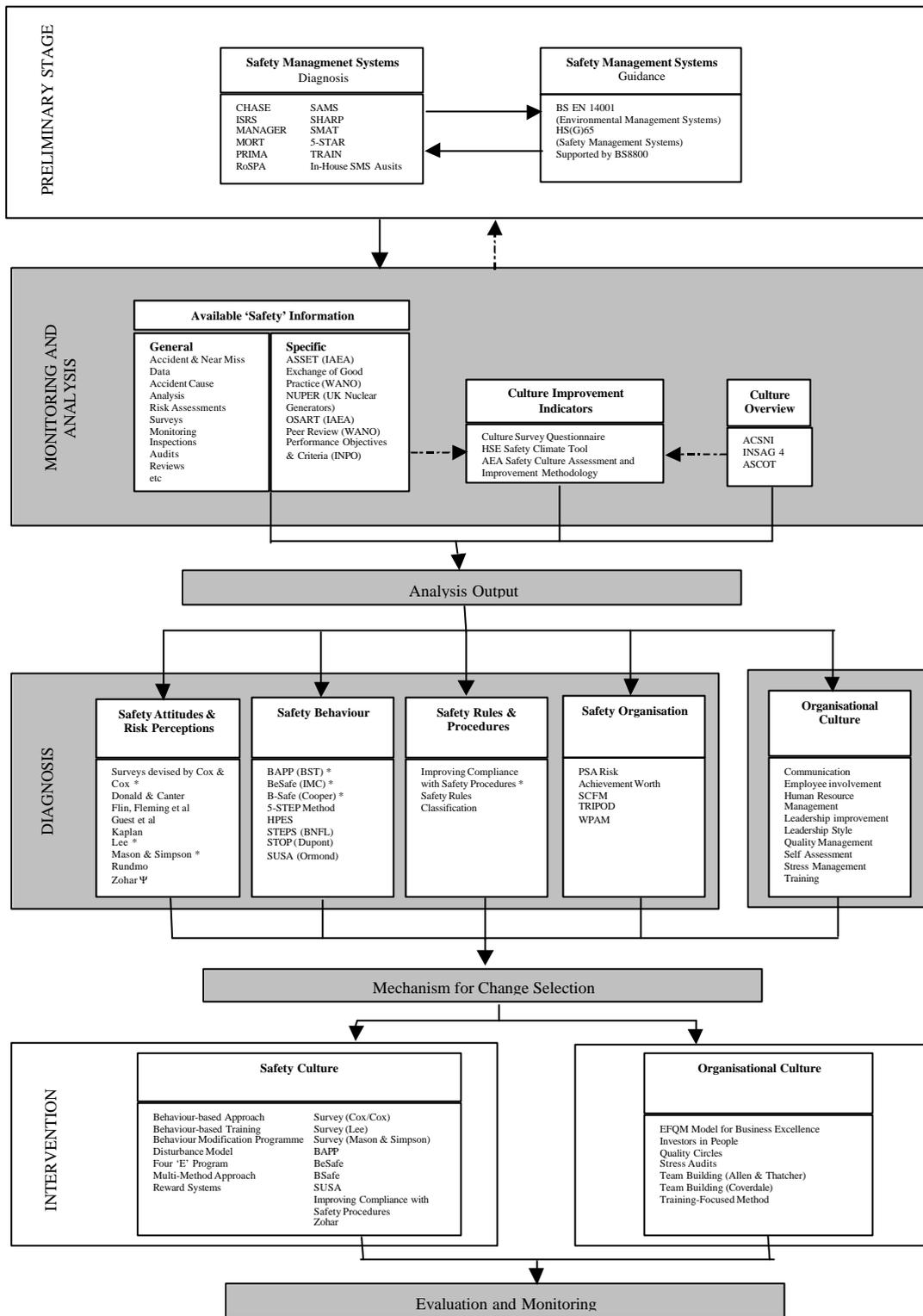


Figure 8
Safety Culture Techniques

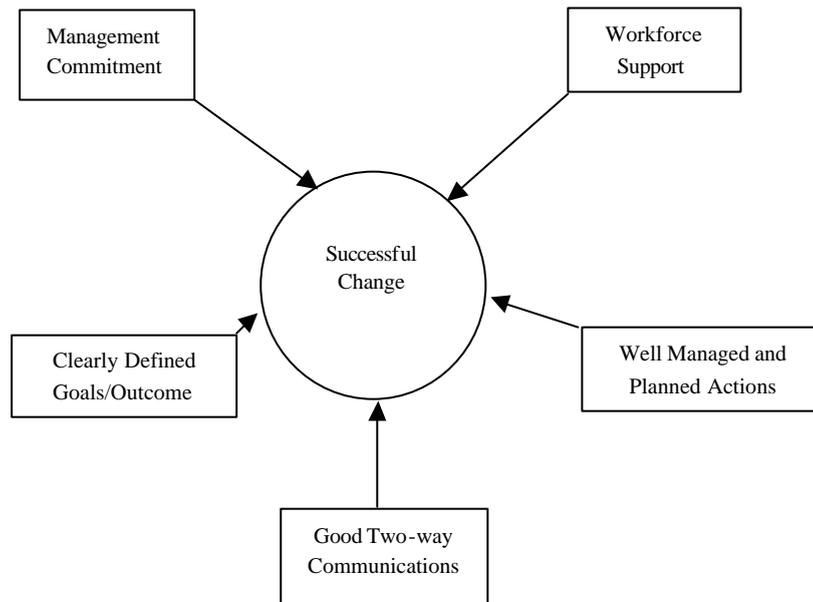


Figure 9
Key change factors

Other authors have suggested alternative presentations of safety culture. In particular, some authors describe a progressive move from dependent through independent to interdependent cultures. Dependent cultures entail management led processes, independent cultures are typified by the idea of “every one is their own safety officer” and interdependent cultures are where every one proactively concerns themselves with each others safety. Such a format has the advantage of delineating progressive stages of development. However, it fails to explain the processes required to move from one stage to another or how to maintain the development of a culture once it has reached the “interdependent” stage. Notwithstanding this, it does highlight the value in identifying progressive stages of development. Therefore, it is proposed to provide guidance on the approach to developing a culture, including the approximate ordering of actions and stages of development.

4.2.2 Initial Scoping of Model

Whilst the ordering of sub-elements may not be certain, it is possible to develop a list of sub-elements by drawing on previous research. These features are elaborated in Table 4. The make-up of points B to E of Figure 6 can, in the main, be drawn out of previous models and safety climate methods whilst the BEM provides ideas on the details of points A and E. Our view of point A is given below.

Point A: Definition of goals and expectations

The features of an organisation that has an effective approach to the definition of cultural norms and goals include:

- all hazards are objectively assessed with the aim of ensuring that the level of control is proportionate to the risk;
- the perceptions of risk held by key internal and external stakeholders are recognised and taken into account in the formulation of safety goals and behavioural norms, but

not to the detriment of health and safety in those cases where risk perceptions underestimate the objective level of risk;

- there is a policy of assessing and managing all health and safety hazards, and not just those of concern to third parties;
- there is a recognition and acceptance of the duty to manage all hazards which pose a significant risk to health and safety of employees or the public;
- there are means of proactive dialogue with internal and external stakeholders, (including staff, general public, customers regulations and management);
- there is a recognition of customer and societal expectations as expressed by regulations, customer standards etc.
- the company's goals and expectations for each hazard (or type of hazard) are disseminated throughout the organisation;
- there is a recognition that the weight assigned to individual hazards may be greater than their potential impact on the business;
- it is recognised that the organisation has a moral imperative to manage all hazards rather than confining its attention to those hazards which pose a threat to the business;
- there is a means of translating corporate safety norms and expectations into a set of meaningful behavioural guidelines and operating/managerial limits, and;
- whilst recognising that the management of health and safety can benefit the business, it is also accepted that business should not be conducted at the expense of health and safety in those cases where a hazard has little potential impact on business performance.

Table 4
Elaboration of composite safety culture model

Macro level main elements	Examples Micro level sub-elements
A. Defining norms and expectations	<ol style="list-style-type: none"> 1. How are corporate safety values and norms formulated? 2. Who is referenced in the formulation of norms, e.g. public, customers, regulators, employees etc? 3. Does management commitment match expectations of external bodies, stakeholders? 4. Use of risk assessment to understand hazards and set norms. 5. Recognition of moral, social and ethical duties as well as business risks associated with health and safety. 6. Clear explanation and dissemination of health and safety policy, performance standards and behavioural norms for each class of hazard.
B. Developing processes and structures to support culture	<ol style="list-style-type: none"> 7. Team working on safety problems. 8. Staff participation in risk assessment, hazard spotting and remediation. 9. No diffusion of responsibility for health and safety. 10. Devolution of health and safety roles and responsibilities to staff and line management. 11. Clear statement of staff and management responsibility for their own performance. 12. Clear definition of boundaries of acceptable behaviour and limits on personal discretion and decision making. 13. Participation in decision-making, development of rules and procedures etc.; managers working with groups to identify safety concerns/problems and finding solutions for them. 14. No organisational barriers to team working, communication and decision making. 15. Staff participation in two-way communication: safety concerns, difficulties raised by the staff and dealt effectively with by the management. 16. Confidence in competence of oneself and others. 17. Coaching and training in health and safety is sufficient to allow all persons to meet required standards of performance and participate effectively in implementing and developing health and safety systems. 18. Staff and management education/training provides a clear understanding of the risk posed by each hazard. 19. Staff and management training provides a clear rationale and understanding of the requirement and justification for each safety rule, control and requirement. 20. Management systems and procedures facilitate compliance with health and safety rules and procedures.

