Understanding and Exploring
Safety Culture

Frank W. Guldenmund

Understanding and Exploring Safety Culture

ISBN 978 90 8891 138 5

Uitgeverij BOXPress
Postbus 313
5060 AH Oisterwijk
tel: 073-5130704
info@proefschriftmaken.nl

Cover illustration: Hanabusa, Itcho (1652-1724) *Blind monks examining an elephan*t, LOC cph 3g08725

Design & typesetting: jules guldenmund layout & text, The Hague
Printed by: Proefschriftmaken.nl || Printyourthesis.com

Understanding and Exploring Safety Culture

Proefschrift

ter verkrijging van de graad van doctor
aan de Technische Universiteit Delft,
op gezag van de Rector Magnificus prof.ir. K.C.A.M. Luyben,
voorzitter van het College voor Promoties,
in het openbaar te verdedigen op dinsdag 12 januari 2010 om 12:30 uur

door

Franciscus Wilhelmus GULDENMUND
doctorandus in de psychologie
geboren te Den Haag

Dit proefschrift is goedgekeurd door de promotor:
Prof.dr. A.R. Hale

Samenstelling promotiecommissie:

Rector Magnificus, voorzitter
Prof.dr. A.R. Hale,Technische Universiteit Delft, promotor
Prof.dr. H.L.M. Bakker, Technische Universiteit Delft
Prof.dr. P.A.E. van de Bunt, Vrije Universiteit Amsterdam
Prof.dr. M.J.G. van Eeten, Technische Universiteit Delft
Prof.dr. R. Flin, University of Aberdeen (UK)
Prof.dr. N.F. Pidgeon, Cardiff University (UK)
Prof.dr. M. Zeelenberg, Universiteit van Tilburg

Das wichtigste in der Musik steht nicht in den Noten

(Gustav Mahler)

To my parents

Table of contents

Introduction

History has it that ever since the INSAG-report following the Chernobyl accident in 1986 (International Nuclear Safety Advisory Group, 1986), the terms 'safety' and 'culture' have been closely linked. Whatever the reason for the committee coining the term, many (social) scientists recognised in this sensitising concept a golden opportunity to broaden their view on safety and, from then on, to include in their research these less tangible aspects of human behaviour that so often herald disaster. This book brings together six papers written over a period of about ten years, which are all devoted to the concept of safety culture (or climate) and reflect the aspiration to come to terms with it. This endeavour, or better still, this quest has been undertaken entirely from the belief that no proper assessment of a concept can be made until it is well understood. The social psychologist Muzafer Sherif formulated this eloquently some time ago when he stated (Sherif, 1966):

> No procedure and no technique for data collection are powerful or effective in their own right. The theory should be the *guide* for fruitful research. The techniques are powerful tools for data collection, if – *and only if* – they are appropriate in terms of the nature and characteristics of the *problem*. And significant *problems* can be formulated only after gaining substantial familiarity with the universe of discourse, and not before.[1]

This quote very much reflects De Groot's empirical circle, also from around that time (De Groot, 1961). The empirical circle describes (the) five successive stages of empirical research: observation, induction, deduction, testing and evaluation. In particular, theory formation, i.e. induction, precedes the formulation and testing of hypotheses (deduction) and evaluation of their predictive power. Nonetheless, all this is grounded in observation, at least initially, and in abundant reality checks, that make up empiricism.

The quest for the understanding of safety culture that fuelled this book was primarily steered by the empirical cycle of De Groot. A second important point of departure was offered by Edgar Schein. Schein envisions organisational culture as consisting of a core of basic assumptions, surrounded by

1 Sherif has this passage precede with "*No model, no theoretical scheme is 'right' or 'correct' in its own right, no matter how much fun it is nor how intellectually intriguing*".

layers of espoused values and artefacts. Whereas the latter two can be more-or-less easily observed, the core cannot and should be 'deciphered' from its outer two layers (e.g. Schein, 1992, 1999). Although empiricism is still on board here, data are thoroughly (re)processed to arrive at something that is really meaningful with regard to the culture studied.[2] Culture conceived as a layered concept can also be found with other scholars (e.g. Hofstede, 1991; Peters & Waterman, 1982; Sanders & Neuijen, 1987; Trompenaars & Hampden-Turner, 1997) but the notion of 'espoused values' is found exclusively with Schein (and with Argyris & Schön, 1996, as espoused theories). Moreover, most scholars also put forward an implicit and covert core that defines the essence of a culture. Because this core is taken to be covert also for its beholders, it is no use to ask them directly about it.[3] Actually, it only reveals itself to its beholder by comparison – by comparison with another, contrasting culture, that is. Because a culture is supposed to be shared amongst a group of people, staying within this group therefore does not reveal its identity to its members. However, according to Schein, trying to change a particular organisational culture can also bring it more to the surface, although the members might not experience it as such (Schein, 1992, p. 22 ff., rather speaks of anxiety).

Concepts such as espoused values and a covert core cast doubt upon the accuracy of all statements that beholders of that core make about it. This includes spoken statements ('We mostly are …', 'We always have …', 'We continuously do …', etc.) and various official claims e.g. in policy docuemnts but also responses on questionnaires, i.e. attitudes. Moreover, only after a deciphering process might the 'true' meaning behind the espoused values possibly be revealed. This can be done by an outsider, although Schein also provides a procedure for self-analysis, but again, supervised by an outsider (ibid., pp. 147 ff.). Below, the status of the outcome from a cultural analysis will be discussed further.

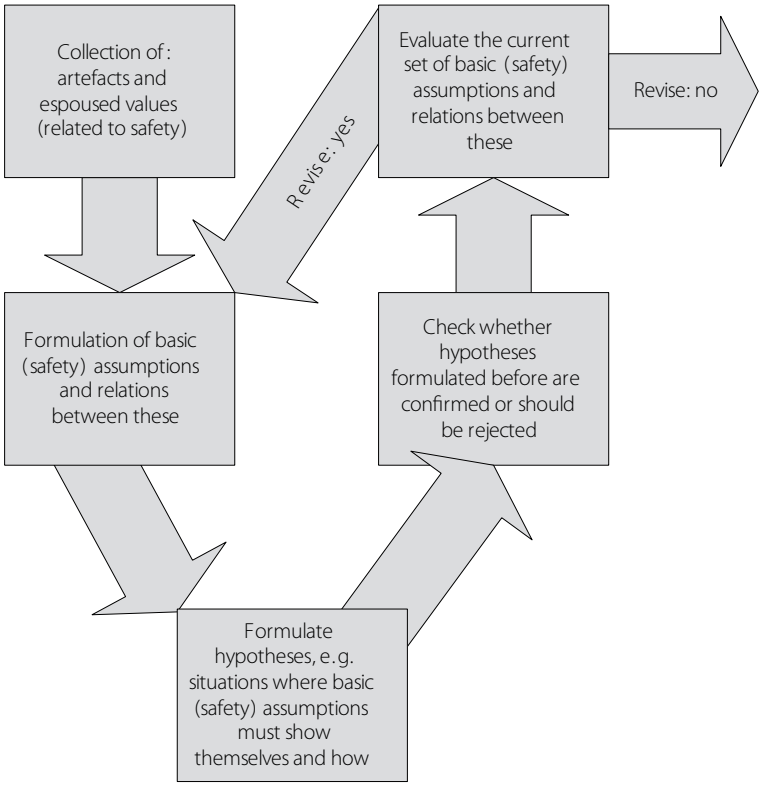
So, the model put forward by Schein – observable artefacts, recordable espoused values and implicit basic assumptions – is a descriptive model, which gives structure to a particular research process, as the empirical cycle does. One could therefore say that, by using Schein's model, one develops a *theory* about an organisation's culture. By going through the empirical cycle several times, basic assumptions are deciphered and refined until a particular point of saturation is reached (Fig. 1); that is, when:

2 Because research findings about cultures are often a complex admixture of empirical data and the researcher's interpretation of these, the link between final outcome and raw data is not always immediately apparent.

3 By beholders are meant those members of a culture that share particular basic assumptions, or, to quote Hofstede (1980), that share particular 'mental software'.

1. Adding more data stops adding any analytical value (saturation);
2. The basic assumptions are shown to be shared amongst a (relevant) group of people (essential element of culture);
3. It is possible to approach the research question or issue satisfactorily with the current set of basic assumptions (usefulness).

Figure 1 Generic model for safety culture research



By applying Schein's model of organisational culture – that is, by collecting artefacts and espoused values – and passing through the empirical cycle until saturation is reached, a theory of an organisational culture is formulated. So far, so good. However, the following question might then arise: What is exactly the status of this theory? Is it considered to be 'universal', independent of the researcher who formulated it, or is it the product of a particular researcher, meaning that it will probably turn out differently when another person carries out the research? Or is it the specific researcher-organisation pair that determines the status? Although Schein does not address this question explicitly, he seems to suggest that the basic assumptions he derives are quite definite and

indisputable. Evidently, the quest for understanding safety culture will inevitably bring up the classic controversy between positivism and constructivism, although this is not often acknowledged as such.

An important assumption that runs through this collection of papers is the notion that the study of culture – any culture, for that matter – should be non-judgemental, i.e. value free.[4] This notion echoes the idea of cultural relativism; that is, cultures cannot be really judged from the outside; a notion which is important to many sociologists and anthropologists. Additionally, the belief is expressed here that cultures are a product of both trial-and-error and survival, so the assumptions that make up the core of a culture actually show how a group has adapted itself to its changing environment.[5] A problem with the notion of cultural relativism in combination with safety is that the latter is not value free. If some culture harbours unsafety this is undesirable. Various scholars have dealt with this issue by trying to formulate either 'a safety culture' – a kind of safety heaven that you either have or have not (e.g. International Safety Advisory Group (INSAG-4), 1991; Reason, 1997) – or a developmental hierarchy, describing several stages of increasing 'safety culture' (Lardner, Fleming, & Joyner, 2001; Parker, Lawrie, & Hudson, 2006; Westrum, 1991). Whether the last stage is attainable or not primarily depends on the beliefs of the particular researcher.

It is especially this element of 'value' that makes the marriage of safety and culture an unhappy, but nevertheless prolific one, at least for me. Combining something value-free with something judgmental has proved to be challenging. Arguing from the culture side, measures meant to improve safety should adapt to local cultural circumstances. Working from the safety side, local circumstances should be adapted to safety. However, a third notion can also be put forward: changing some circumstances and showing repeatedly that these are beneficial for safety will probably – according to dissonance theory – result in cultural adaptation. This solution both runs with the hare and hunts with the hounds, in that a local culture is respected as it is but safety measures are nevertheless taken. The latter points are discussed extensively in the papers comprising Chapters 5 and 3, respectively.

4 When claims of universality and objectivity are being made, it will be next to impossible to be also judgemental; nevertheless, a researcher might have a certain *preference*. E.g. in his book, Schein contrasts two organisational cultures – Multi and Action (1992). One cannot, however, escape from the notion that he prefers 'Action' over 'Multi'.

5 Overall, cultures are shaped through a process of adaptation (Schein, 1992). However, at least two comments are relevant. Firstly, although cultures can be considered functional, particular functions can wear out over time and become dysfunctional. One example is the famous 'monkey experiment' where five caged monkeys stop reaching for a banana because they are hosed down each time they make an attempt (read further at: http://publicorgtheory.org/2007/07/01/why-think-about-organizations/). Secondly, some adaptations can be considered maladaptations, in that they ultimately limit and even damage the performance of a group significantly (e.g. because of a leader who is a sociopath).

Hence, the two approaches discussed so far – De Groot's empirical cycle and the multi-layered model of culture by Schein – do not provide the full means with which a safety culture can or should be understood and used to improve safety. Various additional assumptions have to be made to make the approach 'workable'. None of the papers in this book actually goes as far as this: making suggestions to improve safety. Here, safety culture research is taken as a goal in itself, although the research method advocated in Chapter 3, i.e. participative inquiry, aims at finding effective and practical solutions. Hence, the scope of the papers is limited to understanding and exploring a culture, not changing or adapting to it. This discussion finally brings us to the two research questions that will be – hopefully – answered by digesting the six papers constituting this book.

1. How can – or, possibly, even should – safety culture be understood?
2. How can this understanding of safety culture be grasped and explored?

These research questions are answered within the boundaries described above: (1) adhering to the interpretation of culture by Schein following the empirical cycle of De Groot; (2) culture, in principle, as a value-free and interpretive concept that can be deciphered through a thorough data-processing procedure; (3) the essence of culture lies deeply hidden and (partly) unconscious within its beholders. Another assumption buried in this set of papers, is the notion that (4) safety culture is a useful concept to explore. In other words, this book will not decide on the validity of the safety culture concept itself. As is discussed in Chapter 3 *The safety culture research process*, safety culture research is ideally carried out in close participation with the client company – i.e. such research is not conducted *about* or *on* but together *with* the company – because researcher and client company are able to define a common framework that is meaningful for both of them. In the absence of such a common framework, any results might be poorly understood and therefore subsequently be ignored. When both parties agree on the problem and approach, embark on the study together, and base their diagnosis on collective findings, the willingness to work with these results will be obviously higher. Although such an approach might be limited by a certain bounded rationality defined by a consortium with mutual dependency, this is more than compensated by a higher degree of recognition and willingness to work with the results. This is not a proven statement, but rather a working hypothesis.

And what about the falsification of the culture model itself? Is it possible to reject the two-layer/ single core model in favour of another model? To start with, this model can both deal with congruence (artefacts and espoused values both reflect the covert core) and incongruence (artefacts and espoused values are both *not* expressions of the core). Moreover, Martin (2002; Salzer-Morling, 2003) has already distinguished between integration, differentiation and fragmentation views. In short, the integration view holds that there is only one (substantial) organisational culture, whereas the differentiation view supports

the idea of more subcultures within one organisation. The fragmentation view stresses the continuous sense-making organisational members have to engage in, which overshadows any permanence they might achieve together. An integrative culture concept has already been challenged by different scholars. However, in the current book, notes from both the integration and differentiation views can be overheard. While sense-making is an important aspect of organisational life, it would not make much sense to conduct culture research solely from this point of view.[6] Furthermore, the two-layer/ single core model remains unchallenged in this book, as it is also a convenient means to organise culture related data (see Chapter 3, Fig. 2).

What follows are six papers, each preceded by a short preamble and, if updating or discussion of new insights is required, by an afterword. In the preamble the rationale for the subsequent paper is discussed. The six papers generally follow the empirical cycle although not all papers touch all five bases equally extensively. As it is, using the empirical cycle to research *a particular culture*, as depicted in Fig. 1, versus using the empirical cycle to explore *the concept of culture* are not exactly the same thing. Given the two guiding questions posed above, it is apparent that the book will dwell considerably longer on the more theoretical bases than the more empirical ones. Moreover, given the complexity of the culture concept, no one empirical study can either reject or affirm the concept's status, only a culmination of multiple studies might be able to do this. Therefore, the focus is on the review and discussion of current studies and recent developments.

The series of papers starts with a review of the organisational/ safety culture and climate field (Chapter 1; published in *Safety Science*, 2000); this could be equated with the induction step of the empirical cycle. The next step, that of deduction/ operationalisation, is covered by two chapters. Firstly, the focus is placed on a particular operationalisation of safety culture, namely safety climate, through questionnaires (Chapter 2; published in *Safety Science*, 2007). Thereafter, a more general approach towards safety culture research is deliberated using the initial steps of research before actual data collection (Chapter 3; written specially for the book). In Chapter 4 (published in *Journal of Occupational Health and Safety – Australia and New Zealand*, 2008) an actual case study is reported using various tools from the safety culture toolbox, discussed in the previous chapter. Although not a true trial, this chapter is meant to represent the test base of the empirical cycle. Finally, the next two chapters are devoted to the evaluation of the safety culture concept. In Chapter 5 (submitted) this is done in light of the general concept of culture and how this has been applied in the field of

6 Although sense-making and culture are both important concepts in understanding what is going on in organisations, the latter might be understood, for some part, as a result of the former. That is, (some) basic assumptions could be considered the implicit result of sense-making at the group level. This assessment follows from an important function of culture, namely continuity (e.g. Van Hoewijk, 1988). If the process of sense-making would remain unresolved at the group level, continuity might be jeopardised.

safety. In the final Chapter 6 (written specially for the book), various views on safety culture (assessment) are brought together and presented, not so much as incompatible but rather as overlapping and complementary.

If there is one message to be gleaned from this set of papers, perhaps it is that safety culture is very much what a particular researcher wants to make of it. Doing this conscientiously and consistently will then be the most important challenge. Applying multiple techniques to gather data is generally the best advice. Carrying this out in close collaboration with a client company (as in participatory inquiry) is probably the best approach.

References

Argyris, C., & Schön, D. (1996). *Organizational learning II: theory, method and practice*. Reading, Mass.: Addison Wesley.

De Groot, A. (1961). *Methodology: foundations for research and thinking in the behavioural sciences (in Dutch)*. Den Haag: Mouton.

Hofstede, G. R. (1980). *Culture's consequences*. London: Sage Publications.

Hofstede, G. R. (1991). *Cultures and organisations: software of the mind*. London: McGraw-Hill.

International Nuclear Safety Advisory Group. (1986). *Summary Report on the Post-Accident Review Meeting on the Chernobyl Accident* (No. 75-INSAG-1, Safety Series). Vienna: IAEA.

International Safety Advisory Group (INSAG-4). (1991). *Safety culture* (No. 75-INSAG-4, Safety Series). Vienna: International Atomic Energy Agency.

Lardner, R., Fleming, M., & Joyner, P. (2001). Towards a mature safety culture. *IChemE Symposium Series, 148*, 635-642.

Martin, J. (2002). *Organizational culture: mapping the terrain*. Thousand Oaks, CA: Sage Publications Inc.

Parker, D., Lawrie, M., & Hudson, P. T. W. (2006). A framework for understanding the development of organisational safety culture. *Safety Science, 44*(6), 551-562.

Peters, T. J., & Waterman, R. H., Jr. (1982). *In search of excellence. Lessons from America's best-run companies*. New York: Harper & Row.

Reason, J. T. (1997). *Managing the risks of organizational accidents*. Aldershot: Ashgate.

Salzer-Morling, M. (2003). Cultivating culture: Mats Alvesson, Organisationskultur och ledning, Liber förlag, Malmö, 2001; Joanne Martin, Organizational Culture: Mapping the Terrain, Sage, London, 2002; Martin Parker, Organizational Culture and Identity, Sage, Thousand Oaks, 2000. *Scandinavian Journal of Management, 19*(3), 385-392.

Sanders, G., & Neuijen, B. (1987). *Organisational culture: diagnosis and influencing (in Dutch)*. Assen: Van Gorcum.

Schein, E. H. (1992). *Organizational culture and leadership* (2nd ed.). San Francisco: Jossey-Bass.

Schein, E. H. (1999). *The corporate culture survival guide: sense and nonsense about cultural change*. San Francisco: Jossey-Bass Inc.

Sherif, M. (1966). Theoretical analysis of the individual-group relationship in a social situation. In G. DiRenzo (Ed.), *Concepts, theory, and explanation in the social sciences* (pp. 47-72). New York: Random House.

Trompenaars, F., & Hampden-Turner, C. (1997). *Riding the waves of culture: understanding cultural diversity in business* (2nd ed.). London: Nicholas Brieley Publishing Ltd.

Van Hoewijk, R. (1988). The meaning of organisational culture: an overview of the literature (in Dutch). *M&O, Tijdschrift voor Organisatiekunde en Sociaal Beleid, 1*, 4-46.

Westrum, R. (1991). Cultures with requisite imagination. In J. Wise, P. Stager & J. Hopkin (Eds.), *Verification and validation in complex man-machine systems*. New York: Springer.

Chapter 1

The nature of safety culture: a review of theory and research

Published in Safety Science, 34(1-3), 215-257, 2000

Abstract

This paper reviews the literature on safety culture and safety climate. The main emphasis is on applied research customary in the social psychological or organisational psychological traditions. Although safety culture and climate are generally acknowledged to be important concepts, not much consensus has been reached on the cause, the content and the consequences of safety culture and climate in the past 20 years. Moreover, there is an overall lack of models specifying either the relationship of both concepts with safety and risk management or with safety performance. In this paper, safety culture and climate will be differentiated according to a general framework based on work by Schein (1992) on organisational culture. This framework distinguishes three levels at which organisational culture can be studied – basic assumptions, espoused values and artefacts. At the level of espoused values we find attitudes, which are equated with safety climate. The basic assumptions, however, form the core of the culture. It is argued that these basic assumptions do not have to be specifically about safety, although it is considered a good sign if they are. It is concluded that safety climate might be considered an alternative safety performance indicator and that research should focus on its scientific validity. More important, however, is the assessment of an organisation's basic assumptions, since these are assumed to be explanatory to its attitudes.

The nature of safety culture: a review of theory and research

1 Introduction

In the last two decades empirical research on safety climate and safety culture has developed considerably but, unfortunately, theory has not been through a similar progression. Although most of the research reported is conducted according to the familiar routines of social scientific – especially social and organisational psychological – research, little consensus has been reached on the different aspects, commonly associated with a concept within this scientific discipline. For instance, while the importance of the concept of safety climate or culture is stressed by most authors, very few have attempted to support their claim by reporting an indication of its construct validity or predictive validity. Most efforts have not progressed beyond the stage of face validity. Basically, this means that the concept still has not advanced beyond its first developmental stages.

The present paper reviews the research on safety climate and safety culture. It will try to separate out different schools of thought and views. Special attention will be given to the presence of a theoretical model in an approach, because it is thought that such a model, however simple it may be, should be the start of any scientific enterprise. Most of the papers that have been considered for this review are listed in Table 1. While not an exhaustive list, it is thought that it is representative of this research field. Research on culture in general and organisational culture in particular has been of interest not only to social, personnel and organisational psychologists but also to sociologists, anthropologists and political scientists. The main emphasis here, however, is on applied research in the social psychological or organisational psychological traditions. One important assumption associated with these traditions is that a large group of organisational cultures can be described with a limited number of dimensions. Such dimensions are usually sought through large, organisation-wide questionnaire surveys with the ultimate purpose of description or diagnosis and – possibly – intervention. It is acknowledged that this is not the whole story, though. Therefore, some other approaches and views are also discussed.

No review of safety climate or safety culture is complete without a summary of those aspects of the discussion on organisational culture and climate, that are relevant for the present review. These aspects will be reviewed first. Next, the different definitions given for safety climate and safety culture are discussed.

As will be shown, most authors aim at the same concept but differ on what this concept might encompass, i.e. their operationalisations of the concept differ. As a matter of course this leads to a discussion of the dimensionality of the concept and the causal model underlying it. Unfortunately, not many authors have put forward a theoretical model that can be tested and – ultimately – be falsified. A reflection on the important issue of level of aggregation will round off this part of the review. Thereupon, a framework will be outlined that integrates the review findings.