Macro level main elements	Examples Micro level sub-elements	
C. Communicating, reinforcing and demonstrating commitment to norms.	21. Rules, procedures and safety requirements are practicable, up to date and in proportion to the risk.	
	22. Mutual trust and respect between the management and the staff.	
	23. Informal and formal channels of communication available e.g. safety manager/representative has a direct access to the C.E.	
	24. Effective system of reporting safety incidents.	
	25. Safety practices at work continuously under review to ensure timely responses to internal and external changes.	
	26. Prepared to learn from the knowledge gained from past experiences to improve future performance.	
	27. Continuity of staff – ensuring a good mix of experience and maturity with the new talent.	
	28. Safety policy statement and clear-cut goals and targets formally stated.	
	29. Explicit and continuing steps towards commitment to safety from the highest level, including the chief executive board.	
	30. Involvement of management; managers actively take part in the training sessions, safety performance review meetings etc.	
	31. Commitment of funds and other resources e.g. I.T., latest technology in the prevention and mitigation of undesired incidents.	
	32. Publicity awarded safety.	
	33. High/Important/ Significant status of safety personnel.	
	34. Targets & goals are made known, understood and agreed upon by all.	
	35. “Macho” approach to risk taking strongly discouraged by the management.	
	36. Reward and recognition of safe behaviours.	
	37. How are external and internal peer group influences on norms moderated?	
	38. Development of single organisational identity i.e. the traditions, values, customs, practices and socialisation processes of the organisation.	
	39. Understanding and acceptance of behavioural norms and expectations.	
	40. Recognition of appropriate behaviours and discouragement of inappropriate ones.	
	D. Reviewing performance	41. What are the employees’ perceptions of the level of risk they face?
		42. Do they have clear understanding of hazards?
		43. Do they clearly understand the safety controls and procedures?

Macro level main elements	Examples Micro level sub-elements
E. Recognising and responding to changes in expectations and/or poor internal performance	44. Do they have confidence in safety controls and the procedures?
	45. Do they accept the safety controls and procedures?
	46. Do they have confidence in the supervisors & management?
	47. Is there a full-time safety review group that reports directly to the plant manager?
	48. Does the organisation share safety information with the operators of other plants?
	49. Are employees kept informed about the safety performance and are they satisfied with it?
	50. Open-mindedness
	51. Outward looking
	52. Proactive seeking out lessons learnt
	53. Able to recognise issues
	54. No blame (appropriate blame) culture
	55. Endeavour to seek out root causes and general lessons learnt.
	56. Positional authority does not override technical ability.
	57. Keeping formal success/failure records of the organisation's safety performance
	58. Means of evaluating stakeholders' expectations
	59. Do behaviours match expectations of internal and external stakeholders.
	60. Means of benchmarking performance against other plants and other organisations
	61. Means of promoting the organisations safety performance inside and outside the organisation
62. Tracking customer, public and regulators satisfaction with the safety culture	

5. COMPARISON WITH BUSINESS EXCELLENCE MODEL

5.1 METHOD OF COMPARISON

The correspondence of the BEM with models of safety culture has been assessed by:

- A. A high level comparison of the main elements of the BEM and the composite safety culture model described in section 4;
- B. A content analysis – comparing the content of questions and issues addressed by BEM and the earlier safety culture models. This is a judgmental comparison, making allowance for differences in wording of questions which address the same issue;
- C. A comparison of the compatibility of the sub-division and ordering of questions, and;
- D. Back-fitting BEM to the composite safety culture model to test their compatibility.

In addition, the implications of previous research into the congruency of management and staff attitudes for the validity of reading across from one area of performance to another have been examined.

These assessments are preceded by a summary of BEM.

5.2 THE BUSINESS EXCELLENCE MODEL

The Business Excellence Model was developed in the 1990s by the European Foundation of Quality Management along with a group of leading European companies recognised for their excellence in business management. In the UK, the model is disseminated by the British Quality Foundation (BQF). The Model is now used by thousands of organisations to assess their business excellence.

A wide range of aspects of the business performance is considered, ranging from management style, resource management and strategic planning through to customer satisfaction, impact on the community and business results. There are nine elements of business excellence considered in the Model (shown in figure 9 below). These elements are grouped into two broad areas:

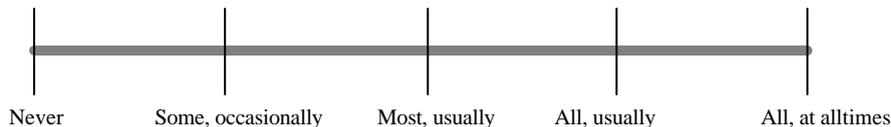
- A. Enablers: help us look for ways in which improvements can be made;
- B. Results: what we target, measure and achieve.

The elements are summarised in Table 5.

Each element has a set of questions for which a score is awarded, as illustrated below.

An example of a question is:

Do our leaders demonstrate commitment to the organisation's goals and behave in a manner consistent with its values?



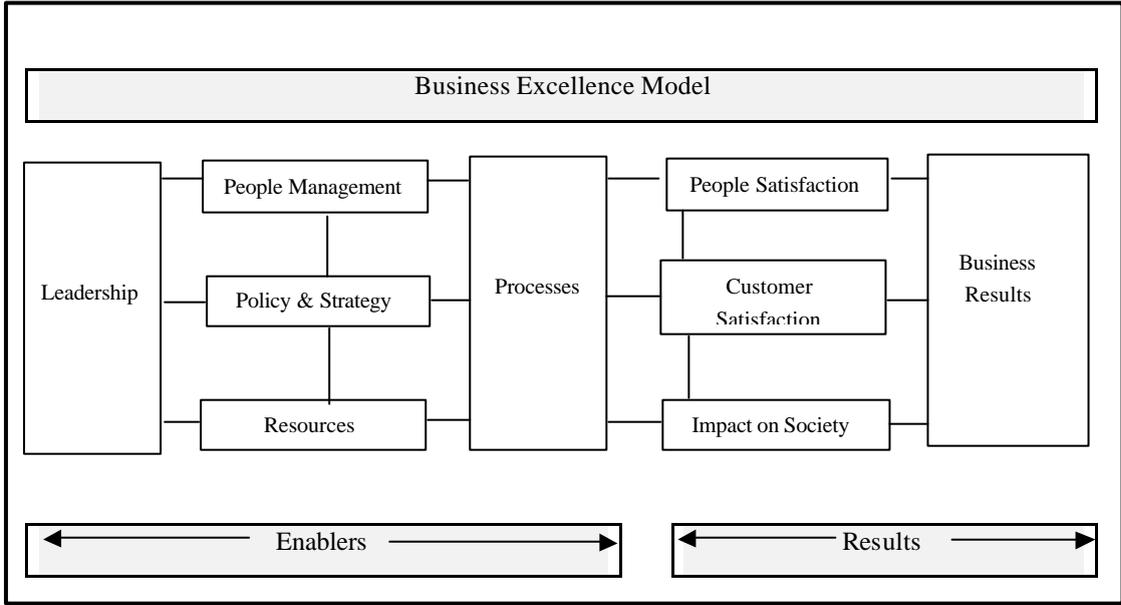


Figure 10
Summary of Business Excellence Model

Table 5
Summary of B.E.M Elements.

Elements	Summary	Examples of excellence
Leadership	This section is about the behaviour of all the leaders in leading the whole organisation towards business excellence: how they themselves are involved in leading improvement, how they ensure that everyone in the organisation is aware of their part in continuous improvement, how they recognise and reward individual effort, how they provide resources to help improvement activities.	<ul style="list-style-type: none"> • Strong commitment to employee satisfaction from leaders • Strong customer and supplier focus from leaders • Highly visible ‘missionary’ leaders • Leaders develop role model behaviours • Leaders give and receive training • Leaders act as coaches
Policy & Strategy	This section looks at how the organisation’s mission (the organisation’s purpose), values (the understanding and expectations on which people’s behaviour is based), and vision (the kind of organisation we would like to be) reflect the principles of business excellence and how this is made known to people in the organisation.	<ul style="list-style-type: none"> • Vision, values reflect principles of business excellence and customer satisfaction • Aggressive ‘leapfrog’ goals • Overall policy and strategy integrated with business planning • Long term horizons in planning • Aggressive planning ‘drivers’ derived from study of world leaders • Key targets derived from customer requirements and deployed to all units • Plans driven from and linked to suppliers and customers • Policy & strategy developed from feedback from customers, suppliers and people within organisation

Elements	Summary	Examples of excellence
People Management	How all the employees of the organisation are managed so that their full potential is channelled into continuous improvement.	<ul style="list-style-type: none"> • HR plans integrated with strategic plans • 'Internal customers' concepts used • Comprehensive training & education programmes with relevance/effectiveness continuously reviewed • Empowerment, flexible assignments, people involvement encouraged • Team & individual recognition
Resources	How financial, information, and technological resources, suppliers, materials, buildings and equipment are managed and used to support the organisation's goals.	<ul style="list-style-type: none"> • Focused to support key processes and policy and strategy • Regular reviews of effectiveness • Operationally integrated management systems
Processes	How all the activities that add values to the organisation are identified, reviewed and continuously improved	<ul style="list-style-type: none"> • Clear definition of key processes • Quantitative orientation – focus on actionable data • Multiple and interlinking measures – internal and external • Challenging targets identified and used • Focus on response times • Quality system standard e.g. ISO 9000 in place • Integration of prevention & correction with daily operations • Linkage to suppliers

Elements	Summary	Examples of excellence
Customer Satisfaction	This section measures the organisation's success in the satisfying the needs and expectations of its customers.	<ul style="list-style-type: none"> • Proactive customer system leading to measure that customers see as relevant • Use of 'all relevant listening posts' e.g. surveys, product service follow-ups, complaints, turnover of customers , employees • Assessment of all relevant market segments • Surveys go beyond current customers • Results benchmarked against leaders
People Satisfaction	This section measures the organisation's success in satisfying the needs and expectations of its people i.e. the employees of the organisation.	<ul style="list-style-type: none"> • Perceptions measured & surveyed with relevance to employees • Results benchmarked to leaders • Inter and intra organisation comparisons • Use of predictor, leading & influencing measures as well direct perceptive surveys
Impact on Society	Measuring the organisation's success in satisfying the needs and expectations of the community at large.	<ul style="list-style-type: none"> • Use of measures that directly indicate society's perceptions of the organisation • Results benchmarked against leaders • Significant community support and partnerships • Exemplary practices with respect to preservation of global resources
Business Results	This section looks at the financial and non-financial measures of the organisation's success as a business. Non-financial measures could be results	<ul style="list-style-type: none"> • Broad base of improvement trends in products, services, internal operations, cycle times, productivity, key processes, financial results • Results benchmarked to leaders • Improvements in supplier quality

5.3 COMPARISON WITH ACSNI, INSAG-4 AND USNUREG MODELS

Tables 6 and 7 provide a comparison of the BEM with the earlier models of nuclear safety culture. Table 6 summarises where issues raised by the earlier safety culture models appear to match elements of the BEM. Table 7 lists those issues noted in the earlier models that cannot readily be matched to BEM elements.

Key points of comparison:

- A. The safety culture models do not pose questions on “results”.
- B. The majority of matches are in the area of leadership, policy and strategy and people management.
- C. The safety culture models pose questions in the following areas which are not found in BEM:
 - interaction with regulators;
 - hazard management;
 - procedural compliance;
 - government commitment to safety, and;
 - roles of research and design organisations in safety management.

These differences may be said to reflect the origins of the models, namely that:

- the BEM reflects a view that quality and business excellence must be driven by an outward looking attitude, comparing performance with competitors and gauging performance by assessing customer satisfaction;
- the early safety culture models focus on the internal processes of leadership and communication, reflecting the focus of early research in the area of safety culture, and;
- the BEM covers the more formal aspects of resource management and management processes. These processes are generally regarded to fall into the area of safety management systems rather than safety culture.

It is suggested here that the lack of matches to the “results” part of the BEM reflects the limitation of the earlier safety culture models rather than a failing on the part of the BEM. That is, the earlier models should have paid greater attention to the assessment of the “results” of steps taken to improve safety culture. This conclusion, in combination with the finding that the first 3 elements of the BEM do match well with the safety culture models, suggests that the BEM may be a reasonable “vehicle” for framing a developmental model of safety culture.

Table 6
Comparison of BEM with safety culture models/frameworks developed by
ACSNI Study Group, EG & G Idaho Norm Survey, USNUREG and INSAG4

Business excellence model		Safety culture models											
		ACSNI Study group			EG & G Safety survey			USNUREG			INSAG 4		
Elements	Total No. of Questions	Match	Possible Match	No Match	Match	Possible Match	No Match	Match	Possible Match	No Match	Match	Possible Match	No Match
Leadership	14	8	—	6	6	5	3	2	2	10	8	1	5
Policy & Strategy	12	7	4	1	5	3	4	1	2	9	4	4	4
People Management	18	6	6	6	6	3	9	8	2	8	6	1	11
Resources	14	—	—	14	4	—	10	—	3	11	4	1	9
Processes	13	—	—	13	2	—	11	1	1	11	1	—	12
Customer Satisfaction	5	—	—	5	—	2	3	—	—	5	—	—	5
People Satisfaction	5	—	—	5	—	—	5	—	—	5	—	—	5
Impact on Society	5	—	—	5	—	1	4	—	—	5	—	—	5
Business Results	5	—	—	5	—	5	—	—	—	5	—	—	5

Table 7
Questions from Safety Culture Models, which did not match any of the questions from the BEM

Safety Culture Models	No. of Questions in models	Elements of each model	No. of spare/unmatched questions
ACSNI Study Group	12	Review of organisational structure - Licensees	5
	13	Review of safety culture – Licensees:	
		Policy, Planning, Organisation & Communication	2
		Hazard Management	6
		Monitoring & Review	3
7	Regulators and Safety Culture	4	
Total	49		20
EG & G Safety Survey	4	Safety Awareness	1
	6	Teamwork	0
	7	Pride & Commitment	4
	5	Excellence	1
	4	Honesty	0
	10	Communications	0
	11	Leadership & Supervision	0
	5	Innovation	0
	7	Training	0
	2	Customer Relations	0
	14	Procedure Compliance	2
	6	Safety Effectiveness	1
	7	Facilities	2
	Total	88	
USNUREG	4	Administrative Knowledge	0
	3	Communications	0

Safety Culture Models	No. of Questions in models	Elements of each model	No. of spare/unmatched questions
	4	Organisational Culture	0
	5	Decision Making	0
	4	Human Resources Allocation	0
Total	20		0
INSAG4	8	Governmental Commitment to Safety	8
	14	Performance of Regulatory Agencies	14
Operating Organisation:	4	Corporate Level Safety Policy	1
	6	Safety Practices at Corporate Level	2
	3	Definition of Responsibility	0
	13	Training	1
	3	Selection of Managers	3
	13	Review of Safety Performance	2
	7	Highlighting Safety	4
	3	Work-load	3
	5	Relations between Plant Management & Regulators	5
	19	Attitude of Managers	8
	20	Attitude of Individuals	20
	5	Local Practices	5
	4	Field Supervision by Management	4
	8	Research Organisations research Analysis to Safety Analysis	8
	5	Design Organisations codes for Safety Aspects of Design	5
	3	Design Review Process	3
Total	143		96

5.4 COMPARISON OF COMPOSITE MODEL WITH BEM.

As a further test of whether the BEM provides a useful “vehicle” for assessing safety culture, we have sought to “back-fit” the BEM onto the composite model of safety culture. This entails trying to re-word the BEM question set to be specific to safety culture, i.e. what is the safety culture analogy of each BEM question? Having reworded the elements, the extent to which they cover the full scope of the composite model can be considered. The re-wording of each element and the example issues is shown in Table 8.

This indicates that:

- The wording and intent of some questions in BEM are very similar, if not almost the same, as many questions raised by the composite safety culture model.
- Many questions posed by BEM have direct analogies to those posed by safety culture but need to be made specific to safety to be of any value, such as questions on “results”.
- Some BEM questions are analogues to SMS issues rather than safety culture.

Therefore, at the very least, it would appear that there is a broad match between questions raised by safety culture and those raised by BEM although the range and wording of questions need to be adjusted to make them meaningful in the context of safety culture.

In particular, Table 8 shows that the following elements of the BEM reflect the corresponding parts of the composite safety culture model:

BEM element	Corresponding part of composite safety culture model
Policy & Strategy	Part 1: Defining norms
People management and processes	Part 2: Developing structures and processes to support safety culture
Leadership	Part 3: Communicating, reinforcing and maintaining commitment to norms (and some of part 1)
People Satisfaction	Part 4: Reviewing performance
Customer satisfaction, Business results and Impact on Society	Part 5: Recognising and responding to changes in expectations and/or poor internal performance

However, there are a number of reservations, as follows:

- The safety analogy of some parts of Business results and Resources reflect issues that are more commonly labelled “safety management system” factors rather than safety culture factors.
- The definition of the “customer” in Customer satisfaction has to be broadened to include the regulator.

Finally, the question must be asked whether the sub-division of BEM elements, their scope and general content is consistent with the sub-division of factors in the composite safety culture model. On this point, it is possible to note the following.

- A. It is not certain how safety culture factors should be sub-divided.

- B. The split between leadership, processes and results is similar to the split of factors in the composite safety culture model, although leadership does cover aspects of 2 parts of the safety culture model.
- C. The BEM model does broadly cover the whole scope of the composite model, if allowance is made for deletion, addition and re-wording of specific questions.
- D. Some BEM questions are analogous to safety management system factors rather than safety culture factors – although these could be deleted or re-focussed without degrading the general match of BEM to the safety culture model.
- E. The progressive improvement matrix in BEM is a better framework for providing a safety culture improvement matrix than the descriptive models developed by ACSNI etc.