Table 1 Overview of the sources, causal models and goals of safety culture and climate researches

Author(s)	Source	Causal model	Goal
Zohar (1980)	Literature review of characteristics that differentiate between high vs. low accident-rate companies	Based on a variety of cues present in their work environment, employees develop coherent sets of perceptions and expectations regarding behaviour-outcome contingencies and behave accordingly	1. Describe a particular type of organizational climate 2. Examine its implications
Glennon (1982)	A review of the organisational climate literature and safety management literature	Organisational climate can be viewed as a bridge between formal organisational characteristics and individual behaviour. [...] The effects of the characteristics are mediated through the perceptions and beliefs of significant individuals and groups amongst management and employees	Put a handle on the within-company variables that constitute the necessary safety climate in which desired behaviours for hazard reduction and elimination are fostered
Brown & Holmes (1986)	Zohar (1980)	It is acknowledged that no single study can establish causal relationships ("chicken-egg position")	1. Replicate Zohar's factor structure 2. Establish valid factor structure 3. Explore differences in climate perceptions between pre- and post-traumatic employees
Lutness, J. (1987)	Self developed	Not explicitly stated	1. Revealing a safety program's strengths and weaknesses 2. Find solutions to the problems unearthed 3. Establish benchmarks for a safety program 4. Define safety trends
Cox & Cox (1991)	Framework by Purdham (1984)	Not explicitly stated	Study was set up as the first part of a programme to further develop safety culture as part of one means of improving on the company's [...] safety culture
Dedobbeleer and Béland (1991)	Brown & Holmes (1986)	Not explicitly stated	Test of Brown & Holmes 3-factor model

Author(s)	Source	Causal model	Goal
Ostrom, Wilhelmsen & Kaplan (1993)	Self developed	Improve overall level of safety	1. Discussion of the concept of safety culture 2. Presenting an survey instrument developed to assess the safety cultures of organisations 3. Discussing how the results of the survey instrument can be used to improve safety culture
Safety Research Unit (1993)	Facet theoretic approach (a.o. Zohar)	The climate of an organisation represents the context in which behaviour occurs and the basis of people's expectations; it provides a frame of reference to guide behaviour (cf. Zohar)	1. Produce a relatively short question set for measuring attitudes 2. Identify the basic constituents of safety attitude and to develop scales from them to demonstrate their relationship to safety performance 3. Examine empirically the relationship between attitudes and safety performance in the chemical industry
Cooper & Philips (1994)	Zohar (1980)	Not explicitly stated	1. Replicate Zohar's factorial structure 2. Ascertain if the factor structure is replicated in a post-test 3. Assess any changes in the perceptions of safety climate that may have occurred as a result of a goal-setting and feedback intervention
Niskanen (1994)	Review of safety climate literature	Safety climate provides a link between attributes occurring at the individual (workers and supervisors) level and the organisational level and may be induced by the policies and practices that organisations impose upon their workers and supervisors	1. Develop an approach to safety climate 2. Explore differences in safety climate perceptions 3. Develop new and supplemental perspectives for safety performance
Geller (1994)	Engineering (i.e. equipment design) and psychology (i.e. behavioural and social sciences)	ABC-model (A = Activator, B = Behaviour and C = Consequence)	"A safety professional's ultimate goal is to achieve a total safety culture" (p. 18).

Author(s)	Source	Causal model	Goal
Coyle, Sleeman & Adams (1995)	Nominal group technique to determine the relative importance of health & safety issues + Zohar (1980) & Glennon (1982)	As safety climate factors are a representation of the employees' perception of their work environment, their identification indicates these areas where employees feel analysis and/or change may be necessary	Assess whether an analysis of two highly similar organisations would identify the same sets of similar factors
Berends (1996)	Literature review, interviews and clustering of its results	Safety culture shapes the employees' safety behaviour	1. Develop an alternative measure for safety performance 2. Identify strengths and weaknesses 3. Assess effectivity of safety programs 4. Assess the opportunities and threats for the implementation of a new safety management tool 5. Reveal differences in perceptions between shop floor workers and management
Lee (1996)	Based on the outcome of discussions of five focus groups	Organisations with a positive safety culture are characterised by communications founded on mutual trust, by shared perception of the importance of safety and by confidence in the efficacy of preventive measures (cf. ACSNI)	1. To identify those aspects of the safety culture that are in need of improvement 2. To comprehend the underlying order and structure of safety cultures and their dynamic links with other organic variables, such as management style
Cabrera, Isla & Vilela (1997)	Zohar (1980) + additions	Safety climate is considered to produce a "collective schema of meaning", that is thought to have a stronger impact on behaviour than safety policies	1. The development of a series of evaluation measures for training programs aimed at improving safety levels at airport ramps 2. Evaluate the relationship between safety climate with safety level and safe behaviours 3. Evaluate the influences of various personal and organisational factors on attitude and safety
Williamson, Feyer, Cairns & Biancotti (1997)	Literature review for aspects, Cox & Cox (1991) and Dedobbeleer & Béland (1991)	Safety climate is thought to predict the way employees behave with respect to safety in a workplace	To develop a measure of perception and attitudes about safety as an indicator of safety culture for use with working populations

2 Organisational culture and climate

The concepts of organisational culture and climate gained much attention in the 1970s and 1980s. Clearly, the appeal of such integrative 'umbrella' concepts, especially for managers, is great. The prospect of obtaining an overall helicopter view of one's organisation is indeed attractive. However, because of the fact that these concepts are so global and abstract, they can also run the risk of becoming virtually meaningless.

The literature on, as well as the concept of, organisational culture and/or climate has already been reviewed and discussed (e.g. James & Jones, 1974; Schneider, 1975; Glick, 1985; Van Hoewijk, 1988; Schein, 1992). As will become clear, several points emanating from these discussions are equally relevant for the present review of safety culture and climate.

Before defining safety culture and climate, the distinction between culture and climate has to be resolved, i.e. whether it is useful to make such a distinction and if so, why that distinction should be made – or if not, why not.

2.1 Organisational climate versus culture

In the 1970s, much research was undertaken under the title of organisational climate, which naturally also resulted in several debates on the concept (e.g. James & Jones, 1974; Jones & James, 1979; Glick, 1985; De Cock et al., 1986). Gradually, during the 1980s, the term culture replaced the term climate, in this type of research. Hence, the development of these concepts has been successive rather than in parallel. Below, a short summary of this development will be given.

Jones and James (1979, p. 205) talk about climate which they describe 'as a set of perceptually based, psychological attributes'. To separate climate from job-related attitudes and satisfaction 'the *descriptive* and *cognitive* nature of psychological climate' is stressed and contrasted with the affective and evaluative aspects of attitudes. They nevertheless conclude that between the two concepts a 'dynamic interrelationship' might be assumed. This distinction between descriptive and affective attributes is brought up by Schneider (1975) in terms of 'perceptions of organizational practices' and 'reactions to those same practices and procedures' (p. 464) respectively, although he acknowledges that it is quite difficult to distinguish the two.

Ekvall (1983) emphatically distinguishes organisational climate from culture. He divides an organisation's social system into (1) organisational culture, i.e. beliefs and values about people, work, the organisation and the community that are shared by most members within the organisation; (2) social structure, i.e. especially the informal organisation; (3) organisational climate, i.e. common characteristics of behaviour and expression of feelings by organisational members; and (4) work relations, i.e. especially the nature of the relationship between management and employees. Ekvall argues that all four segments are mutually related but distinguishable.

Glick (1985) considers the distinction in terms of applied methodology, particularly because the two concepts stem from different disciplines. He argues that research on organisational climate developed primarily from a social psychological framework, while culture is rooted firmly in anthropology. Evidently, both disciplines contribute different research paradigms, the former a more quantitative approach while the latter uses mainly qualitative techniques to study its research objects. Moreover, research on culture is much more focused on the dynamic processes at work in an organisational culture, continuously creating and shaping it. In addition, Glick considers culture research as succeeding climate research. Although initially distinguishing climate from culture Glick (ibid., p. 612) concludes that '[t]he minor substantive differences between culture and climate may prove to be more apparent than real.'

Van Hoewijk (1988, p. 9) describes organisational climate as a term comprising 'several correlating views, habits and the atmosphere' but the concept of organisational culture remains undefined although several convergent and divergent views from various authors are given.

One of the most renowned scholars in the field of, especially national, culture research is Hofstede. He narrows organisational climate down to job satisfaction and to something that is typically the concern of lower and middle management. Organisational culture is considered to be top-management's business (Hofstede, 1986).

De Cock et al. (1986) attempt to distinguish organisational climate from culture. They argue that organisations are characterised by a coherence of numerous processes. Organisational climate then, is the perception of this coherence by all the members. On the other hand, organisational culture is the underlying meaning given to this coherence, which forms a pattern of significance and values.

Schein (1992) conceives of climate as preceding culture, i.e. climate is culture in the making. Further on, Schein writes that 'climate will be a reflection and manifestation of cultural assumptions' (p. 230). Climate is replaced by culture and culture then conveys a broader and more profound meaning.

So initially, the term organisational climate might have signified the broad construct envisioned by researchers but, successively, it has been restricted to attitudinal or 'psychological' phenomena within an organisation, which is how it was initially operationalised. Climate was replaced by the term culture, which nowadays has this comprehensive meaning formerly covered by the term climate.

On the other hand, within the field of safety culture and safety climate research, both terms are still notably in use. Berends (1995a, 1996) considers culture simply a replacement of climate. Other authors, however, restrict themselves to the term safety climate and consider this to be the 'psychological' or attitudinal climate with regard to safety within an organisation (e.g. Donald & Canter, 1994; Niskanen, 1994).

For the present the following can be concluded. The term organisational climate was coined to refer to a global, integrating concept underlying most organisational events and processes. Nowadays, this concept is referred to by the term organisational culture whereas the term organisational climate has come to mean more and more the overt manifestation of culture within an organisation. Therefore, climate follows naturally from culture, or put another way, organisational culture expresses itself through organisational climate.

This is also clear from the way in which both concepts are currently operationalised and assessed – assuming of course, that the particular researcher still distinguishes the two. Organisational climate is commonly conceived of as a distinct configuration with limited dimensionality surveyed through self-administered questionnaires. Such measures are, up to a certain point, objective and semi-quantitative. Organisational culture is often determined phenomenologically, i.e. through observations and interviews, through trial-and-error, mutual comparison and the like. Such measures are regarded as qualitative and thus difficult to quantify.

Portrayed this way, organisational climate assessment shows a lot of similarity with attitude measurement. Attitudes are conceptually defined as 'a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor'. Within this definition, evaluating refers to 'all classes of evaluative responding, whether overt or covert, cognitive, affective, or behavioral' (Eagly & Chaiken, 1993; p. 1). An organisational climate then, would be defined or given by the aggregated attitudes of its members.[1]

Amongst attitude theorists it is commonly assumed that beliefs[2] are in some sense the building blocks of attitudes (Eagly & Chaiken, 1993). Projecting this assumption on the current discussion of organisational culture and climate, certain strong organisational beliefs could be associated with organisational culture. Or, put in another way, certain beliefs – or better still – dogmas or convictions form the core that is associated with organisational culture.

Similarly, this distinction can be applied to safety culture and safety climate, with the latter denoting attitudes to safety within an organisation and safety culture being the strong convictions or dogmas underlying safety attitudes. These latter beliefs do not have to be specifically about safety, but underlie all organisation's attitudes.

1 Please note that the current conception of attitudes is much broader than, for instance, in the 1970s. At that time, attitudes were considered to be primarily affective, not cognitive. This led Jones and James (1979) to distinguish between cognitive and affective processes and descriptive and evaluative responses as descriptors of organisational climate and job-satisfaction, respectively. Presently, both affective and cognitive processes and responses are considered to underlie attitudes (Eagly & Chaiken, 1993).

2 'Mental assent to or acceptance of a proposition, statement, or fact, as true, on the ground of authority or evidence.' (The Shorter Oxford English Dictionary, 3rd ed., 1959).

2.2 *Characteristics of organisational culture and climate*

Now that culture and climate have been distinguished, the most important findings and the lessons learned from the research on organisational culture and climate are summarised, which are considered relevant for the present review. Organisational culture has been given the following characteristics (needless to say, most of these characteristics equally apply to climate):

1. It is a *construct* (e.g. Guion, 1973; James, 1982; Berends, 1996). Basically this means that culture is an abstract concept rather than a concrete phenomenon. This characteristic already sets the stage for significant disagreement, because it allows the researcher considerable degrees of freedom to both define and operationalise culture. When operationalising a construct it is generally assumed that there are several variables that covary or fit together to form an unified whole (see also 3).
2. It is relatively *stable*. De Cock et al. (1986) have found a period of stability of at least five years for organisational culture.
3. It has *multiple dimensionality* (e.g. Guion, 1985; Jones & James, 1979). Again, this characteristic is the cause of many differences between researchers. Because dimensions are nearly always composites, comprised of several variables, the labelling of a dimension becomes very much a personal matter, reflecting both a common denominator and the researcher looking for it. Clearly, a pre-defined model might guide a researcher here. Additionally, as Jones and James (1979) assert, there might exist both a 'central core of dimensions' as well as specific dimensions applying to some particular situation. The extent to which this is true, or that particular cultural manifestations are simply local variants of a central core is still open to investigation.
4. It is something that is *shared* by (groups of) people (e.g. De Cock et al., 1986; Hofstede, 1986; Schein, 1992). Culture is something that is mutual and reciprocal. Consequently, it is *holistic* (e.g. Hofstede, 1991) or refers to *molar* perceptions (Schneider, 1975). Culture is a synergistic aggregate composed of several parts. Some would argue that it is a whole that is more than the sum of its parts. This attribute, however, highlights the fact that not only those constituting parts of culture have to be defined, but also the composition rule which binds them all together (cf. Glick, 1985). Others (e.g. De Cock et al, 1986) consider culture to be an integrative concept, contributing to a helicopter vision that management craves for. This characteristic is the basis for assuming multiple cultures within a large organisation in that such an organisation can be divided into divisions, departments, units etc. that will all have developed their own culture. De Cock et al. (1986, p. 6-7) mention 6 levels: national culture, corporate culture, organisational culture, departmental culture, group culture and psychological climate. More fundamental, however, is the consideration of distinguishing cultures and making statements about these differences. Again, this characteristic draws attention to the question of what makes up a culture. Schein (1992, p.

14) argues '[...] behavioral regularity should not, therefore, be the basis for defining culture'. And, 'when we observe behavioral regularities [at a particular instance], we do not know whether we are dealing with a cultural manifestation'. By making this initial exception for behaviour, Schein wants to prevent 'behavioral regularities' elicited by situational characteristics being considered manifestations of culture. The issue of what constitutes a group should not be overlooked. For instance, a common awareness or understanding between a few people cannot be considered a manifestation of a sub-culture. This is also what Schein is aiming at above. With regard to groups Schein stresses the importance of stable membership, common history, shared learning and leadership. This issue will be taken up later, when the topic of aggregation is discussed.

5. It consists of *various aspects*; this means that several, different cultures or climates can be distinguished within an organisation, e.g. a 'service climate' (Schneider, 1975), a 'creative climate' or 'innovative climate' (Ekvall, 1983) or a safety culture. These distinctions have only been made for analytical or practical reasons to narrow the concept and thus make it more tangible.
6. It constitutes *practices*; this characteristic is supplied by Hofstede (1991). He discusses organisational culture primarily in relation to national culture. Hofstede, but other authors as well, conceives cultures as having multiple layers,[3] not unlike the layers of an onion. At each of these levels, culture has its manifestations which can be studied separately. Hofstede locates norms and values at the central core. His next layer consists of rituals, the following layer of heroes whilst the outer layer consists of symbols. In considering organisations, only the last three layers – rituals, heroes and symbols – are relevant, according to Hofstede. He calls these three layers 'practices' in contrast to the norms and values of the core. These practices are more easily changed than the norms and values while the more outward a layer is situated, the more superficial it is. Norms and values are learned during childhood through parental upbringing and schooling and remain relatively stable during the rest of our lives. This characteristic also implies that culture is *learned*. However obvious, this fact offers a major justification for contemporary culture research in that it explains the quest for culture's influences, ingredients and consequences. We wish to influence and change it.

3 These layers should not be confused with the dimensions mentioned above.

Table 2 Levels of culture

Author	Central core	Layer 1	Layer 2	Layer 3
Deal & Kennedy	values	heroes	rites and rituals	communication network
Hofstede	values	rituals	heroes	symbols
Sanders & Nuijen	values and principles	rituals	heroes	symbols
Schein	basic underlying assumptions	espoused values	artefacts	
Van Hoewijk	fixed convictions	norms and values	myths, heroes, symbols, stories	codes of conduct, rituals, procedures

Although authors are relatively consensual about the general ordering of the layers, there is considerable disagreement about what the different layers might encompass (Table 2). Schein (1992) is careful in interpreting the meaning of the outer layers, which is reflected in his phrasing, i.e. *espoused* values and *artefacts*, hereby clearly indicating that what is seen and heard is not always a true expression of culture. Schein is therefore very reluctant to count behaviour as a cultural expression *per se*. He also removes values from the core, which he replaces with basic assumptions. Hence, what seems to be the core of most authors' onions, is spread over two layers in Schein's.[4] Any other manifestation of culture is, for him, an artefact whereas the other authors make several distinctions within those artefacts.

7. It is *functional*; this attribute is discussed by Schneider (1975) but is also implied by Hofstede (1991) and Schein (1992). Culture – probably climate also (Safety Research Unit, 1993) – is functional in the sense that it supplies a frame of reference for behaviour. Schein (1992) considers culture to be the product of adaptive (or external) and integrative (or internal) processes of a group, steered by its leader. A simple and well-known definition of (organisational) culture reads 'The way we do things around here' which effectively captures this functional aspect.

Overall, organisational culture is a relatively stable, multidimensional, holistic construct shared by (groups of) organisational members that supplies a frame of reference and which gives meaning to and/or is typically revealed in certain practices.

4 It is stressed again that Hofstede's onion is based on his research into national cultures. With regard to the basic assumptions of organisations, the norms and values that distinguish national cultures are obviously far more substantial. I therefore agree with Hofstede that Schein's basic assumptions are less 'basic' than national norms and values. However, I also agree with Schein that within organisations certain beliefs are more pervasive than Hofstede's practices.

2.3 The conceptualisation of organisational culture and climate

Organisational culture and climate are complex concepts. Guion (1973) declares, '[t]he concept of organizational climate is undoubtedly important, but it also seems to be one of the fuzziest concepts to come along in some time' (p. 121). Glick (1985) actually talks about a 'conceptual morass' (p. 601) and states that '[organisational] climate is a generic term referring to a class of dimensions that many have argued is so broad and diverse as to make the concept useless' (p. 605). Douglas (cited in De Cock et al., 1986) writes: 'Culture is a blank space, a highly respected, empty pigeonhole'. Schein states in the preface of his 1992 book (p. xi): 'The concept [of organisational culture] is hard to define, hard to analyze and measure, and hard to manage'. He also mentions the following uses of the term organisational culture (p. 8 ff.): *'observed behavioral regularities when people interact (language, customs and traditions, rituals), group norms, espoused values, formal philosophy, rules of the game, climate, embedded skills, habits of thinking/mental models/linguistic paradigms, shared meanings and 'root' metaphors or integrating symbols'*, to illustrate the fact that behind the term culture a lot of different meanings are hiding.

Organisational climate was studied initially as a causal factor influencing job performance and satisfaction (e.g. Friedlander & Margulies, 1969; Payne & Pheysey, 1971) and was established through the measurement of individual perceptions of attributes of that climate. In his 'note', Guion (1973) wonders whether climate actually refers to attributes of organisations or attributes of people. To identify genuinely objective organisational attributes he proposes to present all members with statements about such attributes that can be answered by a simple yes or no. The truly descriptive attributes will all have a very high frequency of endorsement. This confusion about whether organisational climate is an organisational attribute or an individual attribute made James and Jones (1974) suggest a distinction between organisational climate (organisational attribute) and psychological climate (individual attribute).

Dieterly and Schneider (1974) conceive organisational climate as intermediate, 'locationary perceptions [...] which help individuals to 'fix' or locate themselves in their larger environment prior to behaving' (p. 317). More authors have stressed the function of organisational climate or culture as a frame of reference for the members of the organisation that directs behaviour (e.g. Safety Reseach Unit, 1993; Schneider, 1975). Consequently, members' behaviour within the organisation becomes more predictable which possibly also reduces anxiety (Van Hoewijk, 1988). In like manner, culture functions as a defence mechanism (Schein, 1992) creating both stability and continuity within the organisation (Van Hoewijk, 1988). Accordingly, organisational culture not only functions as a conceptual umbrella but also as a 'real' umbrella, shielding from the precipitation of the unknown or the unwanted.

Overall, researchers do not disagree on the general function of organisational culture or climate as a patterning concept providing a coherent structure to

organisational life or certain parts thereof. However, there is no real consensus on how to describe the climate or culture of an organisation, i.e. what is its basic structure, how can it be typified and how should it be determined? This leaves one to wonder why it is so difficult to obtain that consensus.

Firstly, it might be that issues relating to the causes and effects of organisational culture have become intertwined. This relates to the layers of culture mentioned earlier. It is postulated that the core is explanatory for the outer layers. When these layers are confused, one mixes causes with effects, independent variables with dependent.[5] However, the layered concept of culture introduced above, gives the possibility to distinguish climate from culture in terms of these layers. Culture then, would be best associated with the core or Schein's 'basic assumptions'. The next layer would be culture's primary manifestation or climate.

Secondly, there seems to exist a certain tension between the holistic characteristic of culture and climate and the reductionistic approach of most researchers. Researchers from sociology or a (social) psychological research tradition are inclined to assume that a given culture or climate can be described by a limited number of dimensions. The research objective becomes to uncover that structure, which is usually accomplished by a questionnaire survey. The structure of the culture or climate follows then from analysis of results. Obviously, other approaches are conceivable but also other ways of representing culture. For instance, there is the unresolved debate of whether an organisation *has* a culture or *is* a culture. Furthermore, it is possible to depict culture as a separate entity within an organisation – usually existing beside organisational structure and processes – or as an aspect system, permeating the whole of the organisation (e.g. Frissen, 1986). Moreover, it is of major significance whether one considers organisational culture a collection of – observable – practices (e.g. Hofstede, 1991), a finite set of – conscious – attitudes (e.g. Jones & James, 1979) or a small amount of – unconscious – basic assumptions (e.g. Schein, 1992). Clearly, such diverging views will result in different research questions, paradigms, methods and outcomes.

Thirdly, there is the issue of the level of aggregation. Several authors have tried to shed some light on this aspect of organisational culture (e.g. Guion, 1973; James & Jones, 1974; Jones & James, 1979). It is questioned to what extent individual measures can be used to say something about organisational levels higher than the individual one. Clearly, this is an issue of great importance because very often aggregated individual measures, from questionnaire surveys for instance, are used to say something about the full organisation or certain parts thereof. Or, as Jones and James (1979) state in their study of US Navy enlisted personnel on various ships: '[...] aggregations of such data carry the potential for erroneous inference' (p. 205). Especially so, when 'perceptions are combined across groups

5 It is acknowledged that this is a rather theoretical distinction which might be hard to substantiate in practice where such relationships are more interactive and dynamic.

of increasingly heterogeneous context or structure' (p. 207). Their study enabled them to aggregate their measures – obtained at individual and higher levels – to organisationally meaningful groups or units like ship, division and department. Aggregation to represent ship-wide or departmental-wide conditions did not appear warranted but aggregation to divisional or functional level – like Navigation, Maintenance and Radio Communication – did. Such studies show that seemingly obvious aggregational levels within organisations might not be so homogenous in practice.

Other authors (e.g. Guion, 1973; James, 1982; Glick, 1985) have tried to define criteria for the degree of homogeneity that justifies aggregation. Guion (1973, p. 124) proposes a highly significant amount of agreement or disagreement within the organisation studied on a set of dichotomous questions. Both Glick (1985, p. 607 ff.) and James (1982, p. 221 ff.) propose other indices like η^2 and modifications thereof, which are supplied by one-way analysis of variance (ANOVA) designs. Overall, the level of aggregation and 'aggregation bias' (James, 1982, p. 225) are important methodological issues that merit serious attention and that could be the cause of some of the problems encountered in organisational culture and climate research.

Some of these issues will be taken up again when research on safety culture and safety climate is discussed. This discussion will be conducted under the following headings: definition of safety culture and climate, dimensionality of both constructs, models underlying these constructs, level of aggregation and the nature of safety culture.

3 Safety climate and safety culture

The earliest located paper on safety climate is Keenan et al. (1951). This study was based on introspective ratings from primary individuals in an automotive plant. Successively, theory and research paradigms have improved but not to the extent that a comprehensive theory on safety culture exists, nor that a measurement approach has been developed that has unanimous preference.

3.1 Definition

Although fairly easily given – usually it is just one line – the definition of a hypothetical construct sets the stage for ensuing research, i.e. it is the basis for hypotheses, research paradigms and interpretations of the findings. It demarcates the boundaries of the concept and focuses the research.

Definitions can be explicit or implicit, the latter leaving much more room for interpretations. Definitions of safety culture and climate are listed in Table 3.

Table 3 Definitions of safety climate and safety culture

Author(s)	Definition of safety culture/climate
Zohar (1980)	A summary of molar perceptions that employees share about their work environments (safety climate)
Glennon (1982)	Employees' perceptions of the many characteristics of their organisation that have a direct impact upon their behaviour to reduce or eliminate danger (safety climate) and, Safety climate is a special kind of organisational climate
Brown & Holmes (1986)	A set of perceptions or beliefs held by an individual and/or group about a particular entity (safety climate)
Lutness (1987)	Not explicitly stated (safety climate)
Cox & Cox (1991)	Safety cultures reflect the attitudes, beliefs, perceptions, and values that employees share in relation to safety (safety culture)
Dedobbeleer & Béland (1991)	Molar perceptions people have of their work settings (safety climate)
International Nuclear Safety Advisory Group (1991)	Safety culture is that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance (safety culture)
Pidgeon (1991)	The set of beliefs, norms, attitudes, roles, and social and technical practices that are concerned with minimising the exposure of employees, managers, customers and members of the public to conditions considered dangerous or injurious (safety culture)
Ostrom et al. (1993)	The concept that the organisation's beliefs and attitudes, manifested in actions, policies, and procedures, affects its safety performance (safety culture)
Safety Research Unit (1993)	Not explicitly stated (safety climate)
Cooper & Philips (1994)	Safety climate is concerned with the shared perceptions and beliefs that workers hold regarding safety in their work place (safety climate)
Geller (1994)	In a total safety culture (TSC), everyone feels responsible for safety and pursues it on a daily basis (safety culture)
Niskanen (1994)	Safety climate refers to a set of attributes that can be perceived about particular work organisations and which may be induced by the policies and practices that those organisations impose upon their workers and supervisors (safety climate)
Coyle et al. (1995)	The objective measurement of attitudes and perceptions toward occupational health and safety issues (safety climate)
Berends (1996)	The collective mental programming towards safety of a group of organisation members (safety culture)
Lee (1996)	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, and organisation's health and safety management (ACSNI) (safety culture)
Cabrera et al. (1997)	The shared perceptions of organisational members about their work environment and, more precisely, about their organisational safety policies (safety climate)
Williamson et al. (1997)	Safety climate is a summary concept describing the safety ethic in an organisation or workplace which is reflected in employees' beliefs about safety (safety climate)

Most definitions are very global and therefore highly implicit. The ACSNI (1993) definition – employed by Lee – is the most explicit, outlining most of the assumed contents of safety culture. Of the sixteen definitions given above, nine are about safety climate and seven about safety culture. Nine mention organisation member's perceptions whereas six definitions (also) refer to beliefs and six (also) to attitudes. Five of these are about safety culture. Roughly, perceptions are more associated with climate whereas attitudes are considered to be a part of culture.

The holistic as well as the shared aspect of culture and climate are stressed in most definitions with terms like 'molar' (Zohar, 1980; Dedobbeleer & Béland, 1991), 'shared' (Cox & Cox, 1991; Cooper & Philips, 1994; Cabrera et al., 1997), 'summary' (Williamson et al., 1997), 'group' (Brown & Holmes, 1986; Berends, 1995a, b, 1996; Lee, 1996), 'set' (Pidgeon, 1991), 'assembly' (International Nuclear Safety Advisory Group, 1991), 'employees' perceptions' or 'organisation's beliefs and attitudes' (Glennon, 1982a, b; Ostrom et al., 1993).

The object of these perceptions, beliefs or attitudes are often identified with 'work environments' (Zohar, 1980; Dedobbeleer & Béland, 1991; Cabrera et al., 1997) or simply specified with 'safety' (Cox & Cox, 1991; Cooper & Philips, 1994; Berends, 1995a, b, 1996; Coyle et al., 1995; Williamson et al., 1997). Sometimes also, these objects are more complex like 'organisational characteristics' (Glennon, 1982a, b), 'actions, policies, and procedures' (Ostrom et al., 1993) or, equivalently, 'organisational safety policies' (Cabrera et al., 1997) and even more abstract like 'entity' (Brown & Holmes, 1986) or 'attributes' (Niskanen, 1994).

The characteristics 'construct' and 'dimensionality' of culture and climate described in 2.2 are either implicit (Cox & Cox, 1991; Ostrom et al., 1993; Cooper & Philips, 1994; Coyle et al., 1995; Williamson et al., 1997) or explicit (Glennon, 1982a, b; Brown & Holmes, 1986; Niskanen, 1994; Lee, 1996) in most definitions.

The effect of climate or culture on the organisation and its members is sometimes stated as well (Glennon, 1982a, b; Ostrom et al., 1993; Cooper & Philips, 1994; Geller, 1994; Pidgeon, 1991; Lee, 1996).

To the extent that the particular definition has focused research, Table 1 might yield an answer. Under the heading 'Goal' in Table 1 the goals defined explicitly by the researchers are summarised. Most researchers have formulated quite practical goals, although the objectives of some (Brown & Holmes, 1986; Dedobbeleer & Béland, 1991; Niskanen, 1994; Coyle at al., 1995) also have a more theoretical flavour which might betray the absence of a particular assignment from a company. Hence, most researchers have executed their research with regard to certain questions posed to them by one, or more, companies or institutions, which has given their research a particular focus – e.g. implications of some safety climate or culture (Zohar, 1980; Safety Research Unit, 1993; Lee, 1997; Cabrera et al., 1997), indicator of safety climate or culture (Ostrom et al., 1993; Niskanen, 1994; Berends, 1995a, b, 1996; Williamson et al., 1997) or development of a method for improvement (Glennon, 1982a, b; Lutness, 1987; Cox &

Cox, 1991; Ostrom et al., 1993; Cooper & Philips, 1994; Lee, 1996). None of the researchers, however, seems to have a pre-defined target population in mind. In Table 4 the surveyed populations are enumerated; as can be seen from Table 4 both homogeneous and heterogeneous populations with various types of occupations are used in these studies.

In summary, most researchers have defined either safety climate or safety culture in their publications as well as why they want to explore it. These definitions contain some or most of the characteristics defined earlier. The purpose of these studies is often quite practical, although theoretical motives are also put forward. The accent on either perceptions, beliefs or attitudes as well as one or another aggregate (e.g. 'molar', 'group', 'summary') suggests a self-administered questionnaire research paradigm. Table 4 shows that this is by far the most common approach. Ludborzs (1995) and Kennedy (1997) have opted for alternative approaches, i.e. an audit and a SCHAZOP (Safety Culture HAZOP) respectively. These latter approaches are discussed below.

Table 4 Overview of the amount of questions, surveyed population and dimensions of safety culture and climate researches

Author(s)	# questions/ instrument	population	Type of analysis	Climate / culture dimensions
Zohar (1980)	40, questionnaire is administered during interview	20 Israelian industrial organisations (steel, food processing, chemical and textile industry); 400 respondents	exploratory	Importance of safety training programs Management attitudes towards safety Effects of safe conduct on promotion Level of risk at work place Effects of required work pace on safety Status of safety officer Effects of safe conduct on social status Status of safety committee
Glennon (1982)	68, self-administered questionnaire (SAQ)	Line managers from eight Australian companies (bauxite, mining, sawmilling and logging metal refining, petroleum refining, cement manufacture and general engineering and manufacturing); 198 respondents	no formal testing	Perceived influence of safety and health legislation Perceived corporate attitude to safety and health Perceived organizational status of safety advisory officer Perceived importance of safety and health training Perceived effectiveness of encouragement (vs. discipline) in promoting safety Perceived effect of departmental/section safety record on promotion Perceived risk level of workplaces Perceived status of safety targets relative to production pressures
Brown & Holmes (1986)	40, SAQ	10 American manufacturing and produce companies; 425 respondents	confirmatory	Employee perception of how concerned management is with their well-being Employee perception of how active management is in responding to this concern Employee physical risk perception
Cox & Cox (1991)	18 (+ 4), SAQ	Employees of an European company involved in the production and distribution of industrial gasses; a total of 630 respondents	exploratory	Personal scepticism Individual responsibility Safeness of work environment Effectiveness of arrangements for safety Personal immunity

Author(s)	# questions/ instrument	population	Type of analysis	Climate / culture dimensions
Dedobbeleer and Béland (1991)	9, SAQ	9 construction sites; 272 respondents	confirmatory	Management's commitment to safety Worker's involvement in safety
Ostrom, Wilhelmsen & Kaplan (1993)	88, SAQ	Employees of the Department of Energy in Idaho and its eight contractors; ± 4000 administered	no formal testing	Safety awareness Teamwork Pride and commitment Excellence Honesty Communications Leadership and supervision Innovation Training Customer relations Procedure compliance Safety Effectiveness Facilities
SRU (1993)	65, SAQ	Workers from steel and chemical industries; a total of 1475 respondents	exploratory	Management/supervisor satisfaction (M1) Management/supervisor knowledge (M2) Management/supervisor encouragement and support (M3) Management/supervisor enforcement (M4) Personal management contact (M5) Management support: meetings (M6) Shopfloor satisfaction (A) Shopfloor environment: hardware (B) Work group support/encouragement (C) Shopfloor training (D) Global self safety (E) Meetings (F) Safe working procedures (G) Safety information (H) Safety representatives: practice (SR1) Safety representatives: authority (SR2)

Author(s)	# questions/ instrument	population	Type of analysis	Climate / culture dimensions
Cooper & Philips (1994)	50, SAQ	Personnel of a packaging production plant; 374 (pre) and 187 (post) respondents	exploratory	Management attitudes towards safety Perceived level of risk Effects of work pace Management actions towards safety Status of safety officer and committee Importance of safety training Social status of safety and promotion
Niskanen (1994)	22 (workers) and 21 (supervisors), SAQ	Workers and management in maintenance, construction and central repair shops; 1890 (workers) and 562 (supervisors) respondents	exploratory	Workers: Attitude towards safety in the organisation Changes in work demands Appreciation of the work Safety as part of productive work Supervisors: Changes in job demands Attitude towards safety within the organisation Value of the work Safety as part of productive work
Geller (1994)	-	-	-	Person; i.e. knowledge, skills, abilities, intelligence, motives, personality Behaviour; i.e. complying, coaching, recognising, communicating, demonstrating actively caring Environment; i.e. equipment, tools, machines, housekeeping, heat/cold, engineering

Author(s)	# questions/ instrument	population	Type of analysis	Climate / culture dimensions
Coyle, Sleeman & Adams (1995)	30 (organisation 1) and 32 (organisation 2)	Workforce of two organisations 'involved in the provision of health care and social services to the elderly' (incl. office, nursing and social work duties); 340 (org. 1) respectively 540 (org. 2) respondents	exploratory	Organisation 1: Maintenance and management issues Company policy Accountability Training and management issues Work environment Policy / procedures Personal authority Organisation 2: Work environment Personal authority Training and enforcement of policy
Berends (1996)	34, SAQ	Three industrial organisations (two chemical process industries and one steel company); a total of 434 respondents	exploratory	*Confidence* in the arrangements for safety *Compliance* with safe working practices Perceived *priority* given to safety Own *active effort* put in safety matters *Communication* about safety

Author(s)	# questions/ instrument	population	Type of analysis	Climate / culture dimensions
Lee (1996)	172, SAQ	Employees at British nuclear industry site; 5295 respondents	exploratory	Safety procedures: Confidence in the safety procedures Safety rules: Personal understanding of safety rules Perceived clarity of safety rules Permit to work system: Confidence in effectiveness of PTW General support for PTW Perceived need for PTW Risks: Personal caution over risks Perceived level of risk at work Perceived control of risks in the plant Personal interest in job Job satisfaction: Contentment with job Satisfaction with work relationships Satisfaction with rewards for good work Participation/ownership: Self-participation in safety procedures Perceived source of safety suggestions Perceived source of safety actions Perceived personal control over safety Design: Satisfaction with design of plant Training: Satisfaction with training Selection: Satisfaction with staff suitability

Author(s)	# questions/ instrument	population	Type of analysis	Climate / culture dimensions
Cabrera, Isla & Vilela (1997)	69, SAQ	Employees of several companies at three European airports (ground handling divisions from 4 airlines, one fuel company, two airport authorities); totalling 389 respondents	exploratory	Organisational empasis on safety Communication channel about safety Safety level perceived on the job Feedback performance on safety Specific strategies of accident prevention
Williamson, Feyer, Cairns & Biancotti (1997)	67, SAQ	7 workplaces, covering heavy and light industry and outdoor workers, totalling 660 responses	exploratory	Personal motivation for safety Positive safety practice Risk justification Fatalism Optimism

This particular operationalisation, i.e. a self-administered questionnaire, generally follows a characteristic path of development. First, one demarcates the particular area of interest, which is then thoroughly investigated, mostly through a literature survey. This usually results in the identification of aspects relevant for the area of interest. Given the fact that most researchers focus on beliefs, perceptions and attitudes, these relevant aspects are then the objects of those mental processes. With regard to these aspects, questions are formulated, which are then pre-tested in a pilot study on a relevant population. If the pilot study goes satisfactorily, the questionnaire can be distributed amongst the target population. The results of this survey are then subjected to certain standard analysis methods like factor analysis (FA) or principal components analysis (PCA) (Tatsuoka & Lohnes, 1988; Tabachnick & Fidell, 1989), where linear relations between the questions or variables are assumed, or techniques like HOMALS or PRINCALS (Van de Geer, 1993a, b) where such linearity is not assumed. These analyses result in factors, principal components or dimensions, which are the subject of the next section.

As can be garnered from the column labelled 'Source' in Table 1, this is the approach followed by most researchers, i.e. many start the whole process from scratch again, although the 1980 Zohar study has inspired some researchers in more (Brown & Holmes, 1986; Cooper & Philips, 1994) or less profound ways (Dedobbeleer & Béland, 1991; Safety Research Unit, 1993; Coyle et al., 1995; Cabrera et al., 1997; Williamson et al., 1997). The results of these and more investigations are reviewed next.

3.2 *Dimensionality*

Commonly, social scientific constructs are multi-dimensional. For instance, a construct like intelligence might not only show in the performance on particular arithmetic tests but also on visuo-spatial tasks or on certain language exercises. The range of activities which are shown to be influenced might even become so large that the construct is subdivided into separate types like arithmetic intelligence or social intelligence. This is not only true for social scientific artefacts but applies to the physical world as well. For instance, any object's colour can be described along the three dimensions of the primary colours red, yellow and blue.

Culture and climate have been characterised above as multi-dimensional. Analysis techniques such as FA, PCA, PRINCALS and HOMALS produce such dimensions when they are used for analysing survey results. These dimensions are the result of inter- and intra-respondent tendencies to evaluate certain questions in a similar way. Such tendencies are called correlations, i.e. when two questions are answered overall in a similar way, it is said that these questions correlate. It is assumed then, that these questions have a certain relationship, for instance because they refer to a similar object. This relationship might be obvious but this does not have to be the case. For instance, Hofstede per-

formed a secondary data analysis on information collected amongst employees at IBM, originally collected to determine their attitudes (Hofstede, 1991, p. 251). With these data, however, he was able to produce his famous 4-D model. And Schuman and Presser (1981, p. 153 ff.) describe a correlation between evaluations of economic policy and a non-existing law, which they can only explain with an overall (lack of) confidence expressed in the government.

In Table 4 results from the analyses performed on the survey results are summarised. At first sight, there is not much correspondence between the researches reported. For one, this is because the researcher has considerable freedom to label her or his dimensions. Obviously, most researchers did not have the need to connect to previous research in terms of their dimensions.[6] Moreover, the number of dimensions found differs enormously. These range from two (Dedobbeleer & Béland, 1991) to sixteen (Safety Reseach Unit, 1993) or even 19 (Lee, 1996, when taken literally).

Although this latter finding might seem striking, a few explanations can be put forward to explain these results. As can be seen from Table 4 the surveys were carried out in different organisations, ranging from industry (Zohar, 1980; Glennon, 1982a, b; Brown & Holmes, 1986; Cox & Cox, 1991; Cooper & Philips, 1994; Safety Research Unit, 1993; Berends, 1995a, b, 1996; Williamson et al., 1997) to construction (Dedobbeleer & Béland, 1991; Niskanen, 1994) to energy (Ostrom et al., 1993; Lee, 1996) to airports (Cabrera et al., 1997) and to health care and service (Coyle et al., 1995). Obviously, employees within these organisations have quite different objects for their attitudes. Additionally, what is distinguished by some is considered similar by others, obviously resulting in less complex attitude structures, i.e. fewer dimensions (Eagly & Chaiken, 1993, p. 89 ff.).[7] Cox and Flin (1998) argue that instruments developed in one domain (oil) may not generalise to others (construction). Interestingly, even an attempt aimed at replicating a previously found factor structure in a similar kind of organisation failed (Coyle et al., 1995).

However, additional methodological issues might be important here. For instance, the techniques commonly used – FA or PCA (Tatsuoka & Lohnes, 1988; Tabachnick & Fidell, 1989) – are never questioned for their applicability. The appropriateness of FA or PCA could be questioned with regard to the assumed measurement level of the data. Although for questionnaire data the interval level of measurement is usually assumed, this assumption might not be appropriate and could result theoretically in dimensions which are not actually there. Only the Safety Research Unit applies a different technique called

6 Interestingly, most studies reviewed here are exploratory. Only the research reported by Brown and Holmes (1986) and Dedobbeleer and Béland (1991) are confirmatory studies (Table 4). Both studies failed to confirm factor structures that had been found previously.

7 For instance, at the shop floor 'management' might be everybody in the office building whereas in the offices people might have a more nuanced view of 'management'.

Smallest Space Analysis (SSA; Guttman, 1968). Although this technique uses a mathematical transformation comparable to the other techniques – namely singular value decomposition or SVD (Green & Carroll, 1978) – the final approach is quite different. Hence, the dimensions of the Safety Research Unit in Table 4 are not dimensions in the sense that the others are, they are more appropriately referred to as scales to avoid confusion.

When a FA or PCA has been performed, the final solution is often rotated to facilitate interpretation (e.g. Tabachnick & Fidell, 1989). This rotation is nearly always orthogonal, meaning that the initial solution of uncorrelated dimensions is preserved. However, this does not have to be the case; the attitude objects reflected in the dimensions might be unrelated in the analysis but do not have to be so in reality. It should be pointed out that the methodological points made above, are mere theoretical considerations. However, in most of the papers reviewed the methodological argumentation – if it is discussed at all – is not particularly strong, which is why these considerations are made here.

There is another interesting discussion related to the issue of methodology. Research by Kerlinger (cited in Eagly & Chaiken, 1993) has shown that certain dimensions are not bipolar but unipolar. For instance a dimension like 'political orientation' does not have 'conservatism' and 'liberalism' at its outer poles but is instead split into two dimensions, one denoting 'conservatism' and the other 'liberalism'. Kerlinger found that conservatists are not so much opposed to the ideals of liberalism but rather indifferent to these ideals (Eagly & Chaiken, 1993, p. 98). This important distinction has been observed by others as well (e.g. Van Schuur & Kiers, 1994).

In addition, the level of aggregation might play an important part here too. De Cock et al. (1986) argue that the organisational level at which the study is directed and about which statements will be made should be consistent with the instructions and the questioning. With regard to the studies reviewed it is not clear whether this is always the case. The level of aggregation will be discussed later in Section 3.4.

Despite these methodological considerations, a renaming and grouping exercise might yield some solace as well. That is, one could define a small set of common denominators to classify comparable dimensions under. For instance, all dimensions reflecting safety efforts of management could be classified as Management's Safety Activity. Clearly, when the dimensions found in safety culture and climate research are renamed according to this common classification system, the total amount of dimensions will reduce significantly. Moreover, when the number of times a dimension is found is also taken into account, it will become obvious that certain dimensions are mentioned more often than others are. Such an index might serve as an indication of importance or ubiquitousness.

In summary, a lot of different dimensions have been found to underlie safety culture and climate. Some methodological arguments have been supplied to explain this abundance and to suggest alternative methodological approaches

for application in future research on safety culture and climate. In addition, when many of these dimensions are relabelled their number is significantly reduced and may also yield some insight into the relative importance or ubiquitousness of these dimensions. Additional research and/or secondary data analysis is needed to substantiate these methodological issues and to shed more light on their significance, their consequences and possible solutions.

Deciding on the number of dimensions and their labelling is often facilitated when a model has been used to prepare the questions. The next section reviews the models used for safety culture and climate.