Table 8
Back-fitting of BEM to composite safety culture model

BEM Elements	Part of composite safety culture model	Re wording of BEM to reflect Safety Culture model	Re wording of BEM examples to reflect safety culture model
Leadership	Part 3: Communicating, reinforcing and maintaining commitment to norms. And some of part 3.	This section is about the behaviour of all leaders in leading the whole organisation towards achieving excellence in the area of safety: how they themselves are involved in leading improvement, how they ensure that everyone in the organisation is aware of their part in continuous improvement towards successful safety management, how they recognise and reward individual effort, how they provide resources (provision of information, instruction and training) to help improvement initiatives, how they themselves work with the peripherals e.g. contractors, suppliers and how they promote the success of their organisation in achieving safety excellence e.g. competing for appropriate awards??	<ul style="list-style-type: none"> • Strong commitment to employee health & safety from leaders • Must be goal oriented and have clear set goals & objectives • Highly visible ‘missionary’ leaders • Leaders develop role model behaviours e.g. safety tours • Leaders give and receive training on safety management • Leaders act as coaches on how to achieve high standard of health & safety • Recognising that accidents, ill health and incidents result from failing in management control and not just the fault of individual employees, hence strong and active commitment to safety by the leaders

BEM Elements	Part of composite safety culture model	Re wording of BEM to reflect Safety Culture model	Re wording of BEM examples to reflect safety culture model
Policy & Strategy	Part 1: defining norms	<p>This section looks at how the organisation's mission (the organisation's purpose), values (the understandings and expectations on which people's behaviour is based), and vision (the kind of organisation we would like it to be) reflect the principles of a good safety culture and how this is made known to the people in the organisation. This includes:</p> <ul style="list-style-type: none"> • Satisfying employees' and the society's safety performance expectations • Satisfying the safety rules and regulations • Satisfying the shareholders' safety performance expectations 	<ul style="list-style-type: none"> • Vision, values reflect principles of an excellent safety culture • Health & safety policy and strategy integrated with business management • Key targets derived from appropriate legislation/ best practice on safety culture and from its own performance targets and deployed to all units • Policy & strategy developed by feedback from regulatory authorities, people within the organisation and from the peripheral organisations • Identifying a mechanism by which the organisation can learn and improve its own methods of safety management • Minimising the financial losses which arise from avoidable unplanned events • Recognising that the development of a culture supportive of safety is necessary to achieve adequate control over risks • Ensuring a systematic approach to the identification of risks and allocation of resources to control them • Initiatives aimed at continuous improvement in achieving safety goals

BEM Elements	Part of composite safety culture model	Re wording of BEM to reflect Safety Culture model	Re wording of BEM examples to reflect safety culture model
People Management	Part 2: Developing structures and processes to support safety culture	How all the employees of the organisation are managed so that high standards of safety can be achieved	<ul style="list-style-type: none"> • HR plans integrated with strategic plans e.g. job specifications based upon health & safety assessments of the job • Comprehensive health & safety training & education programmes with relevance/ effectiveness continually reviewed • Empowerment, flexible assignments, people involvement encouraged in management of safety • Team & individual recognition for good safety performance • Sparing use of grievance procedures on safety issues e.g. violations or errors
Resources	Part 2: Developing structures and processes to support safety culture	<p>How financial, information and technological resources, contractors, materials, buildings and equipment are managed so as to:</p> <ul style="list-style-type: none"> • To make the working environment and physical conditions of work safer • Existence of the safety culture is apparent to employees • Managed in way that best supports the policy & strategy in place 	<ul style="list-style-type: none"> • Focused to support key safety culture processes and policy and strategy • Regular reviews of effectiveness of decisions • Operationally integrated safety management systems

BEM Elements	Part of composite safety culture model	Re wording of BEM to reflect Safety Culture model	Re wording of BEM examples to reflect safety culture model
Processes	Part 2: Developing structures and processes to support safety culture	<p>How all the activities that add value to the safety culture of the organisation are identified, reviewed and continually improved? E.g.</p> <ul style="list-style-type: none"> • Hazin • Risk assessment • Effective/ open communications • Focus groups 	<ul style="list-style-type: none"> • Clear identification of key safety culture processes e.g. effective communication, participation, training etc • Quantitative orientation – focus on actionable data • Multiple and interlinking measures – internal and external • Areas of improvement identified and dealt with e.g. by focus groups on safety culture problems • Staff awareness of roles in emergency exercises • Safety performance standards – internal and external in place
(Customer Satisfaction)	Part 5: Recognising and responding to changes in expectations and/or poor internal performance	This section measures the organisation's success in satisfying safety legislation & customers safety expectations, where the 'customers' include regulators	<ul style="list-style-type: none"> • Proactive management systems leading to measures that the regulatory authorities see as relevant i.e. achieving an effective safety culture • Use of 'all relevant listening posts' e.g. customer surveys, dialogues with regulators etc. • Results benchmarked against customers and regulators expectations
People Satisfaction /Employee Satisfaction	Part 4: Reviewing internal performance	This section measures the organisation's success in satisfying the health safety expectations of its employees.	<ul style="list-style-type: none"> • Risk perceptions measured & surveys with proven relevance to employees • Results benchmarked to leaders • Inter and intra organisations comparisons • Use of predictor, leading & influencing measures as well as direct perception surveys e.g. near misses • Safety climate measures show staff have confidence in safety management and "feel" safe

BEM Elements	Part of composite safety culture model	Re wording of BEM to reflect Safety Culture model	Re wording of BEM examples to reflect safety culture model
Impact on Society	Part 5: Recognising and responding to changes in expectations and/or poor internal performance	This section measures the organisation's success in satisfying the health & safety expectations of the community at large.	<ul style="list-style-type: none"> • Interaction of the organisation with the local community to raise the community's awareness of the safety activities on site, safety policies and practical demonstrations • Interaction with the local emergency services as a part of emergency planning • Use of measures that directly indicate society's perceptions e.g. the company's safety performance
(Business) Results	Part 5: Recognising and responding to changes in expectations and/or poor internal performance	This section looks at success in health and safety performance against the predetermined standards within the organisation and external	<ul style="list-style-type: none"> • Health surveillance results e.g. loss time injury, liability payments, use of health related PPE, p/c of incidents related to safety culture • High/low severity accident statistics • Official recognition from enforcing/regulatory authorities e.g. some sort of safety excellence award etc. • Benchmarking of safety culture against other organisations

5.5 EXTRAPOLATING FROM ONE TO ANOTHER AREA OF PERFORMANCE

It is often argued that you cannot and should not separate out health and safety management or culture from the general management of the organisation. Such a division is thought to reduce the effectiveness of health and safety management. It is often further proposed that it is reasonable to assess an organisation's management and culture as a single entity, reading across from one area of responsibility to another, as they form part of a single management culture. Accordingly, it is supposed that a single measure of business or environmental management performance can be extrapolated to other areas of performance. If this line of argument is followed, a single measure of management or culture suffices for business, health, safety, quality and environmental management/culture.

However, whilst we would not dispute the potential benefits of an integrated culture, previous research indicates that organisations often have highly incongruent approaches and attitudes to each area of performance, as noted in section 3 of this report. Also, whilst the research on BPR found that it is difficult to implement participation in health and safety without first developing a participating style of general management, some organisations overlooked health and safety when introducing participation into general management of the business. Indeed, research shows that a reactive minimalist style of management is pursued in the area of health and safety even in those organisations given awards for their proactive outward looking approach to quality management. In addition, previous research shows that organisations can hold incongruent attitudes to individual hazards, with strong commitment to managing some but consciously overlooking other equally important hazards. These incongruent attitudes are rooted in the interaction of many factors, such as public pressure, perceived business risk, awareness of the risk and historical attitudes, many of which are unrelated to the actual risk.

This indicates that it is unsafe to read across from one area of responsibility to another without first checking the congruency and consistency of management style and attitudes. Also, the validity of perceptions of risk posed by each hazard needs to be assessed along with the associated weight and attitude towards each hazard. Consequently, each area of performance should be separately assessed to derive a verified assessment.

6. DEVELOPMENT AND TRIALING OF THE SCIM

6.1 OVERVIEW

This section of the report identifies:

- what options were considered for the design of a safety culture improvement matrix,
- the rationale for the chosen way forward,
- how the SCIM was trialled, and;
- results of the trial and key changes to the SCIM.

6.2 OPTIONS

The following options were considered.

- A. Assume that an organisations score on a normal application of BEM applies equally to all areas of management responsibility including health and safety.
- B. Apply the same question set, but ask questions explicitly in context of health and safety.
- C. Use same questions but give new “safety culture” hints and tips.
- D. Structure the question set around the 9 BEM elements, but develop a modified set of individual questions.
- E. Retain some of the 9 BEM elements and the split between enablers and results, but introduce some new elements and questions.
- F. Retain the split between enablers and results but introduce/re-order the elements.
- G. Develop a completely new safety culture improvement matrix.