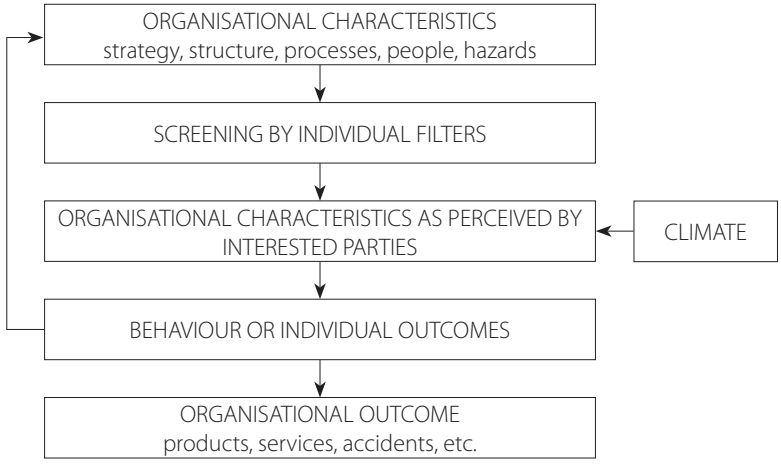
3.3 *Causal model*

The element missing in many publications on safety culture is an explicit, theoretical model outlining the manner in which safety culture is thought to be embedded in the whole of an organisation's practices and system structure – Table 1 reveals this under the heading 'Causal model'. Ideally, this model should be about the *cause*, the *content* and the *consequence* of safety culture or climate.

In general, it is possible to distinguish two types of models: (1) normative or prescriptive models, which seek to describe and specify safety climate or culture *per se* and (2) descriptive or empirical models, which attempt to summarise findings from one or several organisations studied.

The first actual model of safety climate functioning was put forward by Glennon (1982a, b). In effect, this normative model outlines the cause, content and consequences of safety climate, although in a very global way (Fig. 1).

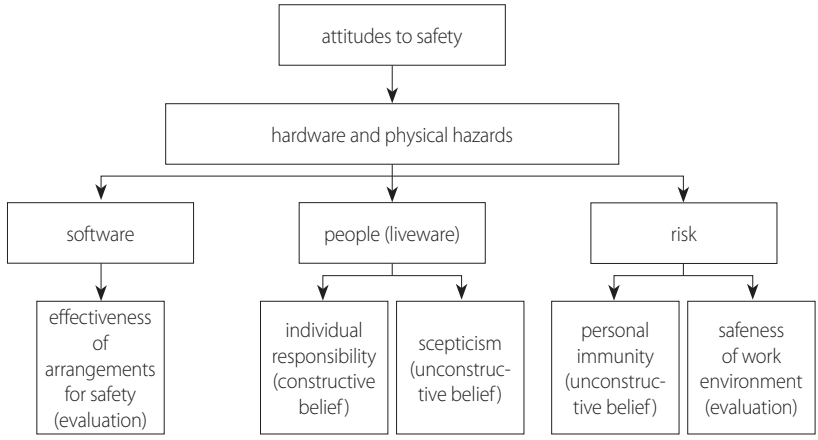
Figure 1 Glennon's (1982a,b) model of organisational climate functioning



Glennon operationalises safety climate as the perception of organisational reality, which seems to suggest a kind of attitude measurement, but only partly because perceptions are not identical with attitudes.

Cox and Cox (1991) based their model on work done by Purdham (1984; cited in Cox & Cox, 1991). This model (Fig. 2) appears to be descriptive and the accompanying factor structure is given in Table 4. In this study, safety culture is primarily discussed in the context of attitudes towards safety and their objects, i.e. what has been defined as safety climate above. The model distinguishes several attitude objects – hardware, software, people/liveware and risks. The attitudes towards hardware and physical hazards though, were not incorporated in their study and it is also not clear how it is thought that they affect the other attitudes.

Figure 2 Cox and Cox's (1991) suggested architecture of attitudes towards safety



Cox and Cox's model is not worked out well, but the idea seems to be that the major attitudes to safety within an organisation are directed at four categories of objects:

1. hardware, i.e. safety hardware and physical hazards;
2. software, i.e. rules and procedures, legislation, safety management and policy;
3. people/liveware, i.e. all classes of people involved like workers, supervisors, management, safety committees, specialists, authorities, unions;
4. risks, i.e. risky behaviour and its regulation.

When talking about attitudes to safety, the objects of these attitudes could always be classified within one of these four major categories.

The model underlying the approach taken by the Safety Research Unit (1993) is established in the 'mapping sentence'. The mapping sentence contains all the

aspects or 'facets' considered relevant for the issue under study (Shye et al., 1994, for details on facet theory). Consequently, the starting point of facet theory is normative although the facet structure is used to generate a questionnaire. Subsequent analyses, however, will eventuate in a descriptive result.

Table 5 Facets in the SRU study (1993)

People	Attitude behaviour	Locus	Activity	Context	Operating conditions
1 self	1 knows about	1 your job in particular	1 passive	1 preparations	1 normal
2 supervisor	2 is satisfied with	2 safety in general	2 active	2 actions	2 maintenance
3 manager	3 carries out			3 checks/ revisions	3 special
4 workmates					

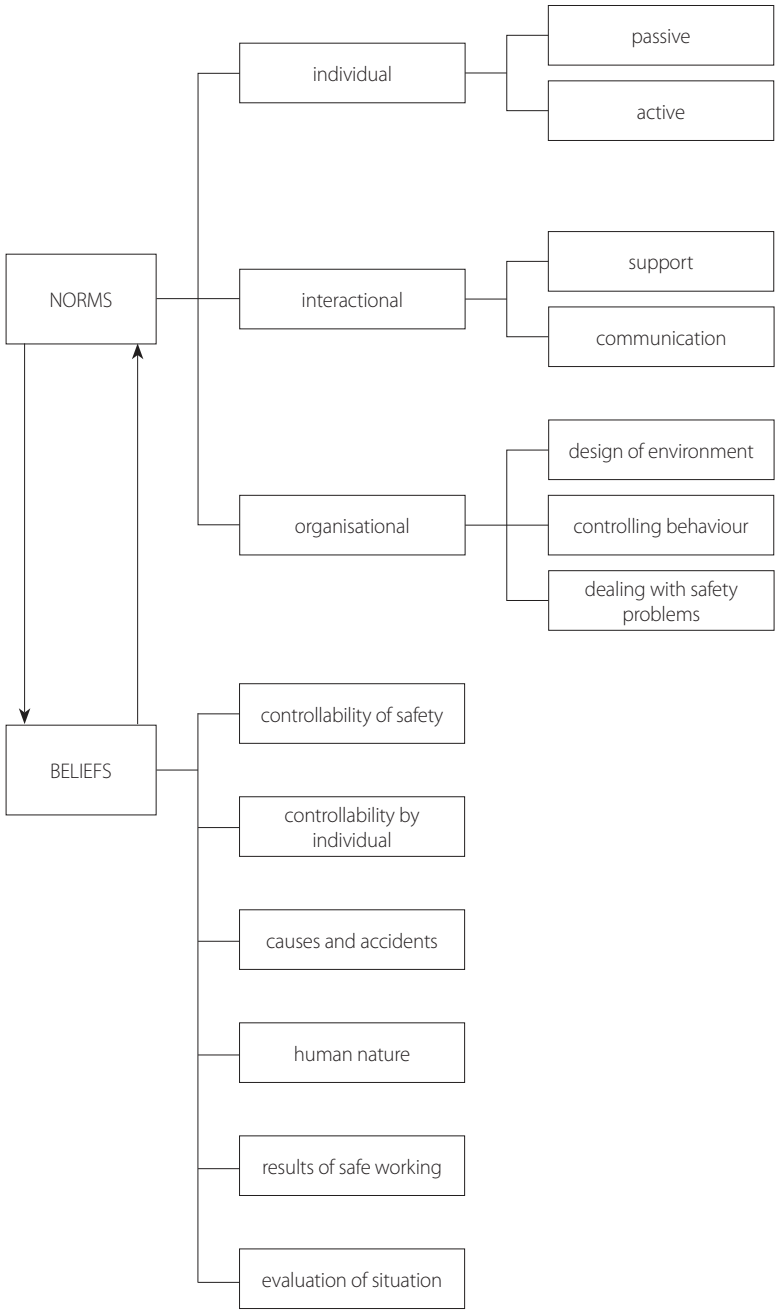
The actual mapping sentence has the following form:

> *The extent to which respondent (x) reports that {People} {Attitude behaviour} {Locus} {Activity} {Context} under {Operating conditions} → {very much ... not at all}.*

where the bracketed words are particular slots for the facets mentioned in Table 5. Based on this mapping sentence some 432 (4×3×2×2×3×3) questions can be generated, which can be evaluated by respondents on a seven-point very much/not at all response scale. Their study resulted in a 16-scale solution, arrived at through SSA (Guttman, 1968). SSA is not so much aimed at an orthogonal *solution* in a low dimensional Cartesian space as, for instance is, FA or PCA, but more at some *configuration* in a low dimensional space (see Borg, 1981, for examples of these configurations). As already remarked, the scales from this study are therefore not dimensions and if they are, they are oblique, which means that they are correlated. In this way, the Safety Research Unit identifies a few major categories around which safety attitudes are formed.

The formulation of the model put forward by Berends (1995b) started with open, unstructured interviews – not unlike free association – with personnel at several companies around the issue of safety. Recurring themes or statements from the interviews were grouped by several independent judges into categories. Their corresponding categories formed the building blocks for the final model. In this model, two broad classes of statements underlie all other categories; norms and beliefs. Norms are subdivided into individual, interactional and organisational norms.

Figure 3 Berends' (1995b) safety culture model



These categories are broken down again into several sub-categories. Beliefs on the other hand, are immediately broken down into sub-categories (Fig. 3). The remarks and statements collected in each of the sub-categories are thereupon reworked into questions.

In a subsequent survey the model was only partly verified. The FA yielded mostly norm-factors while the beliefs-factors were not confirmed in this study. Factors resulting from this study are shown in Table 4.

A truly normative – or better still – prescriptive model of safety culture is put forward by Geller (1994). Geller distinguishes three 'dynamic and interactive factors' (p. 18-19):

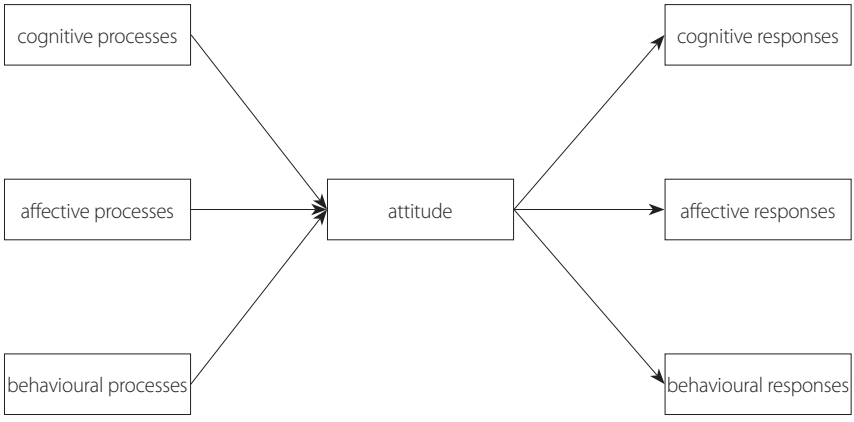
1. person, i.e. knowledge, skills, abilities, intelligence, motives, personality
2. behaviour, i.e. complying, coaching, recognising, communicating, demonstrating actively caring
3. environment, i.e. equipment, tools, machines, housekeeping, heat/cold, engineering.

Moreover, he puts forward 10 principles that form the foundation for a total safety culture. Through 'five processes or intervention domains' these principles should be implemented. Basically, Geller applies principles of behaviourism and social learning theory to the field of safety. The relationship between all the components of his model is not defined nor are they prioritised.

Despite the obviously different approaches, several similarities could be pointed out. For instance, especially both the Cox and Cox and the Safety Research Unit studies focus on attitudes but also the studies by Berends and Geller yield attitude objects.

This is an appropriate place to say something about attitudes and attitude research in general. Attitudes were defined above as 'a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor' (Eagly & Chaiken, 1993, p. 1).

Figure 4 Simple attitude model (Eagly and Chaiken, 1993)



In Fig. 4 the processes preceding and the responses resulting from attitudes are depicted (adapted from Eagly & Chaiken, 1993). With regard to attitudes, it is theoretically possible to separate antecedents from consequences, although both may be of the same order. Perceptions and beliefs are only one process or result within this model, namely a cognitive one. Hence, neither perceptions nor beliefs are attitudes.

Attitudes are always directed at an object, i.e. the entity in the definition above. This entity could be virtually anything, as long as it is somehow discriminable, e.g. abstract objects like policies or safety; concrete objects like personal protective equipment or fire extinguishers; behaviours like risk taking or rule violations. Most of the models described above suggest such attitude objects. For instance all models include a people category. Using Cox and Cox's categories of attitude objects – i.e. hardware, software, people and risks – it would be possible to link Berends' and Geller's models but not the model put forward by the Safety Research Unit.

Interestingly, the demarcation between norms and beliefs in Berends' model could be traced back to the distinction made earlier between descriptive and affective statements about organisational climate, although in his model this distinction is not worked out this way. Another way of looking at this distinction would be in Schein's terms of levels of culture, where the category defined as norms would pertain to 'espoused values' and the beliefs category then would correspond to his 'basic assumptions'. Measuring norms – i.e. 'espoused values' – through a self-administered questionnaire would be feasible according to Schein, but trying to measure beliefs in this way – i.e. 'basic assumptions' – would be bound to fail, which is exactly what happened in Berends' study.

All in all, the models on safety culture are unsatisfactory to the extent that they do not embody a causal chain but rather specify some broad categories of interest and tentative relationships between those. In my proposed terminology, at best they are about the *content* of safety climate, i.e. the objects of safety attitudes.

However, this is not to say that the issue is not also addressed elsewhere. For instance, the domino model underlying the International Safety Rating System (version V) positions the measurement of safety attitudes – i.e. safety climate – in front of safety audits. Within this model, safety attitudes are the primary cause underlying all incidents. From the domain of risk analysis a model has been put forward that represents safety culture, along with other aspects, as an all-pervading influence (Tuli & Apostolakis, 1996). Nevertheless, safety culture itself is still isolated and 'uncaused'. With regard to these last two models it could be said that they are normative models that focus on the *consequences* of safety culture.

Also, in the field of safety management researchers have reflected on safety culture. Reason (1997) spends a full chapter on safety culture – its components and engineering – as do Hale and Hovden (1998), who deliberate safety culture in considerable detail. However, a discussion of these views is considered

beyond the scope of this paper. Nevertheless, it should be noted that the concept of safety culture has raised the interest of researchers in many related fields. Additional approaches of interest are reviewed in Section 3.5.

In conclusion, at present there is no overall satisfying model of safety climate or safety culture. However, throughout the paper several building blocks for such a model have been indicated. For instance, a distinction was made between culture and climate, which was associated with the layered model by Schein (1992). Climate was equated with espoused values, which were thereupon identified as attitudes. As a result, an organisation's safety climate is made up of its members' safety attitudes. Also, the objects of attitudes were mentioned. Following the current line of reasoning these would make up the content of safety climate, while safety culture could be denoted as their cause. Finally, safety climate's consequences would be the evaluative responses, whether cognitive, affective or behavioural. In Schein's terminology these would be called 'artefacts'.

3.4 Level of aggregation

In the above discussion of organisational culture and climate, it was indicated that the level of aggregation is an important point for reflection. Therefore, it is somewhat surprising that this point has not been given due attention in safety culture and climate research. For instance, when talking about the objects of attitudes one can seriously question whether these objects remain the same at different organisational levels. That is, it is at least doubtful that the attitude objects of individuals are the same as those for groups or organisations. Hence, when aggregating individual data to the level of an organisational group or unit, it is open to question whether the combined data actually correspond to an attitude object existing at that level.

Moreover, as discussed previously, at each particular level of aggregation the issue of communality arises – a certain amount of homogeneity of opinion is needed in order to be able to speak of shared attitudes or assumptions.

This is not to say that it is not possible to compare aggregated data but by aggregating data one does not necessarily get information about attitude objects pertinent at that level of aggregation. To obtain data valid at a certain level of aggregation, one should ask questions about objects pertinent at that level. In all other cases one still has data about the individual level. To ensure that their respondents consistently give answers about the whole organisation and not about the work-group De Cock et al. (1986, p. 7) included this requirement in the instructions of their questionnaire.

At first sight, these recommendations seem sensible and easy to follow. However, when working with questionnaires one is confronted with several phenomena like ambiguity, poly-interpretability, the lack of clarity of long sentences etc., which threaten the validity of the results. Obviously, giving answers to questions not about one's own personal environment but about the whole organisa-

tion requires a significant cognitive effort. It is to be expected that respondents will replace such abstract references with their personal substitutions.

As has been said earlier, this issue has not got the attention it warrants. Additional research is needed to shed more light on this issue, the severity of its consequences and possible solutions.

3.5 Other approaches

Up to now, the main focus has been on applied research conducted in the tradition of social or organisational psychology.

The Total Safety Culture (TSC) advocated by Geller (1994) is not a diagnostic or evaluative questionnaire-based approach but is actually aimed at changing the safety culture in a desired, pre-defined direction through mostly behaviour directed processes. A TSC can be developed when employees understand and accept the 10 principles outlined by Geller. This objective is accomplished by the application of five action plans. Geller does not indicate to what kind of industrial organisations his TSC applies or what kind of preconditions are necessary for successful application. It seems that it is argued that just the rigorous utilisation of the five action plans will result in a TSC.

The report on safety culture by the International Safety Advisory Group (1991) also follows a normative approach. According to them, safety culture consist of two elements, a 'necessary framework within an organisation and [...] the attitude of staff at all levels in responding to and benefiting from the framework' (p. 5) and applies to both organisations and individuals within those organisations. Establishing a safety culture means specifying demands at several levels, i.e. requirements at policy level, requirements on managers and responses of individuals. For each of these levels requirements are specified. These pertain, amongst other things, to knowledge and competence, commitment, motivation, supervision, individual awareness and responsibility. With 'framework' the International Safety Advisory Group implies 'organizational policy' and 'managerial action' (p. 2). Although attitudes are considered 'generally intangible' they have manifest outcomes and particular satisfactory indicators are provided by the International Safety Advisory Group.

The safety culture audit method outlined by Ludborzs (1995) is to a large extent comparable with the survey approach discussed extensively in this paper in that it attempts to quantify particular safety culture indicators. However, this is not attained by an extensive survey but rather through interviews with key individuals and employees and through observations, as is common practice in (safety) management audits. Through the analysis of both 'documented and lived structural organisation' and 'documented and lived operational organisation' shortcomings in implementation are assessed. The method defines ten broad areas of analysis, which are investigated by means of checklists with detailed indicators, which have to be scored separately. Safety culture is used here normatively in that it is applied exclusively to organisations with a positive assessment

for all 10 areas with above-average frequency. Varying results are considered an indication of the existence of subcultures or counter-cultures. In that case the term 'lived safety' is applied.

Ludborzs correctly recommends never to lose sight of the 'cultural superstructure' where safety culture is only part of a corporate culture, which itself is part of an industrial culture and a national culture. As a matter of fact, it is remarkable how few researchers point out this subdivision. It might be very well assumed that safety cultures not only differ between themselves, but also because of differences between industrial and national cultures. It is therefore striking that these sources of variance did not get any attention in the applied researches reported. For one thing, this is because the organisation is normally the highest level of aggregation in organisational psychological research. For another, including both industrial culture and national culture in one's investigation would complicate matters beyond what is considered practical research. Therefore, approaches other than those that have been reviewed here, are more of a theoretical and reflective nature.

The Safety Culture HAZOP by Kennedy (1997) is a modification of the Hazard and Operability Study (HAZOP), which is one of the established techniques to identify hazards in complex engineering systems. A HAZOP session – and, likewise, a SCHAZOP session – is a group-based methodology. This group consists of a chairman, a secretary and a selection of personnel knowledgeable about the safety management process being studied. Through a process of brainstorming and an ensuing, structured discussion, a safety management process – represented in diagrammatical form – is examined by means of guidewords (e.g. 'missing', 'skipped', 'mistimed') and property words (e.g. 'person', 'action', 'procedure/specification'). The result of such a session is a set of safety management area vulnerabilities. Interestingly, the method proposed by Schein (1992, p. 147 ff.) to get an initial view of a company's organisational culture is not unlike the SCHAZOP approach discussed here.

In his evaluation of the (sociological) significance of the construct Mijs (1992) views organisational culture as part of a trinity that also encompasses organisational regime and organisational structure. Organisational culture and structure as well as regime are aspect systems that can be distinguished analytically. Quite rightly, Mijs warns that one should guard against reification, in that these systems are considered actual sub-systems that can be isolated and manipulated separately. One should take account of the fact that these systems are embedded into a field of forces consisting of national culture, industrial and occupational cultures and situational factors like technology, type of labour, age of organisation and the like. These influences certainly put a limit on what is feasible in terms of change of, for instance, organisational culture.

When industrial and national cultures are also embraced, we find ourselves in the company of sociologists, political scientists or conceptually oriented psychologists. An example of the latter category is Pidgeon. His scope is apparent from the fact that he considers organisations ultimately as sub-cultures within

societies (Pidgeon, 1991). In several publications (Pidgeon, 1991, 1997, 1998) he embeds organisational safety culture in its industrial and political environment, where the occasional 'man-made disaster' – e.g. Chernobyl, Challenger, Exxon-Valdez – has a profound impact on both political and societal views on safety. According to Pidgeon (1991), a 'good' safety culture can be characterised by three attributes: '*norms and rules* for handling hazards, *attitudes* toward safety, and *reflexivity* on safety practice' (p. 135). Although all three attributes are imbued with political or societal thinking, especially the last is facilitated when it is considered at an industry-wide level, where learning is increased substantially through the collection and dissemination of incident and accident data.

Summarising, the approaches toward safety culture that have been discussed in this section, to some extent define two extremes of the continuum describing the interpretation of the concept of safety culture. At one extreme, safety culture is normative, having distinct features (Geller, 1984; International Safety Advisory Group, 1991). When these features have been implemented, a safety culture is established. At the other extreme, safety culture is seen as just a small element in a field of distinct forces, i.e. safety culture is relative (Pidgeon, 1991, 1997, 1998; Mijs, 1992). Clearly, the approach that has been the main focus of this paper falls somewhere in between, with particular researchers inclining towards one or the other extreme.