In considering these options it was noted that:

- It is dangerous to assume that a score from one area of management performance, such as quality, can be read across to other areas of responsibility, such as safety, due to the possibility of incongruent management philosophies.
- The suitability of norms, and expectations pursued in each area of responsibility has to be verified independently for a reliable assessment to be achieved.
- There are many similar and/or analogous questions/issues in the BEM and composite safety culture model. However, other BEM questions have little, if any, meaning in the context of safety culture, whilst others need to be modified to be meaningful.
- The BEM includes elements such as customer satisfaction, which raises issues that the early safety culture models should have raised.
- The general BEM framework is consistent with the composite safety culture model, although other sub-divisions of elements would be equally valid.

Therefore, as a first step, it was decided to:

- Retain the 9 elements in BEM.

- Modify the question set as appropriate to be meaningful in the context of safety culture, with new questions, re-worded questions and deleted questions along with a new set of “hints and tips”.
- Provide a “statement of intent” regarding the philosophy behind the application of the SCIM, and guidance on its applications.

Whilst it is possible to suggest sub-divisions of safety culture factors different to that within BEM, it is not certain that they offer significant advantages. Therefore, the BEM sub-division may be advocated on the “practical” grounds of allowing a safety culture matrix to be related directly to the business matrix already in place in companies using BEM.

Accordingly, a set of questions and associated guidance has been drafted, structured around the BEM but reflecting the findings of earlier research on safety culture and its assessment. In addition, a “ladder” version of the SCIM was produced comprising of a single table summarising the features of poor, average and good safety cultures.

6.3 TRIALLING OF THE DRAFT SCIM

The purpose of the trial was to test:

- usefulness, does it add to inspectors understanding;
- practicality, can it be applied using inspectors existing knowledge and/or easily acquired information; specifically can the inspectors benchmark performance in element 9?
- What unit of organisation can it be applied to– the licensee, the site, the unit, the department?
- Time required to complete (it is meant to be applicable in a few hours);
- The virtues of alternative structures, such as using HS(G)65 as a format.

In addition, a general discussion aimed to elicit any suggestions on how to improve the usefulness and/or practicality of the SCIM.

The trial of SCIM entailed a desk top application, or partial application, of the SCIM by seven NII inspectors to sites or nuclear licences with which they were familiar. The inspectors were selected to represent a range of power generation, reprocessing, decommissioning and other nuclear related activities.

It was considered essential that the trial covered both the enablers and results part of the SCIM. However, due to time constraints, some enabler elements were skipped to allow the trial to move onto the results in the time allowed. The elements reviewed by each, inspector are shown in Table 9.

Each inspector was asked to apply the SCIM to a site with which they are very familiar, namely the site they are responsible for inspecting. If necessary they focussed in on one or more units on that site.

Each pilot session last between 3 and 4 hours. At least 30 minutes was allowed within the session for debriefing and feedback from the inspector. The consultant was present throughout the trial to resolve factual queries on the SCIM and note any specific comments on the SCIM as the trial proceeded.

Finally, the SCIM can be applied using two methods, namely via the “ladder” and via the full question set. Both versions were trialed

Suggestions for improvements were noted from each session.

Table 9
Inspectors vs elements

Inspectors	Element								
	1	2	3	4	5	6	7	8	9
A	✓	✓	✓						✓
B									
C			✓	✓		✓			
D					✓		✓	✓	
E	✓	✓							
F			✓						
G				✓	✓				✓

6.4 TRIAL RESULTS

6.4.1 Overall Points

The main points of feedback from the trials are noted below:

Overall reaction

The SCIM was well received. It was thought to be relevant, asked questions at a practical level and adds to the understanding of safety culture. Although faults were found, these were felt to be rectifiable and that the SCIM as it stood was well on the way to being releasable.

However, the ladder version was thought to be in need of revision.

Practicality

There were no major concerns with the practicality of the SCIM. An inspector could form a judgement against each question. The benchmarking questions in element 9 would be the most difficult to answer.

Unit of organisation

It was judged the SCIM could be applied to any size of organisation. Inspectors did not have to alter their viewpoint to their licensee to apply the SCIM.

Time

Time taken to complete the SCIM was not considered to be an issue.

Structure

The structure is fine. Only one of the issues raised, that of how the SCIM handles contractors, could be considered to be a structural problem. Otherwise there were no concerns and no obvious preference for adopting another structure, such as HS(G)65.

6.4.2 Improvement Areas

Contractors

These are seen to be different from other stakeholders, certainly not in the same bracket as customers. Where questions overlap they should be separated. It was thought that elements need either specific questions on contractors or that contractor questions be grouped. This has been done, with several questions added to element 4.

Compatibility with nuclear safety philosophy

A concern was raised that some questions read as over encouraging staff initiative. Some questions were perceived to hint that staff initiative can take precedence over procedural controls. These have been reworded.

The SCIM's perspective on risk assessment may have been at odds with NII's viewpoint on nuclear risk (re: safety assessment principles). Separation of the use of risk assessment in the evaluation of nuclear safety risk, from 'risk assessment' used to support other operational and business decisions was suggested. This has been carried through.

Avoid direct compliance questions

It was preferred that the features / sub-points not be binary yes/no compliance with legal requirements. Not only were these questions not felt to be at home in a safety culture model, but they also could place an inspector in an awkward position.

Negative examples as well as positive ones per issue

Requests were made for examples of poor or negative features to be added. Such examples have been added.

Signposting to reference material

Safety culture is not a core expertise of inspectors and further assistance is appreciated. A request was made for the addition of signposts to relevant guidance (or background material).

Editorial issues

The consistency of the wording of the scales with the question has been reviewed, as has questions that suffered from jargon

6.4.3 Response To The Trial

The draft SCIM and the accompanying ladder version have been revised in accordance with the trial results. Discussions with NII inspectors indicate that it could be applied in two ways, namely:

- occasional overall review of a site or unit on a site, perhaps twice a year;
- drawing on points of guidance in the SCIM to inform "day-to-day" inspection work.

7. CONCLUSIONS

It is concluded that:

- there is a sufficient body of research and methods on which to develop guidance on the assessment and management of safety culture;
- a “developmental” model of safety culture best supports the needs of NII and licenses, as opposed to “descriptive” models of the features of a “good” culture;
- the BEM provides a reasonable framework around which to structure guidance and assessment questions, although the specific questions and points must be specific to safety culture;
- the proposed SCIM is practicable for use by NII inspectors and adds to their understanding of this area;
- the BEM version of the SCIM is compatible with HS(G)65.

Whilst it is concluded that the SCIM is useful and practical, further research could focus on:

- applying the SCIM across a series of sites to gain benchmarking data and to validate the SCIM against site safety performance data;
- provide practical examples of safety culture schemes and initiatives, and;
- research the issue of how recently introduced staff reward schemes influence behaviour.

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APPENDIX A
DETAILED SUMMARY OF MODELS

A1. INTRODUCTION

A1 ACSNI STUDY GROUP

The key factors identified by the ACSNI are summarised below in Tables A1 to A3 whilst the ACSNI prompt list of safety culture factors is given in Appendix B.

Table A.1
Organisational factors that influence accident rates

Management/Labour Interactions		Training, Housekeeping, Job Satisfaction and Workforce Composition.	
1.1	Senior Management Commitment	2.1	Training
<p>The most general factor shown to clearly distinguish low accident from high accident plants, is the proportion of financial, personnel or other resources that are allocated to safety management and their perceived status in the organisation. This commitment is demonstrated by:</p> <ul style="list-style-type: none"> • The encouragement of greater personal responsibility and participation by all employees in safety measures; i.e., the ‘ownership’ of safety. • The status within the organisation of the safety committee(s) and of the safety practitioners. • The receipt of regular reports of safety performance at a board level, and the involvement of senior management in formal safety deliberations. • Strong publicity being awarded to the work of safety committees, and the rapid implementation of their recommendations. • Allowing direct access/consultation with the most senior levels of management by safety practitioners. 		<ul style="list-style-type: none"> • Training should also invariably include specific attention to associated risks: optimal methods of safer working; corrective or emergency actions; and any other safety-relevant aspects of the skill. • Skills training have particular relevance to induction training by supervisors, and to skills requiring the use of potentially hazardous tools and equipment. • A thorough review of existing skills training courses to ensure the inclusion of safety aspects is considered a key factor in the organisation of safety. • Formal safety training, this is directed specifically at such aspects as safety rules, safety procedures, accident report and enquiries, alarm systems and emergency procedures. • Safety training of such managers is a first priority. • The training of supervisors in leadership skills. • Safety training should emphasise the understanding of hazards and their manifestation, rather than being satisfied simply with highlighting their existence. • Ideally this understanding should be measurable by, for example, the use of before and after risk perception questionnaires. • The regular and systematic feedback of accident information to all employees. Its effectiveness comes partly from maintaining constant awareness of the consequences of unsafe behaviour, 	
1.2	Management Style		
<ul style="list-style-type: none"> • A ‘humanistic approach, involving more regard by management for personal and work problems. • Moderation in disciplining human errors, with more recourse to verbal reprimands or job transfers than ‘terminations’. 			

Management/Labour Interactions	Training, Housekeeping, Job Satisfaction and Workforce Composition.
<p>1.3 Management Visibility</p> <ul style="list-style-type: none"> • Good managers appear regularly on the 'shop floor'. • Formal or informal reporting of these interactions to those who were not directly affected. • Managers should also be made aware of the fact that what they say is less important than what they are perceived to be meaning. 	<p>but mainly from the provision of a standard or norm against which socially desired improvement can be gauged and quantitative comparisons made with similar departments or organisations.</p>
<p>1.4 Intercommunication</p> <ul style="list-style-type: none"> • Factors like frequent and informal communication between all levels not only contribute to a positive safety culture, but they also flow from it. • Questions about safety become part of the everyday work related conversation. • Multiple means of communication. • Perceived direct access up the hierarchy and an 'open door' policy that was frequently used. 	<p>2.2 Housekeeping</p> <ul style="list-style-type: none"> • Clean and comfortable working environment. • Apart from general housekeeping, the design and layout of the plant to facilitate smooth working is obviously important.
<p>1.5 Pressure for Production - the threatening trade off between production and safety.</p>	<p>2.3 Job satisfaction</p> <ul style="list-style-type: none"> • Accident rates are better in circumstances where both shop floor and management feel confident that equitable systems of promotion are in place, and also where management makes every possible effort to minimise "lay-offs" with variations in demand. • Employees feel that if they behave safely and cautiously it will improve their social status and prospects within the organisation or simply earn recognition.
<p>A positive safety culture is one where safety not only wins out if there is a conflict, but where everything is done to remove the conflict. Well planned and scheduled work, wherever possible, as distinct from 'rush jobs'.</p>	<p>2.4 Workforce composition</p> <p>A high proportion of older, more experienced, socially stable workers.</p>

Table A.2
General organisational factors affecting the safety culture

A Communication of perceptions and attitudes

There is a need for frequent and effective communication to avoid misunderstanding, and to facilitate team working.

The semi-formal 'discussion group' or 'focus group'. A principal aim is feedback of perceptions and attitudes, but such groups also help directly by sharing attitudes and forming standards or norms. Hence, continuity is an essential feature of an effective system, with corrective action by management leading to further discussion.

An alternative way is for the meetings of safety committees to be structured so that the agenda of every meeting includes a specific requirement to discuss safety in general terms.

A further approach is to conduct a systematic attitude survey of all employees.
Two-way communication is one of the main keys to improved safety management.

A survey provides a major vehicle for such communication, as well as eliciting perceptions and attitudes and identifying action points.

B Self assessment

Self assessment is the personal appraisal of oneself by every employee. It includes every form of evaluation of a person's own work situation and method; these are checking, reviewing, analysing, and criticising. It is logically followed by self initiated action to improve things.

C Leadership

Although management may formulate decisions to promote safety and show genuine commitment to them, there remains the necessity to persuade, guide or even coerce the workforce to modify its attitudes and behaviour to conform with these and other company objectives.

Workers expect a different kind of leadership, depending on the type of organisation and its particular function.

-
- a) *Caring* - including such leader behaviour as helping subordinates, looking out for their welfare, explaining things and being friendly and available.
 - b) *Controlling* - includes such leadership behaviour as setting targets, getting subordinates to follow rules and procedures, maintaining performance standards and ensuring clear roles and responsibilities.

The most important feature of the democratic style is participation in decision making and acceptance of shared responsibility.

- a) strike an appropriate balance between caring and controlling for safety purposes;
- b) involve workers in decision making, rule-writing and other actions over safety issues.

D The management of stress

- Emotional disturbance may increase error.

Organisations in the nuclear industry, where the consequences of personal stress could be very serious, should at least use some systematic procedure of this type to identify those at risk, followed up by counselling or other forms of assistance as necessary.

Table A.3
Perceptions and attitudes

The role of risk perceptions and attitudes	Employee attitudes towards risk and safety
<p>One of the main characteristics of a positive safety culture is that every individual member of an organisation accepts a primary responsibility to behave as safely as possible; to avoid or to prevent accidents. However, for this to work effectively the employee must have an accurate perception of the risks involved in different aspects of the work.</p>	<p>Perceptions of the likely effectiveness of individual safety measures such as goggles or machine guards.</p> <ul style="list-style-type: none"> • ‘Macho’ attitudes apply to a subset of hazards where skill and daring can be publicly displayed. • Attitude of distrust and resentment of authority may be directed mainly to first line supervision or to all of management.
<p>The ways in which individuals cope with hazards depends on what they perceive, what they believe and what is expected to bring reward.</p>	<p>Employees may recognise the risks involved but accept them as a trade-off for employment; they may be convinced that no risks exist or they may use denial to suppress their uncertainty.</p>
<p>These aspects of perception, attitude and behaviour are driven by motivations.</p>	<p>If doubts exist about the fairness or prudence of management safety decisions or the effectiveness of safety procedures, employees will be hampered by uncertainty. If there are not well established and constantly reinforced norms about safety behaviour and attitudes, employees will be that much less likely to conform.</p>
<p>If the employee, whether craft worker or chief executive, fails to accept primary responsibility for his own and others’ safety as a basic commitment, they will not provide the continuous effort that makes for an effective safety culture.</p>	<p>As people become socialised they adopt the definition of what is risky and what is not from the social groups and organisations to which they belong.</p> <p>A positive safety culture, by definition, is one in which employees have confidence in the wide variety of arrangements for ensuring safety.</p>

A2 USNUREG

The view of safety culture developed by the USNUREG commissioned research is summarised in Tables A.4 to A.6.

Table A.4
Organisational Processes and safety

Administrative knowledge consisting of these 4 dimensions;

- Co-ordination of work-the planning, integration and implementation of work activities of individuals and groups of workers.
- Formalisation-the extent to which there are well-identified rules, procedures, and/or standardised methods for routine activities as well as unusual occurrences.
- Organisational knowledge-the understanding plant personnel have regarding the interactions of organisational subsystems and the way in which work is actually accomplished within the plant.
- Roles and responsibilities-the degree to which plant personnel and departmental work activities are clearly defined and carried out.

Communications with the following 3 dimensions;

- External communications-the exchange of information, both formal and informal, between the plant, its parent organisation, and external organisations (e.g. NRC, State PUC, and Public Interest Groups.)
- Interdepartmental communications-the exchange of information, both formal and informal, between the different departments or units within the plant. This includes both top-down and bottom-up communication networks.
- Intradepartmental communications-the exchange of information, both formal and informal, within a given department or unit in the plant. This includes both top-down and bottom-up communication networks.

Culture consisting of the following 4 dimensions;

- Organisational culture-plant personnel's shared perceptions of the organisation. It includes the traditions, values, customs, practices, goals, and socialisation processes that endure over time and that distinguish an organisation from others. It defines the "personality" of the organisation.
- Ownership-the degree to which plant personnel take personal responsibility for their actions and the consequences of their actions. It also includes commitment to and pride in the organisation.
- Safety culture-the characteristics of the work environment such as the norms, rules, and common understandings, that influence plant personnel's perceptions of the importance that the organisation places on safety. It includes the degree to which a critical, questioning attitude exists that is directed toward plant improvement.
- Time urgency-the degree to which plant personnel perceive schedule pressures while completing various tasks.

Decision Making consisting of dimensions including;

- Centralisation-the extent to which decision making and/or authority is localised in one area or among certain people.
- Goal prioritisation-the extent to which plant personnel understand, accept and agree with the purpose and relevance of goals.
- Organisational learning-the degree to which plant personnel and the organisation use knowledge gained from the past experiences to improve future performances.
- Problem identification-the extent to which the organisation encourages plant personnel to draw upon knowledge, experience and current information to identify potential problems.
- Resource allocation-the manner in which the plant distributes its financial resources. It includes both the actual distribution of resources as well as individual perceptions of this distribution.

Human Resource Allocation consisting of the 4 dimensions including;

- Performance evaluation-the degree to which plant personnel are provided with fair assessments of their work-related behaviours. It includes regular feedback with an emphasis on improvement of future performance.
 - Personnel selection-the degree to which plant personnel are identified with the requisite knowledge, experiences and abilities to perform given jobs.
 - Technical knowledge-the depth and breadth of requisite understanding plant personnel have regarding plant design, and systems, and of phenomena and events that bear on plant safety.
 - Training -the degree to which plant personnel are provided with the requisite knowledge and skills to perform tasks safely and effectively. It also refers to plant personnel perceptions regarding the general usefulness of the training programs.
-

The 4 assessment methods identified from previous research and pilot trials were:

- A. Structured interviews:** A structured set of questions have been generated around the 20 dimensions of safety, such as “If you receive a safety report that seems inaccurate, what do you do about it?”.
- B. Behavioural checklist:** These checklists comprise key statements about observable events tied to each of the organisational dimensions, such as “If a change in personnel occurred in the course of ongoing work, did the different individuals give/receive a status report?”.
- C. Behaviourally anchored rating scales (BARS):** BARS are single page scales, one for each dimension, with examples of good, poor and average behaviours for the dimension assessed. For example, in the case of Problem Identification Poor (scored as 1) is “Problems go undetected or unreported, since most workers feel any effort to report problems is viewed as worker complaints”, whilst Excellent (scored as a 5) is “Employees are encouraged to proactively identify potential problems...and notify management...who respond ...with timely feedback”.
- D. Survey:** A set of questions based on well documented literature regarding employee perceptions and attitudes of safety-related organisational factors, such as “To what extent do employees perceive that those who work safely are recognised and rewarded?”, with response rated from 1 “Not at all” to 4 “To a very great extent”.