4 The nature of safety culture

The current literature review of safety culture and safety climate has shown that:

1. the concepts of safety culture and safety climate are still ill-defined and not worked out well;
2. the relationship between safety culture and safety climate is unclear;
3. there is considerable confusion about the cause, the content and the consequence of safety culture and climate, i.e.:
   - the cause of safety culture and climate has not been addressed seriously;
   - there is no consensus on the content of safety culture and climate; and
   - the consequences of safety culture and climate are seldom discussed.
4. there is no satisfying model of safety culture nor safety climate; and
5. the issue of the level of aggregation has not received the attention it warrants.

However, this is not to say that nothing has been accomplished, on the contrary. Nevertheless, it is regrettable that few authors have related their work to research by others or have tried to establish an integrative framework. Such a framework is the subject of the next paragraphs and will, hopefully, be useful in steering future research.

4.1 *Safety attitudes*

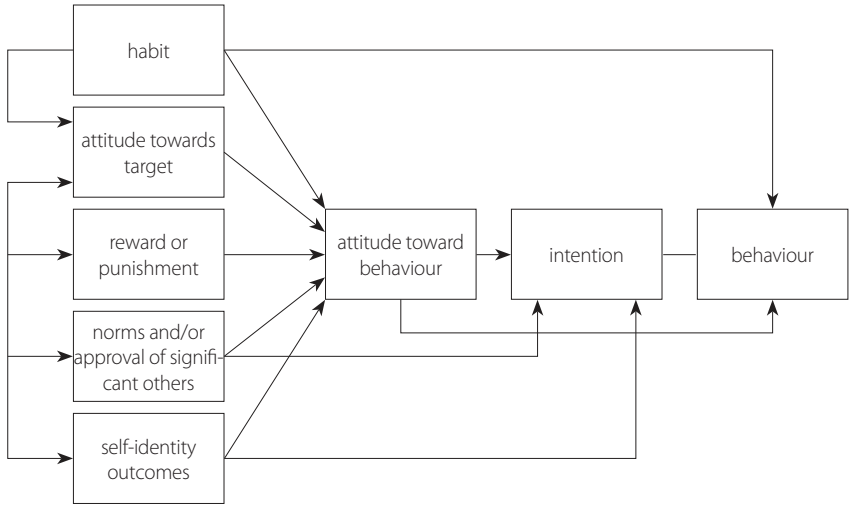
Most researchers of culture – whether national, organisational or safety culture – distinguish several levels at which manifestations of culture can be observed (e.g. Deal & Kennedy, 1982; Hofstede, 1991; Schein, 1992). Examples of such levels have been discussed in Section 2.2 above.

For the present framework the three levels of Schein (1992) are chosen, mainly because of their intuitive appeal and the convenience of just three levels. As a reminder, his three levels are:

I. Basic assumptions
II. Espoused values
III. Artefacts

Also, a very global model of attitudes was discussed in Section 3.3. It stated that attitudes are preceded either by cognitive, affective or behavioural processes and that attitudes yield cognitive, affective as well as behavioural responses. Again, three stages can be discerned. However, this model is still very rough and undistinguished. Eagly and Chaiken (1993, p. 209) propose a composite model of the attitude-behaviour relation, which is more specific. There are two important points to be made about this model (Fig. 5). Firstly, this is still a largely theoretical model, although it is based on models that have already been tested. Secondly, the model focuses on behaviour and therefore neglects the other two attitudinal responses, namely affective and cognitive responses.

Figure 5 Processes preceding attitude formation (adapted from Eagly and Chaiken, 1993)



The advantage of this model is that it specifies – albeit very broadly – the processes that precede attitude formation. Earlier in this paper, attitudes were compared with the second layer in the three layered culture model. Manifestations of culture at this level were called 'espoused values'. It is now suggested to equate attitudes with espoused values. Clearly, the processes that precede attitude formation then should be equated with the core of culture, namely the basic assumptions. I will have more to say about these later.

Up to here, the building of the framework has been neutral with regard to its objective. This framework could be applied to any aspect of organisational culture. However, the present focus is on safety and safety culture.

Attitudes always have objects. Although there are countless objects with regard to safety imaginable, these objects will presumably fall into a few categories. During the discussion of the models that have been devised to account for safety culture and climate phenomena, such categories have already been mentioned. The model by Cox and Cox (1991) for instance, refers to 'hardware', 'software', 'people (liveware)' and 'risks'. As a true behaviourist, Geller (1994) suggests 'people', 'environment' and 'behaviour', leaving out 'software'. Also the accident/incident investigation manual for the US Department of Energy (DOE) mentions 'plant-personnel', 'plant-hardware' and 'procedural systems' and the interfaces between these three (Johnson, 1985).

It is safe to say then that the following four broad categories of safety attitude objects have some substance:

1. hardware/physical environment;
2. software;
3. people;
4. behaviour.

Specific examples of hardware attitude objects would be safety measures and arrangements or personal protective equipment. Safety procedures, training and knowledge will come under the heading of attitudes toward software. The category of attitudes toward people will encompass all different kinds of people and groups that can be distinguished within a company, like management, supervisors, colleagues and so on. Finally, attitudes toward behaviour will include all acts with regard to safety (or lack of safety) like responsibility, safe working, scepticism and communication about safety.

4.2 Safety culture: basic assumptions

Above, something was already said about the core of safety culture, namely the basic assumptions. It would be obvious to assume that these basic assumptions will also be formed around the categories defined for safety attitudes above. However, in the sense that Schein (1992) defines them they do not have to be. He defines basic assumptions as 'the implicit assumptions that actually guide behaviour, that tell group members how to perceive, think about, and feel about

things'. Such assumptions 'have become so taken for granted that one finds little variation within a cultural unit. [...] [M]embers will find behavior based on any other premise inconceivable' (p. 22). Hence, such premises might be specifically about safety but do not necessarily have to be so. For example, if in some organisation written rules or procedures are considered futile, safety rules will be too. Therefore, one might find negative attitudes toward software (rules and procedures) in this organisation. This finding does not mean, however, that the basic assumption is that only safety rules are futile but that rules in general are.[8]

Envisioned this way, basic assumptions can only function as explanatory variables, i.e. they explain the attitude structure found. Moreover, basic assumptions have a more pervasive influence than attitudes in that basic assumptions transcend particular organisational units like groups or departments or particular types of culture like safety culture.

Now we can also see how these hypothesised basic assumptions link to the pre-attitude components of Fig. 5. These categories are habits, attitudes towards targets, utilitarian outcomes, normative outcomes and self-identity outcomes. It is not hard to consider some of these as basic assumptions. For instance, utilitarian or normative outcomes, which pertain to reward or punishment and the approval of significant others respectively (Eagly & Chaiken, 1993, p. 209), are usually deep rooted organisational processes (Schein, 1992). Habits also reflect deep organisational convictions about what works and what does not.

The attitude toward the target might also be a strong, basic assumption. For instance, in a production company a high production is usually considered the greatest good. It should, otherwise the company will go broke in the short run – the whole organisation is generally leavened with this fact. Therefore, individuals might break certain safety rules because of the greatest good – which is production.

In this representation, an organisation's basic assumptions are completely moulded into the cast of attitudes and their corresponding models. This is just one way of getting a firmer grip on an organisation's basic assumptions. Schein (1992) also mentions particular dimensions, around which shared basic assumptions form (p. 95-96):

1. The nature of reality and truth – these assumptions generally define what is real and what is not, or, more specifically, what is safe and what is not;
2. The nature of time;
3. The nature of space – these dimensions define the importance of time and space within an organisation, how they are used and filled. When related to safety, these dimensions could reveal the assumptions about workplaces, their hazards and their housekeeping and the time spent on safety, preparation of work and work itself;

8 For instance, because they provide a means for excuses like 'I didn't do it, because the rules didn't say I should' as the author encountered in one particular company.

4. The nature of human nature – this dimension reflects assumptions about people's intrinsic qualities and what can be done about it, e.g. whether some people are accident prone or likely to engage in risky behaviour;
5. The nature of human activity – these assumptions define what is 'work' and the right thing for people to do in relation to their environment; to what extent people should take initiative or await instruction;
6. The nature of human relationships – this dimension is all about how people relate to each other: e.g. competition, individualism, co-operation, authority of individuals, including issues like whether it is acceptable to correct other people's unsafe behaviour.

Clearly, Schein's dimensions are themselves rather abstract concepts in contrast with more concrete categories of the attitude model. Attitude models like the one above, are usually tested in a laboratory setting. Here, subjects fill out some questionnaires and their responses are subjected to a linear structural relations analysis demanding a numerical input. The questionnaires therefore contain some well-delineated constructs, assumed to be of relevance, that are covered by several questions. On the other hand, Schein's dimensions have more of an anthropological nature seeking understanding rather than reduction. Although both category systems cannot be reduced to one another, it appears that there is still considerable conceptual overlap. For instance, the basic assumptions about human nature will certainly encompass habit formation and beliefs about self-identity. Or, attitudes toward (the approval of) significant others (Fig. 5) most certainly reflect basic assumptions about human relationships.

4.3 Safety culture redefined

Schein (1992) defines organisational culture as 'a pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think and feel in relation to those problems' (p. 12). Schein has included two of the three responses commonly associated with attitudes, i.e. cognitive ('perceive', 'think') and affective ('feel') responses. He has deliberately left behaviour out, which he reserves for the outer layers, i.e. espoused values and artefacts. Schein also limits his definition to, what he assumes is, the core of organisational culture. Actually, in the way Schein conceives and defines (organisational) culture, there is no need for a specific definition for safety culture. The basic assumptions permeate throughout the organisation, including its aspect of safety. In this way, Schein remains faithful to the original conception of organisational culture as an overall, integrative concept. When talking about climate and assuming that climate conforms to the espoused values in Schein's model which are then operationalised as attitudes, it is necessary to define objects for these attitudes. Obviously, depending on the objects of the attitudes, different climates exist.

As observed above, the different types of culture that are to be found in the literature, have only been defined for analytical or practical reasons and to focus the research. Hence, for the same practical reasons, a definition of safety culture will be given. Safety culture is defined as: those aspects of the organisational culture which will impact on attitudes and behaviour related to increasing or decreasing risk.

Table 6 Levels of culture, their visibility and examples thereof

Levels of culture	Visibility	Examples
1. Outer layer – artefacts	visible, but hard to comprehend in terms of underlying culture	statements, meetings, inspection reports, dress codes, personal protective equipment, posters, bulletins
2. Middle layer – espoused values/attitudes regarding: – hardware – software – people/liveware – risks	relatively explicit and conscious	attitudes, policies, training manuals, procedures, formal statements, bulletins, accident and incident reports, job descriptions, minutes of meetings
3. Core – basic assumptions regarding: – the nature of reality and truth – the nature of time – the nature of space – the nature of human nature – the nature of human activity – the nature of human relationships	mainly implicit: obvious for the members invisible pre-conscious	have to be deduced from artefacts and espoused values as well as through observation

In summary, the following framework is proposed (Table 6). Safety culture is conceptualised as having three layers or levels at which it might be studied separately. The core is assumed to consist of basic assumptions, which are unconscious and relatively unspecific and which permeate the whole of the organisation. The next layer consists of espoused values, which are operationalised as attitudes. Attitudes have specific objects and therefore this layer is, necessarily, specific with regard to the object of study. For safety culture four categories of objects are suggested; hardware, software, people and behaviour. Finally, the outermost layer consists of particular manifestations, which are also specific to the object of study. With regard to safety one might think of inspections, posters, wearing (or not) of personal protective equipment, accidents or incidents, near misses or different types of behaviour.

The appeal of this framework is that it fuses safety climate and safety culture and that it also does justice to the integrative, holistic concept of culture as advocated by, for instance, cultural anthropologists. In addition, another elaboration can be made. As has been claimed above, the basic assumptions do not have to be specifically concerned with safety. Although they do not have to be specifically so, it is quite conceivable that some of the organisation's basic assumptions in fact are, when safety is taken seriously within the organisation and reflected upon by all of its members. This would certainly lead to an anchoring of safety within the basic assumptions. This supposition could be converted into a hypothesis stating that it is a good sign that amongst the basic assumptions of an organisation references to safety are made. Conversely, it is suspect when such references cannot be found. It might very well be that one has to conclude that such an organisation does not yield sufficient evidence for the existence of a safety culture.

5 Discussion

This review of safety climate and safety culture research has been largely from a social psychological point of view and has focused primarily on results from 20 years of research in this field. An integrative framework has been proposed, merging safety climate with safety culture and delivering categories for both safety attitudes and basic assumptions that are open to investigation. However, a question that has not been posed yet pertains to the use and utility of the safety culture and climate construct.

As can be seen in Table 1, all researchers have defined certain goals, often being of both theoretical and practical use. Both Lutness (1987) and Bailey and Petersen (1989) outline particular goals that go beyond the mere determination of safety culture in that they consider such measurement a performance indicator. For instance, Lutness (1987, p. 20) aims to reveal 'a safety program's strengths and weaknesses'. Bailey and Petersen (1989, p. 20) want to develop an alternative measure for safety performance while 'the effectiveness of safety efforts cannot be measured by traditional (procedural-engineering) criteria'. These researchers are referring to safety attitude measurement, i.e. what has been called safety climate in this paper.

Hence, the determination of safety climate has been put forward by some authors as an alternative performance indicator, in addition to the more established ones like safety management audits, accidents and incidents and near-misses (see also Budworth, 1996). This means that there should exist strong relationships between all these measures. As has been asserted before, such relationships have not been reported often. At present, there are few studies which have tried to establish such correlations, i.e. a relationship between safety performance measures and safety culture or climate assessments (e.g. Cabrera et al., 1997; Erickson, 1997). Hurst et al. (1996) report a relationship between certain audited management areas and attitudinal measures. Also the modifica-

tion factors resulting from their audit and a self-reported accident measure are highly correlated in their study. Clearly, these relationships need to be explored in more detail to be able to make substantive statements of the usefulness of a safety culture or climate measure as an alternative performance indicator.

Through their empirical, questionnaire-based study, Simard and Marchand (1996) illustrate convincingly the influence of what they call 'micro organisational factors' on safety initiatives. Their results show that, especially, participatory supervision shapes the propensity of workgroups to take such initiatives. Possibly, such a type of leadership is a product of an underlying culture.

Relationships, correlations and, in general, comparisons, bring the issue of quantification up front again. With regard to safety climate this should not cause a major problem, because attitudes are usually surveyed through self-administered questionnaires which generally provide such measures in semi-quantified form. The only point to worry about then is getting enough data to be able to make statistically sound generalisations, hereby keeping a wakeful, methodological eye on the measurement level of the data compared. The assessment of safety culture, however, as conceptualised in this paper as a small set of implicit basic assumptions, does not have a numerical counterpart. Comparisons will have to be made in hypothetical if ... then ... statements, like – *if* such-and-such basic assumptions are uncovered *then* we will also find incidents and accidents with such-and-such causes. Clearly, to be able to make such statements, a fair amount of case studies have to be conducted according to the framework presented in this paper.

However, when a given safety culture or climate has been assessed, the next question will certainly be – so what? Most of the safety climate research reported here would yield some scores on certain dimensions. However, those scores do not speak for themselves, i.e. the meaning of the scores will not be obvious. Moreover, because most researchers work with their own dimensions or scales (Table 4), it is impossible to refer to general norms or benchmarks.[9] Even if it is assumed that scores on certain dimensions are conspicuously low, the question will remain – so what? A subsequent strong (management) focus on the content of those low scored dimensions – communication, for example – would violate the holistic character of culture. Again, one runs into this methodological paradox that the analysis methods impose on the data. Usually, the results of the data analyses are uncorrelated dimensions, but in actuality this is hardly ever the case and is also in contrast with the holistic character that is attributed to culture and climate.

The present paper has not promoted this approach, though. The assessment of safety attitudes or safety climate through questionnaires, is only part of the advocated approach. The basic assumptions, which are explanatory to safety attitudes, also have to be assessed for a recommendation or fruitful inter-

9 However, both Lee and the Safety Research Unit have large databases making comparisons and relative statements possible.

vention. Actually, subsequent interventions should only be undertaken with detailed knowledge of a company's particular basic assumptions as explanatory variables *par excellence*. In that case, there are two alternatives for action. Either, an attempt at changing the basic assumptions is undertaken or an attempt at changing the safety attitudes is undertaken, *given* a particular set of basic assumptions. Clearly, the first effort might turn out to be the most difficult to attain, if it is indeed feasible. The latter one, although the most feasible, might still take a few years. For instance, De Cock et al. (1986) mention five years. Obviously, assessing safety climate or safety culture with the object of changing it is both ambitious and time consuming, spanning a period a lot of managers will not even see the end of.

Consequently, the measurement of safety climate could be considered an alternative safety performance indicator whereas the assessment of safety culture provides more insight into the particular attitudes found, hence – paradoxically – yielding the substrate for both safety improvements and unforeseen major accidents (Pidgeon, 1998). As the present review illustrates, research should not be undertaken to develop 'new' safety climate measurement instruments but should rather focus on the validity of the construct and whether it indeed yields a robust indication of an organisation's safety performance. In addition, increasing research efforts should be directed at developing means to assess an organisation's basic assumptions, for getting a much deeper understanding of 'the way we do things around here'.

Acknowledgements

The author would like to thank Ian Glendon, Andrew Hale and Paul Swuste for their useful comments on earlier drafts of this paper.

References

Advisory Committee on the Safety of Nuclear Installations (ACSNI), Study Group on Human Factors (1993). *Third Report: Organising for Safety*. London: HSMO.

Bailey, C.W. and Petersen, D. (1989). Using perception surveys to assess safety system effectiveness. *Professional Safety, February*, 22-26.

Berends, J.J. (1995a). *Organisation, culture and safety: a literature survey of organisational culture and safety culture (in Dutch)*. Unpublished interim report. Eindhoven: Eindhoven University of Technology.

Berends, J.J. (1995b). *Developing and using a widely applicable measurement tool for safety culture*. Unpublished interim report. Eindhoven: Eindhoven University of Technology.

Berends, J.J. (1996). *On the measurement of safety culture*. Unpublished graduation report. Eindhoven: Eindhoven University of Technology.

Borg, I. (Ed.) (1981). *Multidimensional data representations: when & why*. Ann Arbor: Mathesis Press.

Brown, R.L. and Holmes, H. (1986). The use of a factor-analytic procedure for assessing the validity of an employee safety climate model. *Accident Analysis & Prevention, 18*(6), 455-470.

Budworth, N. (1996). Indicators of performance in safety management. *The Safety & Health Practitioner, November*, 23-29.

Cabrera, D.D., Isla, R. and Vilela, L.D. (1997). An evaluation of safety climate in ground handling activities. In H.M. Soekkha (Ed.), *Aviation safety*. Proceedings of the IASC-97 International Aviation Safety Conference, The Netherlands, August 27-29, 255-268.

Cooper, M.D. and Philips, R.A. (1994). *Validation of a safety climate measure*. Paper presented at the British Psychological Society, Annual Occupational Psychology Conference, Birmingham, January 3-5.

Coyle, I.R., Sleeman, S.D. and Adams, N. (1995). Safety climate. *Journal of Safety Research, 26*(4), 247-254.

Cox, S. and Cox, T. (1991). The structure of employee attitudes to safety: an European example. *Work & Stress, 5*(2), 93-106.

Cox, S. and Flin, R. (1998). Safety culture. Philosophers' stone or man of straw? *Work & Stress, 12*(3), 189-201.

Deal, T.E. and Kennedy, A.A. (1982). *Corporate cultures*. Reading, Mass.: Addison-Wesley.

De Cock, G., Bouwen, R. and Witte, K. de (1986). Organisational climate: an assignment for the personnel policy? (in Dutch). *Praktisch Personeelsbeleid, Capita Selecta, 16*, 1-20.

DeDobbeleer, N. and Béland, F. (1991). A safety climate measure for construction sites. *Journal of Safety Research, 22*, 97-103.

Dieterly, D.L. and Schneider, B. (1974). The effect of organizational environment on perceived power and climate: A laboratory study. *Organizational Behavior and Human Performance*, *11*, 316-337.

Donald, I.J. and Canter, D.V. (1994). Employee attitudes and safety in the chemical industry. *Journal of Loss Prevention in the Process Industry*, *7*(3), 203-208.

Eagly, A.H. and Chaiken, S. (1993). *The psychology of attitudes*. Fort Worth: Harcourt Brace Jovanovich.

Ekvall, G. (1983). *Climate, structure and innovativeness of organisations*. Working paper of The Swedish Council for Management and Organisational Behaviour.

Erickson, J.A. (1997). The relationship between corporate culture and safety performance. *Professional Safety*, *May*, 29-33.

Friedlander, F. and Margulies, N. (1969). Multiple impacts of organizational climate and individual value systems upon job satisfaction. *Personnel Psychology*, *22*, 171-183.

Frissen, P. (1986). Organisational culture: an overview of approaches (in Dutch). *M&O, Tijdschrift voor Organisatiekunde en Sociaal Beleid*, *6*, 532-544.

Geller, E.S. (1994). Ten principles for achieving a Total Safety Culture. *Professional Safety, September*, 18-24.

Glennon, D.P. (1982a). Measuring organisational safety climate. *Australian Safety News*, *January/February*, 23-28.

Glennon, D.P. (1982b). Safety climate in organisations. *Proceedings of the 19th Annual Conference of the Ergonomics Society of Australia and New Zealand*, 17-31.

Glick, W.H. (1985). Conceptualizing and measuring organizational and psyhological climate: Pitfalls in multilevel research. *Academy of Management Review*, *10*(3), 601-616.

Green, P.E. and Carroll, J.D. (1978). *Mathematical tools for applied multivariate analysis* (2nd ed.). New York: Academic Press.

Guion, R.M. (1973). A note on organizational climate. *Organizational Behavior and Human Performance*, *9*, 120-125.

Guttman, L. (1968). A general nonmetric technique for finding the smallest coordinate space for a configuration of points. *Psychometrika*, *33*(4), 469-506.

Hale, A.R. and Hovden, J. (1998). Management and culture: the third age of safety. A review of approaches to organisational aspects of safety, health and environment. In A.M. Feyer, and A. Williamson (eds.), *Occupational injury; risk, prevention and intervention*. London: Taylor and Francis, 129-166.

Hofstede, G.R. (1986). Working on the organisational culture (in Dutch). *Bedrijfskunde*, *58*(2), 102-106.

Hofstede, G.R. (1991). *Cultures and organisations: Software of the mind*. London: McGraw-Hill.

Hurst, N.W., Young, S., Gibson, H. and Muyselaar, A. (1996). Measures of safety performance and attitudes to safety at major hazard sites. *Journal of Loss Prevention in the Process Industry*, *9*(2), 161-172.

International Loss Control Institute (1984). *International Safety Rating System* (5th rev. ed.). Georgia: Institute Publishing.

International Safety Advisory Group (1991). *Safety culture*. Safety Series No. 75-INSAG-4. Vienna: International Atomic Energy Agency.