An example of a survey is shown below in Table A.5.

Table A.5: Safety culture

Please respond to each question using the following scale; 1 = Not at all. 2 = Somewhat. 3 = To a great extent. 4 = To a very great extent.

A- To what extent do workers with strong safety records have a higher chance of being promoted compared to workers who have questionable safety records?

B- To what extent do employees perceive that those who work safely are recognised and rewarded?

C- To what extent are worker's safety records seen as important factors employee's performance evaluations?

D- To what extent do applicants perceive that selection and promotion decisions are made fairly?

E- To what extent do employees feel that the time and money spent on safety training is well allocated?

F- To what extent are employees who successfully complete safety training seen as better workers?

G- To what extent are supervisor's opinions of the training program solicited and used to revise future programs?

H- To what extent is the need for updating or retraining assessed in order to maintain the effectiveness of training?

At the time of reporting they did not recommend any differential weighting of factors. Instead they advocated a simple averaging of responses within categories. The match of techniques to factors is summarised below in Table A.6.

Table A.6
Techniques for assessing organisational factors

Category	Structured interview	Behavioural checklist	BARS	Survey
Culture				
Organisational culture:	x		x	x
Ownership;	x			x
Safety culture;	x		x	x
Time urgency;	x		x	x
Communications				
External;	x	x		x
Interdepartmental;	x	x		x
Intradepartmental;	x	x		x
Decision-making				
Centralisation;	x	x		x
Goal Setting;	x	x	x	x
Organisational learning;	x		x	
Problem identification;	x	x	x	x
Resource allocation;	x		x	
Administrative knowledge				
Co-ordination of work;	x	x	x	x
Formalisation;	x		x	x
Organisational knowledge;	x			
Roles/ responsibilities;	x		x	
Human resource administration				
Performance evaluation;	x		x	x
Personnel selection;	x			x
Technical knowledge;	x		x	
Training;	x			x

A3 UK NUCLEAR SECTOR ATTITUDINAL MODELS

A3.1 RYECRAFT

BNFL's method for judging Safety Culture was developed using IAEA's INSAG4 and the UK Government Advisory Committee on Human Factors 3rd report "Organising for Safety". This method used an interview question framework to review the culture and attitudes of the workforce - placing actions and attitudes in the context of the plant's goals and difficulties.

The interviews were then analysed to identify matching, conflicting, and discontinuous attitudes and perceptions. The resultant findings were also compared with tangible evidence of behaviour to identify conflict between 'what they say and what they do'. The resultant analysis identified the workforce's strengths and weakness' along with positive and negative aspects of the safety management and communication systems. Following the presentation of the results, the plants involved their workforce in the development of a programme to strengthen their safety culture and refine their safety management systems to support the workforce in this endeavour. One plant who had a Safety Culture Review in 1993 has recently reviewed its progress with the conclusion by the operating staff that the safety culture improvement activities have "resulted in a significant downward trend in the accident rate" and "a significant improvement in overall management of safety and in individual attitudes towards safety".

The resulting set of subject domains are shown in Table A7 below.

Table A.7
Subject Domains and Factors
H. S. Rycraft (British Nuclear Fuels, United Kingdom)

-
- | | |
|----------------------------------|---|
| 1. Safety Procedures | 1. High/low confidence in safety procedures |
| 2. Risks | 2. Cautious/incautious attitude towards risks
3. Low/high perception of the level of risks at work
4. Low/high perceptions of the control over risks |
| 3. 'Permit to Work' (PTW) | 5. PTW is efficient/inefficient
6. In favour of/opposed to PTW
7. PTW is unnecessary/necessary |
| 4. Job Satisfaction | 8. Interested/bored by the job
9. Contented/discontented with the job
10. Job has good/bad working relationships
11. Receives praise/does not receive praise for job well done |
-

-
- 5. Safety Rules**
 12. Rules are understood/not understood
 13. Rules are complicated/clear

 - 6. Training**
 14. Training is satisfactory/unsatisfactory
 15. Selection is effective/ineffective

 - 7. Participation**
 16. Perceives sources of safety suggestions to be predominantly with management/workers.

 - 8. Control**
 17. The source of safety-related action is predominately others/self
 18. Control over safety is exercised by self/others

 - 9. Design of Plant**
 19. Uncritical/critical of plant design
-

A3.2 HSE SAFETY CLIMATE ASSESSMENT TOOL

As noted in section 2, Dr N T Byrom and Mr J Corbridge of the Health and Safety Executive have developed a tool consisting 10 factors as follows:

- Organisational commitment and communication.
- Line Management commitment.
- Supervisor's role.
- Personal role.
- Workmate's influence
- Competence.
- Risk taking behaviour and some contributory influences.
- Some obstacles to safe behaviour.
- Permit to work systems.
- Reporting of accidents and near misses.

A4 STRUCTURE AND PROCESS MODELS

A.4.1 DONALD AND CANTER

The 18 scales in the Safety Attitude Questionnaire (SQA) developed by Donald and Canter (e.g. Donald, 1994; Donald and Canter, 1994) are summarised in Table A.8.

Table A.8
Safety Attitude Questionnaire Scale Titles

Management/Supervisor Satisfaction with the Safety System
Management/Supervisor Knowledge of the Safety System
Management/Supervisor Encouragement & Support
Management/Supervisor Safety Enforcement/pressure
Personal Contact with Management/Supervisors
Management Support for Safety Meetings
Workforce Satisfaction with the Safety System
Work Environment: Hardware
Work Group Encouragement & Support
Workforce Training
Global Self Safety
Meetings
Safe Working Procedures
Safety Information
Safety Representatives; Practice
Safety Representatives' Authority
Section Leaders' Practice
Section Leaders' Knowledge and Satisfaction with the Safety System

A3.2 DALLING

As noted in section 2, the AEAT model comprised a set of 8 elements which were divided into 3 Overall Groups. These 3 groups are illustrated below.

At the **Management and Organisational** level policies and procedures are established to promote a positive safety culture. Hence amongst other matters an organisation should demonstrate that they:

- enforce practices that indicate a concern and commitment to safety;
- balance productivity with safety needs;
- set safety targets over and above that required by legislation;
- enable the workforce to share in the responsibility for safety;
- learns from past mistakes;
- are open to information, and willing to learn and adapt.

The **Enabling Activities** are vital to any organisation in order to improve and maintain a positive safety culture. They are the means by which management initiatives:

- are transferred to the workforce and also;
- the means by which to workforce 'feed-back' to management.

They include the provision of:

- reinforcement and incentives;
- safety and work related training and;

- ‘multi-directional’ communication i.e. flows between management and the workforce in both directions.

The **Individual Factors** demonstrate that the individual’s adoption of a personal responsibility for their safety or their individual commitment to safety is as equally important to maintaining a positive safety culture as is the corporate commitment to safety. In addition, the individual’s perception of management’s commitment to safety also has a bearing on safety culture because it is these perceptions that ultimately influence the individual’s safety performance.

Some examples questions are noted overleaf.

Examples questions from SCAT (after Dalling, 1997)

Management

Example of Question	Ideal Response
How often do you discuss safety issues?	The respondent would have to demonstrate that safety issues are regularly discussed with representatives from every level of the organisation.
What is the relationship between management and regulators?	The respondent would have to demonstrate that the relationship was open and co-operative.
How important is team work?	The respondent would have to demonstrate a positive attitude towards teamwork and evidence of it in the organisation.
Are individuals able to voice concerns over safety without fear of reprisals?	The respondent would have to demonstrate that the organisation was one with a blame free culture .
How often do you intentionally visit the shop floor?	The respondent should indicate that regular visits are made to the shop floor demonstrating that management is visible to the workforce.

Enabling Factors

Example of Question	Ideal Response
Is basic safety training provided for new recruits?	Yes
Is the performance of trainees assessed?	Yes
Are the contents of the safety policy made available to everyone?	Yes
Is information from accident and incident investigations fed back to the workers?	Yes
Are award given for safe behaviour?	Yes
Are disciplinary measures taken when safety rules are wilfully ignored?	Yes

Individual

Example of Question
Safety issues are given priority by my senior mangers
My company provides plenty of safety information for all members of the workforce
Safety is my responsibility
My company is committed to training staff at all levels
Senior management will acknowledge a good safety record

APPENDIX B
ACSNI – SAFETY CULTURE PROMPT LIST

The ACSNI study group safety culture prompt-list

1. REVIEW OF ORGANISATIONAL CULTURE - LICENSEES

- Has the organisation evidence to demonstrate that:
- 1.1 Communications at all levels are founded on mutual trust?
 - 1.2 All personnel understand, and agree with, corporate goals and the subordinate goals of their work group?
 - 1.3 All personnel understand, and agree with, the means adopted to achieve corporate and work group goals?
 - 1.4 The work practices of the organisation are under continuous review to ensure timely responses to changes in the internal or external environment?
 - 1.5 Managers and supervisors demonstrate care and concern for everyone affected by the business?
 - 1.6 Managers and supervisors take an interest in the personal, as well as the work problems of their subordinates?
 - 1.7 Managers and supervisors have been trained in leadership skills, and adopt a democratic and not an authoritarian leadership style?
 - 1.8 Workforce participation in decision-making is not confined to peripheral issues?
 - 1.9 Job satisfaction is maintained by, for example, verbal praise from supervisors and peers, equitable systems of promotion, minimisation of lay-offs, and the maintenance of a clean and comfortable working environment?
 - 1.10 The organisation expects the highest standards of competence and commitment of all its employees, but retribution and blame are not seen as the purpose of investigations when things go wrong?
 - 1.11 An appropriate distribution of both young and more experienced socially mature employees is maintained in the workforce?
 - 1.12 The organisation only recruits suitable personnel, but no automatic presumption is made that individuals are immediately competent to carry out the tasks assigned to them.

2. REVIEW OF SAFETY CULTURE - LICENSEES

2.1 Policy, Planning, Organisation and Communication

Has the organisation evidence to demonstrate that:	2.1.1	The Chief Executive takes a personal and informed interest in safety?
	2.1.2	The Chief Executive and the Board takes explicit and continuing steps to ensure that their interest in, and commitment to, safety is known to all personnel?
	2.1.3	A positive commitment to safety is visible throughout the management chain?
	2.1.4	Safety is managed in a similar way to other aspects of the business, and is as much the responsibility of line management as any other function?
	2.1.5	Safety practitioners have high professional status within the organisation with direct access to the Chief Executive or other appropriate Board members?
	2.1.6	Safety committees have high status in the organisation, operate proactively, and publicise their work throughout the organisation?
	2.1.7	Managers at all levels, and supervisors, spend time on the 'shop floor' discussing safety matters, and that steps are taken to ensure that all personnel hear of the visits and the matters discussed?
	2.1.8	Managers and supervisors spend time commending safe behaviour as well as expressing concern if safety procedures are not being observed?
	2.1.9	There are multiple channels for two-way communication on safety matters, including both formal and informal modes?
	2.1.10	Safety representatives play a valued part in promoting a positive safety culture, and in particular contribute to the development of open communications?
	2.1.11	Specially convened discussion/focus groups are established to consider the safety aspects of new projects?
	2.1.12	Everyone in the organisation talks about safety as a natural part of everyday conversation?

- 2.1.13 Everyone in the organisation recognises the futility of mere exhortation to think and act safely as a means of promoting good safety performance?

2.2 Hazard Management

- | | |
|--|---|
| Latent (decision) failures; has the organisation taken explicit steps to prevent and detect: | 2.2.1 Cases where manager with responsibility for the development or implementation of safe operating procedures fail to: <ul style="list-style-type: none"> a) search for, and identify, all relevant hazards? b) assess risks accurately? c) select workable and effective control solutions? d) adopt appropriate methods to monitor and review the adequacy of the procedures? e) determine whether foreseeable active failures are likely to be the result of errors at the skill, or rule, or knowledge-based levels, or the result of violations? f) minimise or eliminate sources of conflict between production and safety? g) ensure that all relevant personnel have had an opportunity to comment on the procedures before finalisation or implementation? h) ensure that all personnel are adequately trained, instructed and motivated to follow safe operating procedures? |
| Active failures; has the organisation taken explicit steps to prevent and detect: | 2.2.2 Cases where managers personally commit violations of safety procedures or professional good practice? |
| Active failures; has the organisation taken explicit steps to prevent and detect: | 2.2.3 Cases where personnel fail (as a consequence of errors and/or violations) to: <ul style="list-style-type: none"> a) search for and identify all relevant hazards? b) match their perception of risks to the actual risk magnitudes? c) accept personal responsibility for action? d) follow systems of work where specified, or otherwise adopt a safe method of work? |

- e) continuously monitor and review the magnitude of risks to which they are exposed, and the effectiveness of the steps taken to keep the dangers under control?
- Do the organisations plans for preventing and detecting latent and active failures take explicit account of the following:
- 2.2.4 Managers, supervisors, and other personnel may tend to underestimate the magnitude of risks:
- a) with no significant potential (when dealing with nuclear hazards)?
 - b) where the consequences are delayed (for example, a long latent period between exposure and harm)?
 - c) affecting people outside the immediate work group?
 - d) where perceptions may not be adjusted sufficiently in the light of new information?
 - e) where snap judgements are made on the basis of extrapolated information about other hazards?
- 2.2.5 Managers, supervisors and other personnel may tend to overestimate their ability to assess and control risks:
- a) where the hazards have been encountered for long periods without apparent adverse affect?
 - b) where the hazards present opportunities for ego enhancement (for example, public displays of daring (macho image); managers seeking to portray decisiveness)?
 - c) where substantial benefits accrue?
 - d) when the assessment is made by a volunteer?
- 2.2.6 Managers, supervisors and other personnel may tend to have an impaired ability to cope with risks:
- a) when affected by life-event (for example bereavement, divorce)?
 - b) when under stress as a result of a lack of confidence in the established procedures?
 - c) when they believe that they have no ability to influence their own destiny or that of others (fatalism)?

Has the organisation adopted the following measures for improving people's perception of risks and/or ability and commitment to control risks

- 2.2.7 A scheme to identify managers, supervisors and other personnel who may:
 - a) be subject to life-event stressors?
 - b) lack confidence in the effectiveness of prevention?
 - c) harbour resentment or distrust of the organisation?
 - d) have an 'adventurous' outlook on risks?

- 2.2.8 Steps to increase individual belief in their own ability to control events?

- 2.2.9 Steps to erode the peer approval of risk taking?

- 2.2.10 Discussion groups to talk through individual perceptions of risks and preventive measures?

- 2.2.11 Safety training founded on:
 - a) a clear recognition and understanding of the likely distortions of peoples perceptions of risk magnitudes and corrective measures?

 - b) the need for refresher training to counter peoples changes in perceptions over time?

 - c) feedback of accident/near miss data?

 - d) explanations of not just how a job must be done, but why it must be done that way?

 - e) the need for team building?

2.3 Monitoring and Review

- 2.3.1 Has the organisation taken explicit steps to determine how its corporate goals compare with those of the local community and society at large?

- 2.3.2 Is the Board seen to receive regular safety reports, to review safety performance periodically, and to publicise the action it has taken?

- 2.3.3 Has the organisation:
- a) a plan to review, and where necessary, improve its safety culture?
 - b) devised methods for selecting, quantifying and measuring (auditing) key indicators of safety culture?
 - c) reviewed, and where necessary changed, its organisational aims and structure to make manifest its commitment to safety?
 - d) taken steps to ensure safety decisions are acted upon without delay?
- 2.3.4 Have members of the organisation been trained to:
- a) carry out a review of safety culture?
 - b) devise and validate key indicators of safety culture?
 - c) prioritise safety culture goals arising from a review?
 - d) draw up an action plan to improve the safety culture of the organisation in priority areas?
 - e) monitor the implementation and effectiveness of plans to improve the safety culture?
- 2.3.5 Has the organisation made arrangements to encourage reflection on, and to elicit the views of all personnel about:
- a) the overall organisational culture?
 - b) the safety culture of the organisation?
 - c) their perceptions of the attitudes of others in the organisation, about safety?
 - d) their perceptions of risk?
 - e) their perceptions of the effectiveness of preventive measures?
 - f) themselves (self-assessment)?
- 2.3.6 Has the organisation introduced incident investigation procedures which take full account of:
- a) multi-casualty?

- b) the need to explore the incidence of latent as well as active failure?
- c) the need to continue the investigation, even when an apparent cause has been found, to determine further causal factors?
- d) the importance of accepting that the ultimate responsibility lies with the organisation, rather than merely assigning blame to individuals?

3. REGULATORS AND SAFETY CULTURE

- | | | |
|--------------------------|-----|--|
| Has the regulatory body: | 3.1 | Considered both the positive and potentially negative effects of regulatory intervention in the promotion of a positive safety culture? |
| | 3.2 | Recognised that a positive safety culture demands that licensees should have a sense of ‘ownership’ of safety? |
| | 3.3 | Appreciated that key indicators of safety culture go beyond the conventional measures of safety performance? |
| | 3.4 | Taken steps to ensure that licensees’ staff are adequately trained to carry out an objective review of their safety culture? |
| | 3.5 | Taken steps to ensure that licensees’ staff are adequately trained in the skills necessary to develop an action plan for the promotion of a positive safety culture? |
| | 3.6 | Recognised that licensees’ possible misperceptions of the quality of their safety culture may be shared by the regulator’s own staff, because the regulators themselves have similar backgrounds and are part of the same social system? |
| | 3.7 | Reviewed, in the context of safety culture, the qualifications, experience and training of their own staff? |