James, L.R. (1982). Aggregation bias in estimates of perceptual agreement. *Journal of Applied Psychology*, *67*(2), 219-229.

James, L.R. and Jones, A.P. (1974). Organizational climate: a review of theory and research. *Psychological Bulletin*, *81*(12), 1096-1112.

Johnson, W.G. (1985). *Accident/incident investigation manual* (2nd ed.). Prepared for the U.S. Department of Energy, DOE/SSDC 76-45/27.

Jones, A.P. and James, L.R. (1979). Psychological climate: Dimensions and relationships of individual and aggregated work environment perceptions. *Organizational Behavior and Human Performance, 23*, 201-250.

Keenan, V., Kerr, W. and Sherman, W. (1951). Psychological climate and accidents in an automotive plant. *Journal of Applied Psychology*, 108-111.

Kennedy, R.J. (1997). *The development of a HAZOP-based methodology to identify safety management vulnerabilities and their associated safety cultural factors*. PhD thesis, University of Birmingham.

Lee, T.R. (1996). Perceptions, attitudes and behaviour: the vital elements of a safety culture. *Health and Safety, October*, 1-15.

Ludborzs, B. (1995). Surveying and assessing 'safety culture' within the framework of safety audits. In J.J. Mewis, H.J. Pasman and E.E. De Rademaecker (eds.), *Loss Prevention and Safety Promotion in the Process Industries*, *1*, 83-92.

Lutness, J. (1987). Measuring up: assessing safety with climate surveys. *Occupational Health & Safety*, *56*, 20-26.

Mijs, A.A. (1992). A sociological perspective on the meaning and popularity of organisational culture (in Dutch). In R. van der Vlist (Red.), *Views on organisational culture. A multidisciplinary perspective (in Dutch)*. Utrecht: Uitgeverij Lemma B.V.

Niskanen, T. (1994). Safety climate in the road administration. *Safety Science, 17*, 237-255.

Ostrom, L., Wilhelmsen, C. and Kaplan, B. (1993). Assessing safety culture. *Nuclear Safety*, *34*(2), 163-172.

Payne, R.L. and Pheysey, D.C. (1971). G.G. Stern's organizational climate index: a reconceptualization and application to business organizations. *Organizational Behavior and Human Performance*, *6*, 77-98.

Peters, T.J. and Waterman, R.H., Jr. (1982). *In search of excellence. Lessons from America's best-run companies*. New York: Harper & Row.

Pidgeon, N.F. (1991). Safety culture and risk management in organizations. *Journal of Cross-Cultural Psychology*, *22*(1), 129-140.

Pidgeon, N.F. (1997). The limits to safety? Culture, politics, learning and man-made disasters. *Journal of Contingencies and Crises management*, *5*(1), 1-14.

Pidgeon, N.F. (1998). Safety culture: key theoretical issues. *Work and Stress*, *13*, 202-216.

Reason, J.T. (1997). *Managing the risks of organizational accidents*. Aldershot: Ashgate.

Safety Research Unit (SRU) (1993). *The contribution of attitudinal and management factors to risk in the chemical industry*. Final Report to the Health and Safety Executive. Guildford: Psychology Department University of Surrey.

Sanders, G. and Neuijen, B. (1987). *Organisational culture: diagnosis and influencing (in Dutch)*. Assen: Van Gorcum.

Schein, E.H. (1992). *Organizational culture and leadership* (2nd ed.). San Francisco: Jossey-Bass.

Schneider, B. (1975). Organizational climates: An essay. *Personnel Psychology*, *28*, 447-479.

Schuman, H. and Presser, S. (1981). *Questions and answers in attitude surveys*. Orlando: Academic Press.

Shye, S., Elizur, D. and Hoffman, M. (1994). *Introduction to facet theory; content design and intrinsic data analysis in behavioural research*. Newbury Park: Sage.

Simard, M. and Marchand, A. (1996). A multilevel analysis of organisational factors related to the taking of safety initiatives by work groups. *Safety Science*, *21*(2), 113-129.

Tabachnick, B.G. and Fidell, L.S. (1989). *Using multivariate statistics* (2nd ed.). New York: HarperCollins.

Tatsuoka, M.M. and Lohnes, P.R. (1988). *Multivariate analysis. Techniques for educational and psychological research* (2nd ed.). New York: Macmillan.

Tuli, R.W. and Apostolakis, G.E. (1996). Incorporating organizational issues into root-cause analysis. *Transactions Institution of Chemical Engineers*, *74*(B), 3-16.

Van de Geer, J.P. (1993a). *Multivariate analysis of categorical data: Theory*. Advanced Quantitative Techniques in the Social Sciences, Vol. 2. Newbury Park: Sage.

Van de Geer, J.P. (1993b). *Multivariate analysis of categorical data: Applications*. Advanced Quantitative Techniques in the Social Sciences, Vol. 3. Newbury Park: Sage.

Van Hoewijk, R. (1988). The meaning of organisational culture: an overview of the literature (in Dutch). *M & O, Tijdschrift voor Organisatiekunde en Sociaal Beleid*, *1*, 4-46.

Van Schuur, W.H. and Kiers, H.A.L. (1994). Why factor analysis often is the incorrect model for analyzing bipolar concepts and what model to use instead. *Applied Psychological Measurement*, *18*, 97-110.

Williamson, A.M., Feyer, A-M., Cairns, D. and Biancotti, D. (1997). The development of a measure of safety climate: the role of safety perceptions and attitudes. *Safety Science*, *25*, 15-27.

Zohar, D. (1980). Safety climate in industrial organizations: theoretical and applied implications. *Journal of Applied Psychology*, *65*(1), 96-102.

Afterword

When I started working on my 'Nature of safety culture' (Guldenmund, 2000) review paper around 1997, the concept was still quite new and safety culture and safety climate were still used interchangeably. Nowadays, the search term 'safety culture' yields 17,000,000 hits at Google (dd. 28.12.2008). Certainly, many of these hits do not refer to research or other scientific applications of the concept – these days, many consultants also come forward with much more pragmatic applications – but this score gives an inkling of how the concept has conquered the hearts and minds of people working in the field of safety.
Apart from providing a state-of-the-art overview of the research field, which was still quite barren, the paper was intended to resolve various issues that were pertinent for me at the time, i.e. (1) the distinction between safety culture and safety climate; (2) the (ultimate) definition of safety culture; (3) a model for safety culture; and (4) the choice for either a quantitative or a qualitative research approach. These subjects will be addressed briefly below.

Safety culture and safety climate

Unfortunately, I had not come across Denison's excellent paper on the distinction between climate and culture (Denison, 1996) when I tried to tackle the issue in the review. However, as it turns out, I have not drifted too far away from his notions and recommendations throughout the years. According to Denison, climate can be distinguished from culture through their distinct foci, i.e. climate is concerned with the particular situation an organisation finds itself in and the influence this has on its members, whereas culture ultimately is about the context and aetiology of this situation. However, more important is his contention that organisational climate and culture do not so much pertain to two distinct phenomena, but rather are about different interpretations of these phenomena. Consequently, the research agendas of organisational culture and climate scholars are different, the former being concerned with *understanding* whereas the latter basically want to change, or improve, things.

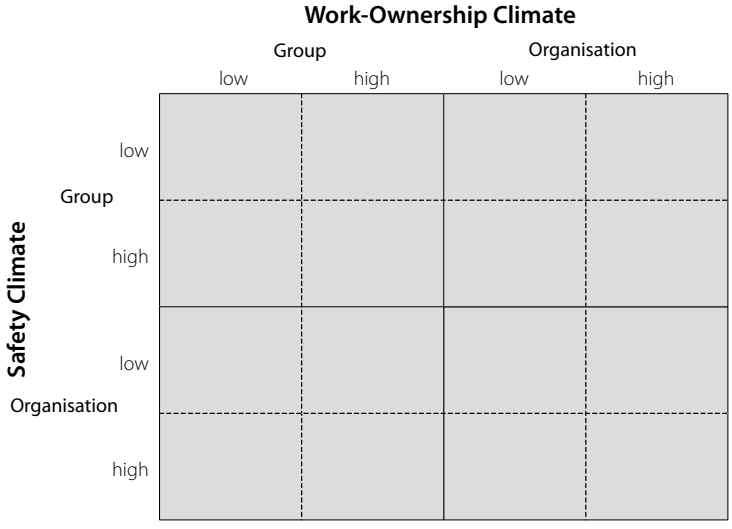
In the next chapter (Chapter 2) questionnaires are discussed extensively, the primary technique of climate researchers. At some point it is mentioned that when these questionnaires are used to decipher basic assumptions – arguably, this is what happens when one tries to interpret components/ factors resulting from a principal components analysis or factor analysis – climate and cul-

ture research converge and the questionnaire results are simply considered as another source of raw data. However, if the constellation of factors and the relative positions of companies (or divisions, departments, teams, etc.) within these are the ultimate aim, culture and climate start to diverge. Please note that the phenomena are still much the same, but interpretations start to differ.

Defining safety culture and climate

Defining culture is tricky. Already in 1952, Kroeber and Kluckhohn counted 164 different definitions (Kroeber & Kluckhohn, 1952) and, hence, providing an operational definition of culture will be equally difficult. Looking from an interpretative perspective this is quite understandable, because one cannot tell beforehand how a particular culture will express itself, nor what this expression ultimately will mean. For climate researchers this is bad news, because they need tangible objects as stimulus for their respondents to determine how they perceive them. In safety climate research therefore, the focus is put more and more on the formulation and enactment of safety policies and procedures by managers and supervisors and, more importantly, how these activities are perceived by the workforce (e.g. Zohar, 2006, 2008). In his 2008 paper, Zohar proposes a framework that includes, next to safety climate, (psychological) work ownership. The latter pertains to the 'psychological possession and attachment' that somebody experiences toward her or his work (ibid., p. 382). Combining the two, Zohar is able to build a multilevel framework that will, possibly, dominate the safety climate research agenda for the coming years (Fig. 1).

Figure 1 Zohar's multi-climate multi-level framework (2008)



Evidently, safety *climate* is getting more clearly delineated and defined. Safety *culture*, however, is much more difficult to capture in an operational definition for the reason given above. To describe the organisational culture of an SME in Australia, and its influence on safety, Brooks (2008) applied the six dimensions suggested by Schein – i.e. the nature of (1) reality and truth; (2) time; (3) space; (4) human nature; (5) human activity and; (6) human relationships – and also brings in Dawkins' notion of 'memes'.[1] Searching for underlying assumptions and how these become established, he is able to present a clear case study with multiple handles that can inspire the research agendas of safety culture researchers for the coming years also.

Safety culture models

Even now, models of safety culture are not plentiful. Models much more clearly belong to climate research, because here researchers test their models statistically, which is, for many people, the ultimate check of any model. The research model presented in the Introduction of this book cannot serve as a model for safety culture, though, because it describes the research *process*, not its *outcome*. As is argued in Chapter 1, a collection of case studies conducted in a similar way, e.g. following Schein's example, might enable scholars to ground a generic model or taxonomy of safety culture, although such a generalisation might rub interpretative purists up the wrong way. Somewhat later, a sort of taxonomy was indeed developed, but this was more of a hierarchy, did not follow Schein and was also quite quantitative (e.g. Lardner, Fleming, & Joyner, 2001; Parker, Lawrie, & Hudson, 2006). However, not many case studies have been conducted yet, so a well-grounded taxonomy based on case studies is still a bridge too far.

Methodology: quantitative or qualitative?

The choice of either a qualitative or a quantitative research methodology has not become a controversy in the safety culture literature. It rather seems to be a preference; that is, there are climate researchers working with questionnaires and culture researchers doing (ethnographic) field studies, with the latter being in a clear minority. Advocates of each methodology seem to be happy with this state of affairs. There are not many hybrid studies around but Chapter 4 of this book presents such a study.

1 In his book *The selfish gene*, Dawkins (1976) puts forward the meme as unit of *cultural* evolution, as counterpart to the gene as unit of *biological* evolution. His theory on memes describes the propagation and survival of less physical products of human activity, like, for instance, dress codes, songs, recipes and designs, etc. which are all part and parcel of a (national) culture.

Summary of later review studies

After my safety culture review paper presented in the previous chapter, similar papers by other authors followed. At about the same time as my review paper, a complementary study was published by Flin et al. who concentrated on the general themes surfacing in climate research (Flin, Mearns, O'Connor, & Bryden, 2000). They came up with five pertinent areas (plus another one, procedures/ rules, which was suggested by my review study) that appeared in many safety climate studies: i.e. management (in 72% of the papers), safety system (67%), risk (67%), work pressure (33%), competence (33%) and procedures/ rules (no percentage given). These themes could be used, for instance, as a blueprint for future questionnaire development. However, this would also mean that, in the end, research outcomes would define the construct, which could ultimately lead to the rather circular reasoning that safety climate 'is' what the questionnaire measures.

Collins and Gadd (2002) bridged the review gap between 1997 and 2002 with their report for the HSE. This report was primarily intended to bring inspectors up-to-date on safety culture and climate research and to provide them with some tips and tricks to support them in their role as advisors to companies. The authors very much put senior management, but also supervisors and the safety officer, into the focus of their attention, as the creators and sustainers of organisational culture and its influence on safety and health. Furthermore, Collins and Gadd provide a list of indicators that might signify a 'positive safety culture' (ibid., p. 25 ff.):

- managers provide effective and feasible planning;
- managers regularly visit the work floor or the field to monitor or inspect safety;
- managers are actively involved in e.g. accident investigations;
- managers participate in safety committees.

Finally, they also point out the important role of good housekeeping, communication (up and downward) and bonus schemes, the latter often resulting in safety getting (more) compromised rather than stimulated.

Sorensen (2002) provides a very nice and critical discussion of the concept of safety culture from the perspective of the nuclear industry, which basically furnished the cradle for the term before it was taken over by other industries, mainly (petro-)chemical and other production type plants. The author argues that the INSAG's notion of the concept of safety culture was too ill-defined and underdeveloped to be of any practical use.[2] Sorensen thereupon sets out to tutor the practitioner about the concepts of culture, organisational culture and the organisational context of human error as discussed by e.g. Reason (1990, 1997). The

2 INSAG stands for International Nuclear Safety Advisory Group; this advisory group investigated, amongst others, the Chernobyl accident.

relationship between safety culture and safety performance is a moot point for Sorensen, for now it is simply assumed by INSAG. As an initial impetus, the author provides two models to explore the mechanism through which safety culture affects safety performance and, ultimately, overall risk. In addition, various indicators are discussed for possible inclusion in these models. Another important point made by Sorensen concerns the role of the regulator and whether they should address the issue of safety culture with their licensees and, if so, how? Given the absence of well-defined and valid safety culture indicators, such influence easily defaults to the promotion of best management practices, like open communication, a strong focus on organisational learning, senior management commitment to safety and a participative leadership style.

More recently, Choudry et al. (2007) once more reviewed much of the safety culture and climate literature from 1998 onwards. They provide brief summaries of empirical research that has been carried out, overviews of safety culture definitions and some characteristics of, what could be considered, a 'positive safety culture'. Additionally, they put forward a model of construction safety culture. The latter is an interesting domain for research, because one could wonder how a safety culture, or an organisational culture for that matter, could be established within an industry sector that works with numerous sub-contractors (and sub-sub-contractors and on and on) and operates solely through temporary projects. It is indeed these latter characteristics that suggest that, perhaps, an occupational or professional culture is at work here, rather than an organisational culture.

In an attempt to knit together various strands of safety culture research Glendon (2008) presents an impressive diagram depicting the main components relevant to the concept of safety culture and their mutual relationships. Quite rightly, he notes that not many studies report the implication(s) of their findings but rather describe relationships between various measures (ibid., p. 263). Questionnaire studies in general do not require researchers to go out in the field and verify their numerical assessments; in the case of culture research this seems to me an apparent weakness of such studies (cf. Denison, 1996, pp. 643-644). The obvious antidote is to apply various, quantitative *and* qualitative, methods, which basically is what Glendon advocates. He ends his paper with specifying various challenges for future research, including research in SMEs (Small and Medium-sized Enterprises) and cross-cultural research (including less well-developed economies) to explore the robustness and predictive validity of the safety culture concept. I would like to add the study of trade or professional (safety) cultures to his list, as these are currently not well represented in the literature.

Perhaps unavoidably, the concept of safety culture has now also been picked up by US traffic researchers (Anon., 2007). The notion of a pervasive, binding but invisible force is too attractive for them to neglect it. However, it will be quite difficult to apply the concept of culture to such a loosely connected and open system, which traffic basically is. Compared to the construction industry,

it will be even more difficult to argue that it are the shared convictions of distinctive groups or categories of people that explain (some of) their observed behaviour.

Conclusion

Safety climate still has the lead in research on safety culture. Various models about the influence of safety climate on safety performance have now been proposed and tested. The conception of safety climate proposed by Zohar (2008) and his research framework based on it, are very likely to inspire researchers for the coming decade. His overall conception actually does not deviate much from the one I propose in the next chapter, but I will discuss this correspondence in the afterword of Chapter 2.

While safety culture was initially coined within the nuclear industry, it was quickly taken over by various other industries, e.g. the (petro-)chemical industry, the steel industry and numerous other types of production plant. In the past years, a new (third) generation of interested parties has announced themselves, e.g. the construction industry, mass transportation (e.g. road traffic, railways, aviation) and hospitals. Given this overwhelming attention, safety culture and climate will occupy many a research agenda for years to come. Researchers are, however, well advised to take note of the various critical discussions that have appeared of these concepts throughout the years, otherwise no real progression in theory formation and validation will be made.

Genuine safety culture *case* studies are still quite absent from the literature and it does not appear this will change drastically in the near future.[3] Purely descriptive or diagnostic studies do not have the interest of most client companies; on the contrary, practicing managers are usually not interested in the theoretical underpinning of research they commission or of its resulting outcomes (cf. Denison, 1996, p. 646). They prefer to hear what to do or adapt.

Given the multiple directions safety culture research has been developing into and the various approaches towards its assessment (e.g. Glendon, 2008), it has become more difficult to get a full overview of these developments and their accompanying findings. Therefore, a common research framework functioning as a point of departure and a source of reference is even more needed to synthesise such diverse enquiries. In Chapter 3 of this book the safety culture toolbox is opened and equipped and safety culture researchers are provided with important philosophical considerations that should guide and support their research. Moreover, a case study applying various tools from this toolbox is described in

3 This is not to say that such studies do not exist. Various authors provide extensive case studies either directly or indirectly related to SHE. For instance, see Abrashoff (2002) for an account of an impressively swift organisational reform on a US Navy warship; Gouldner for the contrast in a gypsum factory between 'surface' factory workers and (underground) miners; Mascini (1999) for a comparative study of a cokes factory and an amine chemical plant or Vaughan's (1996) famous study of NASA and the Challenger disaster.

Chapter 4 and its afterword. Once more, the aspiration is expressed here that multiple, carefully conducted case studies and a clear overview of basic assumptions found, will enable us to discern patterns and build a robust safety culture framework still rooted firmly in empiricism.

References

Abrashoff, D. M. (2002). *It's your ship: management techniques from the best damn ship in the Navy*. New York: Warner Books.

Anon. (Ed.). (2007). *A review of safety culture theory and its potential application to traffic safety*. Washington, DC: AAA Foundation for Traffic Safety.

Brooks, B. (2008). The natural selection of organizational and safety culture within a small to medium sized enterprise (SME). *Journal of Safety Research, 39*(1), 73-85.

Choudhry, R. M., Fang, D., & Mohamed, S. (2007). The nature of safety culture: a survey of the state-of-the-art. *Safety Science, 45*(10), 993-1012.

Collins, A. M., & Gadd, S. (2002). *Safety culture: a review of the literature*. Sheffield: Health and Safety Laboratory, Human Factors Group.

Dawkins, R. (1976). *The selfish gene*. Oxford: University Press.

Denison, D. R. (1996). What *is* the difference between organizational culture and organizational climate? A native's point of view on a decade of paradigm wars. *Academy of Management Review, 21*(3), 619-654.

Flin, R., Mearns, K., O'Connor, P., & Bryden, R. (2000). Measuring safety climate: identifying the common features. *Safety Science, 34*, 177-192.

Glendon, A. I. (2008). Safety culture and safety climate: how far have we come and where could we be heading? *Journal of Occupational Health and Safety - Australia and New Zealand, 24*(3), 249-271.

Guldenmund, F. W. (2000). The nature of safety culture: a review of theory and research. *Safety Science, 34*(1-3), 215-257.

Kroeber, A., & Kluckhohn, C. (1952). *Culture: a critical review of concepts and definitions*. New York: Meridian Books.

Lardner, R., Fleming, M., & Joyner, P. (2001). Towards a mature safety culture. *IChemE Symposium Series, 148*, 635-642.

Mascini, P. (1999). *Risks at work. Handling health risks on the shop floor (in Dutch).* PhD thesis, Erasmus University, Rotterdam.

Parker, D., Lawrie, M., & Hudson, P. T. W. (2006). A framework for understanding the development of organisational safety culture. *Safety Science, 44*(6), 551-562.

Reason, J. T. (1990). *Human error*. Cambridge: Cambridge University Press.

Reason, J. T. (1997). *Managing the risks of organizational accidents*. Aldershot: Ashgate.

Sorensen, J. N. (2002). Safety culture: a survey of the state-of-the-art. *Reliability Engineering and System Safety, 76*, 189-204.

Vaughan, D. (1996). *The Challenger launch decision. Risky technology, culture, and deviance at NASA*. Chicago The University of Chicago Press.

Zohar, D. (2006). *Re-thinking safety climate: a multi-level multi-climate framework*. Paper presented at the 5th International Conference on Occupational Risk Prevention (ORP), Sevilla (Spain), 10-12/05/2006.

Zohar, D. (2008). Safety climate and beyond: a multi-level multi-climate framework. *Safety Science, 46*(3), 376-387.

Chapter 2

The use of questionnaires in safety culture research: an evaluation

Published in Safety Science, 45, 723-743, 2007

Introduction to Chapter 2

About five years after writing the paper presented as Chapter 1, I started working on a review of the use of questionnaires in safety culture research. A critical discussion of questionnaires following the overall review seemed the most plausible step next because the use of questionnaires was the approach I was most familiar with and remains the most popular technique around with which to tackle the safety culture concept.[1]

A first draft of Chapter 2 was prepared for the 23rd International NeTWork-Workshop 'Safety Culture and Behavioural Change at the Workplace', which was held in Blankensee (near Berlin) between September 9-11, 2004. About 15 participants provided input to this workshop that ultimately resulted in a special issue of *Safety Science* edited by Baram and Schoebel (2007) and which also included the paper which constitutes Chapter 2 of this book (Guldenmund, 2007).

References

Baram, M., & Schoebel, M. (2007). Safety culture and behavioral change at the workplace. *Safety Science, 45*(6), 631-636.

Guldenmund, F. W. (2007). The use of questionnaires in safety culture research – an evaluation. *Safety Science 45*, 723-743.

1 To be more precise, what is actually talked about here is safety climate.

Abstract

Questionnaires have not been particularly successful in exposing the core of an organisational safety culture. This is clear both from the factors found and the relations between these and safety indicators. The factors primarily seem to denote an overall evaluation of management, which does not say much about cultural basic assumptions. In addition, methodology requires that levels of theory and measurement are properly recognised and distinguished. That is, measurements made at one level cannot be employed at other levels just like that unless certain conditions are met.

Safety management has been described through nine separate processes that together encompass the safety management system (SMS) of an organisation. Policies developed at the organisational level shape the organisational context and working conditions of the group and individual levels and therefore also attitudes within the organisation. The questionnaires seem to expose only those attitudes that are shared throughout the whole of the organisation. The workforce could very well recognise the safety policies of higher management as concern for their well-being and the overall value attached to safety. Pictured this way, safety climate (attitudes) and safety culture are not separate entities but rather different approaches towards the same goal of determining the importance of safety within an organisation.

The use of questionnaires in safety culture research: an evaluation

1 Introduction

In the past years considerable effort has been put into the construction of a valid and reliable safety climate questionnaire. In safety culture research a (safety climate) questionnaire has been the predominant measurement instrument (Collins & Gadd, 2002; Guldenmund, 2000). This popularity is not surprising, it being a quick but also 'dirty' instrument. Because of this 'dirtiness' a safety climate survey only gives an inkling of what a particular safety culture might be about. The challenge is, of course, to develop a questionnaire that yields just enough relevant and valid information – the trusted 'wet finger' to find out from which way the wind blows – to decide whether and possibly where any corrective measures or actions are opportune. The key words here are relevant and valid.

When developing a safety climate questionnaire two avenues of possibilities can be taken. First, a descriptive model of safety climate can be used as a starting point – a normative or theoretical approach. Second, results of previous research can be combined to construct a new questionnaire – a more pragmatic approach. In an earlier paper (Guldenmund, 2000) an overview is given of both the models devised for safety climate and the scales resulting from safety climate questionnaire research. Basically, the models provide a global taxonomy for the (safety) attitude objects in question, whereas the scales give more precise descriptions of these attitudes.

The purpose of this paper is to look at these taxonomies and attitude objects anew and to propose a common basis that might explain the patterns of shared attitudes found in safety climate research. Furthermore, a list of safety management processes will be put forward that is considered to be fundamental in creating, continuing, changing and hence evaluating safety climate. With this proposal the paper changes focus from what *has been* measured to what *should be* measured.

2 Current state of affairs

Safety climate should be distinguished from safety culture research, where the former is a manifestation or 'snapshot' (Flin, Mearns, O'Connor, & Bryden, 2000) of the latter. Climate is reflected in the 'workforce's perceptions of the organisational atmosphere' (ibid., p. 178), i.e. climate is more superficial and transient

than culture. Following Schein (1992) the essence of culture is reserved for the core of an organisation's culture, which has to be deciphered from many sources, (organisational) climate amongst these. Whether this distinction is purely academic or also has some conceptual texture to it, I will return to later on.

Safety climate is generally explored through a questionnaire survey within the target organisation or parts of it. The questionnaires are often composed of series of thematic questions that tap people's evaluations of various aspects considered to be relevant for safety (climate); several authors have enumerated many such researches (Cooper, 2000; Cox & Flin, 1998; Flin et al., 2000; Guldenmund, 2000; Mearns, Whitaker, & Flin, 2003; Williamson, Feyer, Cairns, & Biancotti, 1997). After the survey the researchers process the data, which could involve the construction of two or more scales through Principal Components Analysis (PCA) *or* finding the scores of the organisation on such scales, which have already been established in previous research. A third variant of a climate survey could be confirmatory in that the researchers try to confirm the scales found in earlier research. All three types of research approaches are to be found in the literature, resulting in many, many scales (Flin et al., 2000; Guldenmund, 2000). A final endeavour of the research team might be to find the correlation between one or more scales and some criterion variable, such as accidents or safety-related behaviour, possibly with reference to different subgroups.

My 2000 paper (Guldenmund, 2000) reviewed research into safety culture and safety climate up to 1997 and proposed a guiding framework for future studies. The paper by Flin et al. (2000) complemented this review with an overview of generalised scales distilled from the plethora of scales found in safety climate research. Additionally, Cooper (2000) put forward a model to 'measure and analyse' safety culture, which was linked interestingly to the framework presented in Guldenmund (2000). Also, Neal et al. (2000) and Thompson et al. (1998) proposed synthesising models bringing together several aspects of the research field.

Papers appearing after this wave of frameworks, syntheses and generalisations referred to these publications in their introductory paragraphs but then started off on their own course (e.g. Glendon & Litherland, 2001; Reiman & Oedewald, 2004). In 2002 Collins and Gadd again reviewed the safety culture research field, but did not report any significant advances since the previous surge of papers (which actually are all from or around 1998, which is when the thematic sessions during the I.C.O.H. conference in Amsterdam and the A.P.A. symposium in San Francisco were held). In effect the following findings currently still hold:

1. There is a large variety in factors (dimensions, scales, facets) that make up the safety climate concept (Collins & Gadd, 2002; Flin et al., 2000; Guldenmund, 2000). However, these can be brought down to a limited number of 'themes' (Collins & Gadd, 2002; Flin et al., 2000).

2. A factor pertaining to 'management' pops up in the analyses about 75% of the time and a factor 'safety system' in about two-thirds of the studies (Collins & Gadd, 2002; Flin et al., 2000).
3. Most studies have not been able to replicate a factor solution from a previous study, not even within the same type of company (Brown & Holmes, 1986; Cox & Flin, 1998; Coyle, Sleeman, & Adams, 1995; DeDobbeleer & Béland, 1991; Flin et al., 2000), but see (Glendon & Litherland, 2001) for more confirmatory findings.
4. Safety climate and 'safety performance' are weakly (.20) related at best (Clarke, 2006).

To summarise, although more research effort has been put into the safety climate concept since the special issues of Work and Stress (1998) and Safety Science (2000) the field is as fragmented and misunderstood as it was left by the reviewers and framework builders more than six years ago.

3 A closer look at questionnaires

In the introduction to this paper questionnaires have been called both quick and dirty. Self-administered questionnaires can be distributed amongst large groups of people in a relatively short period of time fairly easily, hence the term quick. However, the possibilities to control unwanted influences affecting the responses are limited and therefore these include a lot of random 'noise', hence the term dirty. The first characteristic actually cancels the effect of the latter since the 'dirtiness' in the responses is averaged out over the large number of responses, provided, of course, that the unwanted influences are unsystematic and normally distributed.

These are not the only methodological reasons for doing a large survey. Questionnaires often also provide instant quantified results that enable the researcher to produce medians or means, compare subgroups and benchmark these. Obviously, a self-administered questionnaire is a valuable tool in (social scientific) research.

In organisational culture research however, certain conditions apply which might make the self-administered questionnaire less useful. For instance, culture is, by definition, something that is shared between people and the variance created by the dirtiness of questionnaires may obscure the assumptions they share. The degree of variance *per se* defines the extent to which assumptions are commonly held amongst the members of a group. Moreover, within organisations the groups we can assume to have a common culture are often not large enough to average out the random influences. Furthermore, the scales that are used to record the responses (Likert scales, preference scales, indices of importance or significance) are assumed to be at the (quasi-) interval measurement

level, but this is at least doubtful.[1] This principally means that calculating means, variances, correlations and other linear transformations is not allowed. Again, with large populations this would not be such a problem, but within most studies of organisations, so far published in the safety climate literature, it probably is. Basically, in survey research one is caught between the theoretical demands of statistics (heterogeneous normally distributed variables around a single mean obtained from large populations) and the theoretical requirements of culture ([strong] convictions shared by groups or categories of people, which are small enough to interact and create a culture about safety or any other related topic).

Yet another source of confusion in safety climate research is the distinction that is made between perceptions and attitudes. Perceptions seem to be regarded as 'descriptive' and referring to 'external objects' whereas attitudes are considered personal 'evaluations' of the same objects; e.g. see Williamson et al. (1997), Glendon and Litherland (2001). It could, however, very well be argued that these perceptions are infused with the attitudes that underlie them, in that perceptions are not mere descriptions but, rather, evaluations of what people see around them. Consequently, perceptions reflect attitudes (Eagly & Chaiken, 1993). My point here is that *safety climate research is basically attitude research*.[2] Importantly, in linking safety climate research to attitude research the theoretical development in the latter field could readily be applied also in the field of safety climate; see Fiske and Taylor (1991) or Eagly and Chaiken (1993) for impressive overviews on theoretical and practical aspects of attitudes.

To make matters even more complex, with regard to culture the organisation cannot be considered a closed system. That is, not only local conditions within the organisation determine the culture of its members. Actually, when a company has not experienced any serious problems during its existence there probably will not be a typical culture (Schein, 1992); its culture will be determined largely by external (national, regional) conditions and the (educational, social-economic, religious) background of its workforce (Guldenmund, Ellenbroek, & van den Hende, 2006).

So, what kind of information do we collect with questionnaires? Although we intend to uncover an underlying trait called culture, the questionnaires invite respondents to espouse rationalisations, aspirations, cognitions or attitudes at best, that is, the very thing called espoused values by Schein (1992). Obviously, one could still argue that behind all these espoused values the 'true' shared values, if any, hide, but it takes a lot of deciphering and a creative analyst to uncover these. Hence, we are stuck with a set of factors and scores on them

1 Interval level measurement implies that the psychometric distances between categories of the scale are all the same, i.e. the distance between strongly agree and agree is the same as disagree and neither agree, nor disagree. It is indeed doubtful that this is actually the case.

2 Attitudes are defined as a 'psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor' (Eagly & Chaiken, 1993, p. 1).

but we do not know what they really mean or imply. We maybe have an answer to the what?-question but we certainly do not know why. Basically, we are back where we started from with trying to figure out why this company shows these artefacts and expresses these espoused values. Or, put in another way, survey research does not yield processed climate or culture results but rather provides another source of raw data to extract an organisational culture from.

4 Safety climate structure

4.1 Introduction

In my 2000 paper (Guldenmund, 2000) I proposed four principal 'attitude objects' with regard to safety climate – hardware/physical environment, software, people and risk – these partly being taken from Cox & Cox (1991). However, this classification is too coarse and unspecific to be of any use.

Flin et al. (2000) identify in their review paper six 'themes' common to 18 papers they have scrutinised: i.e. management (72%), safety system (67%), risk (67%), work pressure (33%), competence (33%) and procedures/rules. Although a little more extended, this taxonomy still does not put a sufficient handle on the concept of safety climate.

Instead, I would like to classify the scales found according to the organisational level at which the processes they refer to, take place. This classification provides some insight into the information that surveys might actually have collected. Firstly however, the organisational levels will be outlined.

4.2 Organisational levels

Generally, in organisations several structural levels can be distinguished, based on the different types of processes taking place at these levels. For instance, in a report for the Dutch government de Boer & van Drunen (2003) list four levels at which behaviour within organisations can be observed – macro-organisational, micro-organisational, individual-rational and individual-perceptual. Also Hofmann et al. (1995) distinguish macro, micro and individual behavioural levels with regard to safety (performance). I would like to adopt these levels for the present taxonomy, re-labelling them for the current purpose *organisational*, *group* and *individual*.

With the *organisational* level I refer to (behavioural) processes taking place at higher organisational levels – i.e. plant management, the management team or senior management. There is an abundance of literature on the importance of such processes at this level for safety performance, see for instance Collins & Gadd (2002) for a review.

The *group* level refers to (behavioural) processes within groups or teams the respondent works in and belongs to, *including* the team leader or supervisor

(the importance of the role of supervisors is stressed in several publications, e.g. Simard & Marchand (1996) or Flin et al. (2000)).

Finally, following de Boer & van Drunen (2003), we find primarily rational and perceptual processes influencing behaviour at the *individual* level, i.e. processes particular to the respondent. Combining this with what has been said about attitudes above part of the processes at this level could be considered attitudinal processes.

Table 1 Management systems and their manifestation at different organisational levels

Process	Organisational level	Group level	Individual level
Risks	Policies with regard to which, when and how risks are evaluated (i.e. what the present dangers and risks are and how they should be perceived and controlled).	Risks and dangers present in the primary tasks performed by a group	Risks and dangers associated with the particular task (and location) at hand
Hardware design & layout	Policies with regard to how identified risks are avoided, reduced or controlled by design or layout (i.e. policies determining the choice of barriers that control present dangers and risks).	Barriers encountered/used by the work group to control the risks they face during the execution of their primary tasks	Particular barriers present, used and/or operative during the execution of a particular task
Maintenance	Policies with regard to maintenance and inspection (e.g. when [preventive vs corrective], how often, etc.).	Maintenance and/or inspection tasks carried out by the group (if relevant). Maintenance and inspection plans.	Particular inspection/maintenance tasks carried out.
Procedures	Policies with regard to formal procedures and instructions (balanced by what is trained and how workers are recruited and selected). Basically, policies determining the structure of work	Detailed rules, procedures and safety instructions related to work group functions and tasks.	Presence of rules, procedures and work instructions for a particular task and their level of detail.
Manpower planning	Policies with regard to (minimum) manning levels during (a) normal operations, (b) process disturbances and (c) emergency situations (i.e. basically policies determining work pressure).	Work schedules and manning levels: people of work group assigned to tasks, shifts, rosters. Planning of personnel for major maintenance stops.	Time and people available to carry out a particular job.
Competence	Policies determining what competencies (skills, knowledge, physique) are required to perform any task (balanced by what is written down in formal procedures).	Function and task descriptions and requirements. The qualities (skills, knowledge, physique) present in the work group.	Particular task requirements in terms of knowledge (plant, process, instruments, tools) and physical abilities.
Commitment	Policies with regard to supervision and motivation of the workforce and the adherence to rules (e.g. what is acceptable behaviour and how deviations should be corrected).	Motivation or incentive programs and ways of supervision. Adequate and dedicated behaviour shown in relation to the primary tasks of the work group (either execution or supervision).	Adequate and dedicated behaviour shown in relation to this task. Supervision and/or active behavioural modification programs functioning during the execution of a particular task.
Communication	Policies with regard to effective collaboration and interaction of (groups) of people (i.e. policies determining who should talk with whom about what).	Communication (between members of the work group) related to the primary tasks: meetings, hand-over procedures, permits-to-work (PTWs), field vs. panel operator routines.	Types of communication involved with executing a particular task (e.g. hand-over, PTW, communication with control room or colleagues).
Monitoring and change	Policies with regard to performance indicators and adjustments to the technology or safety management system.	Registration of performance indicators by/of work group members: audits, inspections, checklists, to-do lists, accident/incident reporting. Change management procedures.	Opportunity and means to give feedback on deviations that occurred during the execution of a particular task & proposals to change work methods or layout.

Now, we will look more closely at the processes taking place at each level (Table 1). The nine dimensions used as structure here are adapted from those developed in Delft in research on auditing of management (e.g. Guldenmund, Hale, Goossens, Betten, & Duijm, 2006; Hale, Kirwan, & Guldenmund, 1999). At the highest, organisational, level the processes carried out here can be equated with safety management efforts at, what has been called, the 'policy' or strategic level. What is decided at this level of the organisation in terms of policies, ambitions, strategies, goals, targets, means and so on, is passed on to the next, or group, level, where such decisions are usually divided amongst groups or individuals and worked out in detail, often by technical or staff services. The important point here to observe is that *how* these processes are detailed is both dependent on what is outlined at the level above, as well as on the circumstances the particular groups operate in. This means that the very generic outcomes of the processes defined above, become concrete functions and activities (Table 1, third column) of groups and teams.

Clearly, what can be defined in most global terms at the highest level of the organisation becomes much more detailed and nuanced at the level below. Moreover, this is also the actual environment of the worker and this is what (s)he has primary knowledge of, experiences with and feelings and, hence, attitudes about.

Finally, getting at the lowest level the information that has been processed (i.e. specified or detailed) at the group level becomes reality for the individual worker during a particular task or job (Table 1, fourth column).

The inventory of all these processes has been so detailed to make one point very clear: the (very) general objects that are the subject of policies at the organisational level (competence, procedures, hardware) become very specific matters (knowledge about a particular piece of hardware, specific procedures to do a certain job, etc.) at the individual level. So what is quite coherent at the organisational level becomes quite fragmented at the level of individuals.

5 Organisational levels and attitude objects

5.1 Organisational level

The nine dimensions defined above and processed at each of the three organisational levels could also be envisioned as things people have actually done or perceived being done, or have knowledge or particular feelings about. To put it another way, these processes could also function as attitude inputs or objects and, hence, produce evaluative responses.

Referring again to Table 1, this also provides a rough overview of how policies that are promulgated at the highest level of the organisation, trickle down through the other levels to arrive at the primary process as specific conditions under which individual tasks are performed. What is important to appreciate is that policies propagated at the organisational level furnish what could be con-

sidered the *Gestalt* of safety within the organisation – i.e. what is considered safe, acceptable and controllable. Put yet in another way – this is the stuff that beliefs and convictions are made of.

It has already been pointed out in several reviews, e.g. (Cox & Flin, 1998; Flin et al., 2000; Guldenmund, 2000), that both the questionnaires as well as the target populations in safety climate research differ significantly. Although this might explain some of the variation in the factor solutions found, it is nevertheless very striking that many studies report finding similar or comparable 'management' and 'safety system' factors (Flin et al., 2000). Obviously, these two factors would compare well with the nine processes defined above.

In Table 2 the scales that have been found in previous safety climate studies are labelled somewhat tentatively according to the level and the attitude object (i.e. one or more of the nine processes) the scale seems to denote. In this table only studies are used that mention either the *eigenvalues*[3] or percentage of explained variance (or both) resulting from the analysis (which is usually PCA) as well as the questions that make up the scale. Also included are the alpha-coefficients, which are a measure of the internal consistency of a particular scale.

What can be clearly seen from Table 2 is that the most important factors – i.e., those having the highest *eigenvalues* and, hence, percentage of explained variance – have acquired the label 'organisation'.[4] As it is, these factors account for the bulk of the variance within a data set and their constituting variables (the questionnaire items) therefore have the highest co-variation amongst themselves.

The issue of aggregation of questionnaire data has been raised more than once, see for instance Guldenmund (2000) or Mearns et al. (2003). To produce their factor solutions all studies aggregate their data to the level of the organisation. While this might be meaningful for some issues, other issues are best explored at the group or even individual level. However, because of the small amount of data a PCA might not be feasible then. In addition, as long as correlations between variables function as input for the analysis methods, another issue can arise. For instance, when there are two tight groups with very opposed points of view – this is not an uncommon situation in some organisations – the overall correlation (i.e. aggregated correlation) between the variables expressing these views will be low, while the within group correlations will be high. These variables will also show a bimodal distribution. Again, the analysis methods will not work well for these variables and they will not contribute much, if at all, to the scales identified. Yet they could indicate important cultural differences between groups within one organisation.

3 Eigenvalues result from the decomposition of a correlation or co-variance matrix and which is part of the principal component analysis (PCA) Basically they express the amount of variance a particular dimension accounts for. Eigenvalues are always presented in descending order.

4 Some original labels are rather misleading in that they employ words like 'personal' or 'motivation'. Inspection of the constituting questions revealed that these factors actually refer to organisation level attitude objects.

Table 2 – Research teams, factors and associated statistics and organisational level

Research team	Year	Safety climate scale	ev	% variance	α	Level
Zohar	1980	Importance of safety training programs	9.84	40.9%		Organisation (competence)
		Management attitudes towards safety	4.63	19.3%		Organisation (risk)
		Effects of safe conduct on promotion	2.53	10.6%		Organisation (commitment)
		Level of risk at work place	2.34	9.7%		Group (risk, hardware)
		Effects of required work pace on safety	1.66	6.9%		Organisation/Group (availability)
		Status of safety officer	1.17	4.8%		Organisation (commitment)
		Effects of safe conduct on social status	1.07	4.4%		Group (commitment, competence)
		Status of safety committee	0.84	3.4%		Organisation (commitment)
Cox & Cox	1991	Personal scepticism	3.34	19,00%		Organisation/Group (commitment)
		Individual responsibility	1.84	10,00%		Individual (commitment, competence)
		Safeness of work environment	1.51	8,00%		Group (risk, hardware)
		Effectiveness of arrangements for safety	1.25	7,00%		Organisation/Group (hardware)
		Personal immunity	1.06	6,00%		Individual (commitment, competence)
Cabrera & Isla	1994(?)	Company policies towards safety	–	38.9%		Organisation (risk)
		Emphasis on productivity versus safety	–	6.4%		Organisation (commitment, availability)
		Group attitudes towards safety	–	5,00%		Group (commitment)
		Specific strategies of prevention	–	3.9%		Organisation (risk, hardware)
		Safety level perceived in the airport	–	3.7%		Group/Individual (risk, hardware)
		Safety level perceived on the job	–	3.6%		Group/Individual (risk, hardware)
Coyle & Sleeman	1995	Maintenance and management issues (organisation 1)	–	49.12%		Organisation/Group (a.o. maintenance, commitment, procedures)
		Company policy (organisation 1)	–	11.27%		Organisation (a.o. commitment, competence, monitoring & change)
		Accountability (organisation 1)	–	9.51%		Organisation (commitment, procedures, monitoring & change)
		Training and management issues (organisation 1)	–	8.56%		Organisation (competence, procedures)
		Work environment (organisation 1)	–	7.87%		Group (hardware, commitment)

Research team	Year	Safety climate scale	ev	% variance	α	Level
		Policy / procedures (organisation 1)	–	7.39%		Organisation (hardware, procedures)
		Personal authority (organisation 1)	–	6.27%		Individual (competence, commitment)
		Work environment (organisation 2)	–	71.19%		Organisation/Group (a.o. maintenance, commitment, procedures)
		Personal authority (organisation 2)	–	17.62%		Organisation (commitment, monitoring & change)
		Training and enforcement of policy (organisation 2)	–	11.19%		Organisation/Individual (procedures, hardware, competence, commitment)
Berends	1996	Confidence in the arrangements for safety	11.12	20.2%	0.83	Organisation (hardware)
		Compliance with safe working practices	3.35	6.1%	0.82	Group (commitment)
		Perceived priority given to safety	2.4	4.4%	0.8	Organisation (commitment)
		Own active effort put in safety matters	2.08	3.8%	0.8	Group/Individual (commitment)
		Communication about safety	1.96	3.6%	0.82	Group (communication)
Williamson, Feyer, Cairns & Biancotti	1996	Personal motivation for safety	–	18,00%	0.86	Organisation/Group (commitment)
		Positive safety practice	–	11.9%	0.84	Organisation/Group (commitment)
		Risk justification	–	7.2%	0.79	Individual (competence, hardware)
		Fatalism	–	5.9%	0.65	Group/Individual (commitment, monitoring & change)
		Optimism	–	4.2%	0.39	Group (commitment, hardware)
Glendon & Litherland	2001	Communication and support	5.89	18.3%	0.93	Organisation/Group (a.o. communication, commitment, availability)
		Adequacy of procedures	4.4	13.7%	0.92	Organisation/Group (procedures)
		Work pressure	4.17	13,00%	0.89	Organisation (availability)
		Personal Protective Equipment (PPE)	3.23	10.1%	0.86	Group/Individual (hardware, monitoring & change)
		Relationships	2.3	7.2%	0.82	Organisation/Group (commitment)
		Safety rules	2.18	6.8%	0.72	Group (procedures)

Research team	Year	Safety climate scale	ev	% variance	α	Level
O'Toole	2002	Management's commitment to safety	–	11.94%		Organisation (commitment)
		Safety supervisory process	–	9.72%		Group (commitment)
		Emergency response	–	7.59%		Organisation (risk, hardware, procedures)
		Education and knowledge	–	5.62%		Organisation (competence)
		Employee involvement and commitment	–	5.48%		Organisation/Group (commitment)
		Off-the-job safety	–	3.89%		Not covered
		Drugs and alcohol	–	3.04%		Organisation (commitment, procedures)
Itoh, Andersen & Seki	2003	Motivation	–	25.8%	0.643	Organisation/Group (commitment, competence, procedures)
		Satisfaction with own competence	–	8.5%	0.901	Organisation/Individual (competence)
		Safety awareness of operation	–	6.4%	0.323	Group (risk, competence)
		Morale	–	5.3%	0.312	Organisation (commitment)
		Satisfaction with manual and checklists	–	5.1%	0.737	Organisation (procedures, monitoring & change)
		Satisfaction with management system	–	4.5%	0.553	Organisation (procedures, commitment)
		Trust in management	–	4%	0.573	Organisation (commitment, monitoring & change)

What this tells us is that substantial correlations will only be found amongst variables that are unimodally distributed and also (are perceived to) have meaning at that level of measurement and aggregation. Only then might such high correlations reveal shared notions in the (aggregated) population. As the analysis of the research in table 2 shows, these are often shared notions about the products of processes operating at the organisational level (e.g. organisational context, working conditions, knowledge, capacities, etc.). Most likely these factors therefore provide an evaluation of higher management *per se* and, in the absence of actual knowledge or experience, are primarily based on an affective stance towards this management.[5] Similar observations about the nature of these management factors have been offered by Cabrera et al. (1998; 1997) and Mearns et al. (2003).

Another problem exposed here that mars all attitude-related research is that people will almost always express an attitude when asked about it (Fiske & Taylor, 1991, p. 520). Schuman and Presser (1981) report an interesting finding in this respect (p. 148 ff.). In a nationwide survey US respondents were asked to agree or disagree with a particular act about to pass congress. While this particular law proposal was hardly even known, answers to this question were nevertheless collected. It appeared however, that these answers correlated significantly with a question about the economic performance of the current administration. This relationship is explained as expressing a more general confidence in the current government. Such a general trust would provide a positive attitude towards *any* bill they propose.

Related causal reasoning seems to underlie both structural models of Thompson et al. (1998) and Neal et al. (2000). These papers propose levels that can be identified as the organisation, group and individual levels, where the factors pertaining to the organisation level reflect general ideas about management and the group and individual levels refer to concrete knowledge, conditions and practices. Interestingly, at the latter two levels the word 'safety' also becomes more prominent.

Summarising, the dominant factors found in most safety climate research can be ascribed to mostly affective evaluations of the workforce about its management at an organisational level of aggregation. It has been further argued that nine generic safety management processes at the organisational level shape these notions.

5 Behavioural and cognitive as well as affective processes can function as inputs to attitude formation. In the absence of both behavioural experience and actual knowledge of what goes on at the organisational level, it is therefore argued that affective processes play a prominent role in attitude formation amongst those at lower organisational levels.

5.2 *Group level*

Although processes at the organisational level deliver the context and conditions for all activities at lower levels, the results of these processes are still rather unspecific. Additional inputs for attitude formation are provided at the group level where the organisational level outputs are worked out in detail and divided amongst, and processed by groups or individuals. In specifying and executing these processes the shop floor starts to get conscious of the policies and provisions of its management. The role of the supervisor in this process has been stressed in several publications (Collins & Gadd, 2002; Hofmann & Stetzer, 1998; Sorensen, 2002; Zohar, 2002) and (s)he is added emphatically to this level. The supervisor often explains, justifies and applies (or downplays and undermines) higher management's policies to and on the work floor and is therefore responsible for the notions that live amongst the workers about its management, or, for example, the cause of accidents (Gherardi, Nicolini, & Odella, 1998; Hofmann & Stetzer, 1998). Clearly, when policies are not put into operation, workers develop other notions about safety then when they are. For instance, when policies are sold as 'compliance' to the workforce the main message becomes to obey and, therefore, please your boss ('comply to the rules') rather than doing yourself a favour ('return home unharmed'). This particular relationship between organisational, group and individual ideas and values is quite important but a somewhat underdeveloped field in terms of research. The important role of supervisors as the tender of organisational culture in creating congruence by mixing organisation, group and individual interests into a meaningful whole cannot, however, be overstated.

What might be hypothesised here is that, when significant correlations appear between variables that refer to group level attitude objects in data sets that are aggregated to the level of the organisation – for instance, questions about colleagues, rule following, working conditions – this might reflect the existence of shared attitudes at *both* the organisational and group level, meaning that there is some evidence of congruence between these two levels. Such congruence is indicative of an organisational culture, e.g. see Schein (1992, 1996). Nevertheless, such congruence is never a given, which means that within an organisation multiple sub-cultures can flourish. However, being both a shared and learned phenomenon, such sub-cultures can basically exist only within interacting groups or groups with a comparative formal educational background (Jones & James, 1979; Schein, 1996).

Summarising, when factor solutions from aggregated data sets provide factors referring to group level attitude objects, it is hypothesised that these factors express a certain degree of congruence within the organisation, with regard to that factor. In other words, groups within the organisation will show comparable attitudes.

5.3 Individual level

According to the framework by de Boer & van Drunen (2003) both rational and perceptual processes influence behaviour at the individual level. Perceptual processes are more of a skill- and rule-based nature whereas the rational processes are typically knowledge-based. The safety management processes 'competence' and 'procedures' typically shape all skill-, rule and knowledge-based activities (Table 1), and both should be well-balanced with regard to what has to be trained and well-known versus what should be done according to detailed instructions along with checklists or more sophisticated means of decision support. Obviously, this balance is a matter of choice because an organisation can choose to train its people very well and leave the procedures on the shelf, or instruct its people how to use the procedures.

The aspect of competence itself has a large cultural flavour to it, as culture is learned and competence is mostly learned too, that is, apart from its physical/anthropometrical component. National cultural values are generally acquired early in life at home and at school (Hofstede, 1991) whereas more practical input is provided later in life at work. The cultural values passed on through education are often more binding than the ones acquired at work through interaction, e.g. see Jones & James (1979) for the interesting finding on several navy ships where functional groups (e.g. navigation, maintenance, missiles) showed more perceptual cohesion than structural groups (e.g. ships and various groups on ships). With regard to organisations Schein (1996) also distinguishes executives from engineers from operators – functional groups obviously with a different educational background.

An individual level variable that has shown predictive value with regard to injury rates in hospitals is a good previous safety record of employees (Vredenburgh, 2002). Employees who are engaged on such a record have significantly fewer injuries. Obviously, such employees have good competence (skills or rules), which apparently can be transposed effectively to other hospitals.

Walker has been doing interesting work in Australia on psychological contracts between individual workers and their employers (Walker & Hutton, 2005). A psychological contract contains implicit information about mutual expectations (especially obligations) the employee has of his or her employer. When such expectations become shared between the members of a group, this may be either a structural or a functional group, they might become part of the culture this group has, i.e. become shared basic assumptions and convictions the group has about its management. The shared set of beliefs regarding reciprocal obligations may be viewed as a group level psychological contract or a normative contract (Rousseau, 1995).

However, within the context of culture research individual level variables do not have much meaning as the level of theory of the two levels differs. The level of theory pertains to the level at which generalisations will be made and it often also determines the level of measurement – i.e. the source level of the data.

Whether individual level questions are used to construct higher-level climate dimensions should largely depend on empirical characteristics of the data. If there is sufficient perceptual agreement at a higher level of aggregation, then these aggregated values might be used. Suitable statistics for assessing perceptual agreement are the CCI(1) and CCI(2)[6] (Glick, 1985; James, 1982; Jones & James, 1979).

Moreover, variables defined at the group or organisational level usually do not work very well at the individual level. This pertains to the issue of aggregation bias (James, 1982), which will be taken up below. Nevertheless, most questionnaires applied in safety climate research use questions defined at the individual (or group) level and these show up in primary factors in aggregated data sets. It has been argued above that these factors represent most likely evaluations of management *per se*.

6 The organisational context of culture

Within organisations three major forces are operating at the same time on (the behaviour of) the people who work there. These generic forces are structure, culture and processes and they are dynamically interrelated, that is, the particular strength of each force is determined by the other two. This actually means that these forces are also functionally related in that their particular strengths are both meaningful and significant with regard to each other and, hence, with regard to the organisation. Together they shape the context in which behaviour, and therefore also safety related behaviour, takes place.

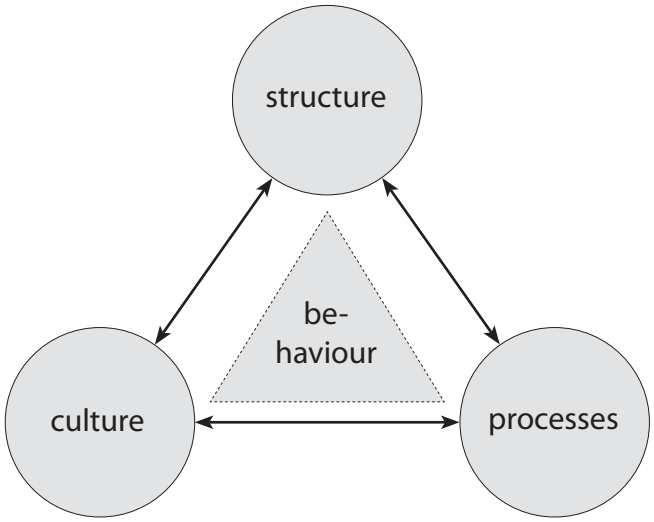
The structure primarily outlines the formal organisation, i.e. the proposed allocation of power and responsibilities (horizontal and vertical differentiation) and the mechanisms of communication, coordination and control. This defines how the organisational mission should be accomplished and by whom. The culture is the basic assumptions, the underlying convictions. For instance – 'We need a lot of supervisors because our people need to be watched constantly'. Such a conviction you will find back in the structure of the organisation and therefore also on the work floor, e.g. in the number of supervisors and where they are situated (organisationally and physically). The processes are the actual primary and supporting (incl. management) processes going on in the entire organisation; in this example the process of supervision, aimed at ensuring commitment and the reduction of violations. This might be according to structure, but this does not have to be the case. For instance, (some) supervisors do not watch constantly, or do not correct workers, although they see them make mistakes or commit violations. The reason for this might be structural – the wrong man in the right place – or cultural – the convictions of a group of supervisors

6 Intraclass correlation. ICC(1) denotes agreement amongst individuals and ICC(2) pertains to the reliability of group means (James, 1982).

and/or their workforce do not match up to the structure. Fig. 1 depicts these three major forces.

One important implication of the figure is that any organisation's culture cannot be isolated from its structure or processes. In carrying out the processes and coping with difficulties groups of people develop a culture, either despite of or because of some particular structure. This provides also a strong argument for a holistic exploration of culture.

Figure 1 The organisational triangle



Within this triangle the nine management processes defined above are formulated at the organisational level, use the structural component of the triangle and shape the conditions for the primary business process(es) and related operational processes at the levels below. Safety climate is of course part of the culture component and is, evidently, influenced by both structure and processes. This triangle again illustrates that shared organisational attitudes (culture) might be largely determined by organisational level processes and structures whereas specific local conditions (structure) and processes might shape group and individual level attitudes (culture).

7 Safety outcomes

The whole point of constructing climate scores is their assumed influence on safety related behaviour or safety outcomes. As can be seen from table 3, the relationship between climate factors and several criterion variables (often safety

related behaviour) is far from convincing. Again, the issue of aggregation might play a role here, along with issues regarding levels of theory and measurement.

When scores are aggregated to the level of the organisation, individual influences disappear and the overall mean becomes the replacement score. However, when this aggregated score is combined with values still at the individual level, an uneven mix is obtained which often even produces inflated results because of 'aggregation bias' (James, 1982).

Table 3 – Research teams, scales and relationships with criterion variables

Research team	Year	Safety climate scale	Criterion variable	Coefficient
Zohar	1980	Overall (sum) safety climate score	Safety inspectors' rankings of safety practices and accident prevention programs of participating plants	r_s = .90 (chemical) r_s = .80 (metal) r_s = .50 (textile)
Cox & Cox	1991	See table 2	None	
Cabrera & Isla	1994(?)	Company policies towards safety Emphasis on productivity versus safety Group attitudes towards safety Specific strategies of prevention Safety level perceived in the airport Safety level perceived on the job	Comparisons are made between a fuelling company, airport authority and handling division all active at an airport. Rankings of these companies on safety level, safety climate and safety attitude are similar. Age and time at company are also contributing variables.	
Coyle & Sleeman	1995	See table 2	None	
Berends	1996	Compliance with safe working practices Communication about safety	Accident rate Response rate (on questionnaire)	r_{part} = –.45 (n.s.) r_{part} = –.32 (n.s.)
Williamson, Feyer, Cairns & Biancotti	1996	Personal motivation for safety	Dangers in workplace (yes/no)?	F = 3.73 (5%)
			Accident while working (yes/no)?	F = 1.94 (n.s.)
		Positive safety practice	Dangers in workplace (yes/no)?	F = 56.3 (0.01%)
			Accident while working (yes/no)?	F = 10.5 (0.1%)
		Risk justification	Dangers in workplace (yes/no)?	F = 6.49 (1%)
			Accident while working (yes/no)?	F = 1.62 (n.s.)
		Fatalism	Dangers in workplace (yes/no)?	F = 1.06 (n.s.)
			Accident while working (yes/no)?	F = 0.4 (n.s.)
		Optimism	Dangers in workplace (yes/no)?	F = 19.5 (0.01%)
			Accident while working (yes/no)?	F = 19.6 (0.1%)
Glendon & Litherland	2001	Communication and support	Percentage safe behaviour	n.s

Research team	Year	Safety climate scale	Criterion variable	Coefficient
		Adequacy of procedures	Percentage safe behaviour	n.s
		Work pressure	Percentage safe behaviour	n.s
		Personal Protective Equipment (PPE)	Percentage safe behaviour	n.s
		Relationships	Percentage safe behaviour	n.s
		Safety rules	Percentage safe behaviour	n.s
O'Toole	2002	Management's commitment to safety	Deviation from 'norm'	+ (n.s.)
		Safety supervisory process	Deviation from 'norm'	+ (sign.)
		Emergency response	Deviation from 'norm'	– (sign.)
		Education and knowledge	Deviation from 'norm'	+ (n.s.)
		Employee involvement and commitment	Deviation from 'norm'	– (n.s.)
		Off-the-job safety	Deviation from 'norm'	+ (n.s.)
		Drugs and alcohol	Deviation from 'norm'	– (sign.)
Itoh, Andersen & Seki	2003	Motivation	Weighted accident/incident rate	trend
		Morale	Weighted accident/incident rate	trend

Moreover, as has been argued previously, the findings from climate research might very well represent general attitudes towards management and its perceived influence on working conditions rather than an evaluation of the conditions themselves and it may not make much sense to correlate general notions about management with safety performance indicators in the form of output variables (behaviour or accidents). It is therefore important when doing research that recognises multiple levels of theory that these levels are also appreciated and, furthermore, assessed with appropriate source data.

8 Conclusion and discussion

This paper has tried to explain two striking results from safety climate research:

1. Analyses provide many different factors that are hard to replicate
2. Most analyses produce one or several higher management related or organisational factors that account for most of the variance in the data

Attitudes towards several generic safety management processes can account for these results while these processes shape the context and working conditions for the entire organisation. Nine such processes have been defined, which together cover the full safety management spectrum (Guldenmund et al., 2006). It depends on the questionnaire, the primary business process and the target population how many of these safety management processes will be recognised in the factors resulting from a data analysis. Furthermore, it is argued that these factors probably represent an evaluation of management and the way they consider and handle safety.

However, not only work-related processes but also values are operative at all levels of the organisation. De Boer & van Drunen (2003) refer to relevant work by Schwarz (Schwartz, 1992; Schwartz & Sagie, 2000) and also Reiman & Oedewald (2004) refer to a 'value framework', that they have adapted from Cameron & Quinn. In addition, the International Atomic Energy Agency (IAEA) emphasise in their SCART-guidelines the importance of 'safety as a value' being present throughout the whole of the installation (International Atomic Energy Agency, 2005).[7]

While values regarding safety seem to be important they have not been successfully assessed through self-administered questionnaires yet. Neither Reiman & Oedewald (2004) nor Berends (1996) succeeded in operationalising values or beliefs respectively. It might very well be that safety value assessment simply requires a different research strategy.

7 SCART stands for Safety Culture Assessment Research Team. A temporary multidisciplined team assembled by the IAEA to assesses the safety culture of nuclear installations on their request.

Furthermore, the extent to which safety indeed is a value in any organisation is largely determined by the decisions and choices made at the organisational level, which start to take shape – that is, to manifest themselves – at the group level. Put in this way, (safety) climate, attitudes and (safety) culture now begin to share common borders. Particular manifestations of (un)safety visible to people at work in their groups or on their own will be, in the end, understood by them as how concerned management is with their well-being. As such safety is constructed and re-constructed not only on a daily experiential basis (cognition, behaviour) but also from the general notions of concern (affection) that 'trickle down' (DeJoy, 2005) from above.

Following this line of argument it would make much sense to consider the outputs of the nine management processes not only as safety attitude objects for individual and group level evaluations but also as themes expressing (management) values regarding safety. In the first case the nine management process dimensions can be used as objects to generate questions to elicit the cultural dimensions, which influence whether the processes operate successfully or not. In the latter case the (self-administered) questionnaire should perhaps be used with more reservation, as an approach using a similar set of themes has not been so successful in exposing values in the past (see above). It is probably more efficient to integrate the value aspect in an audit tool aimed at assessing the quality of the nine management processes. Quite comparable reasoning can be found in Grote & Künzler (2000), although they primarily rely on questionnaires to elicit aspects of organisational culture and it is also not clear whether their levels of theory and measurement sufficiently overlap. Nevertheless, their approach is exemplary for the one advocated here, that is, assessing organisational and safety culture within the context of organisational processes and structure, which both shape and are shaped by the present culture.

Acknowledgements

The author wishes to thank Michael Baram, Markus Schöbel and especially Andrew Hale for their useful comments on earlier drafts of this chapter.

References

Berends, J. J. (1996). *On the measurement of safety culture*. Unpublished graduation report. Eindhoven: Eindhoven University of Technology.

Brown, R. L., & Holmes, H. (1986). The use of a factor-analytic procedure for assessing the validity of an employee safety climate model. *Accident Analysis & Prevention, 18*(6), 455-470.

Cabrera, D. D., & Isla, R. (Eds.). (1998). *The role of safety climate in a safety management system*. Oxford: Pergamon.

Cabrera, D. D., Isla, R., & Vilela, L. D. (1997, August 27-29). *An evaluation of safety climate in ground handling activities.* Paper presented at the IASC-97, International Aviation Safety Conference, The Netherlands.

Clarke, S. (2006). Contrasting perceptual, attitudinal and dispositional approaches to accident involvement in the workplace. *Safety Science, 44*, 537-550.

Collins, A. M., & Gadd, S. (2002). *Safety culture: a review of the literature*. Sheffield: Health and Safety Laboratory, Human Factors Group.

Cooper, M. D. (2000). Towards a model for safety culture. *Safety Science, 36*(2), 111-136.

Cox, S., & Cox, T. (1991). The structure of employee attitudes to safety: an European example. *Work & Stress, 5*(2), 93-106.

Cox, S., & Flin, R. (1998). Safety culture. Philosophers' stone or man of straw? *Work & Stress, 12*(3), 189-201.

Coyle, I. R., Sleeman, S. D., & Adams, N. (1995). Safety climate. *Journal of Safety Research, 26*(4), 247-254.

de Boer, J., & van Drunen, M. (2003). *Occupational safety from a behavioural perspective* (No. E-03/12). Amsterdam: Institute for Environmental Studies (IVM), Vrije Universiteit.

DeDobbeleer, N., & Béland, F. (1991). A safety climate measure for construction sites. *Journal of Safety Research, 22*, 97-103.

DeJoy, D. M. (2005). Behavior change versus culture change: divergent approaches to managing workplace safety. *Safety Science, 43*(2), 105-129.

Eagly, A. H., & Chaiken, S. (1993). *The psychology of attitudes*. Fort Worth: Harcourt Brace Jovanovich.

Fiske, S. T., & Taylor, S. E. (1991). *Social cognition* (2nd ed.). New York: McGraw-Hill, Inc.

Flin, R., Mearns, K., O'Connor, P., & Bryden, R. (2000). Measuring safety climate: identifying the common features. *Safety Science, 34*, 177-192.

Gherardi, S., Nicolini, D., & Odella, F. (1998). What do you mean by safety? Conflicting perspectives on accident causation and safety management in a construction firm. *Journal of Contingencies and Crisis Management, 6*(4), 202-213.

Glendon, A. I., & Litherland, D. K. (2001). Safety climate factors, group differences and safety behaviour in road construction. *Safety Science, 39*, 157-188.

Glick, W. H. (1985). Conceptualizing and measuring organizational and psyhological climate: pitfalls in multilevel research. *Academy of Management Review, 10*(3), 601-616.

Grote, G., & Künzler, C. (2000). Diagnosis of safety culture in safety management audits. *Safety Science, 34*(1-3), 131-150.

Guldenmund, F. W. (2000). The nature of safety culture: a review of theory and research. *Safety Science, 34*(1-3), 215-257.

Guldenmund, F. W., Ellenbroek, M., & van den Hende, R. (2006). Organisational culture research in a true Dutch company (in Dutch). *Tijdschrift voor Toegepaste Arbowetenschap, 19*(2), 24-32.

Guldenmund, F. W., Hale, A. R., Goossens, L. H. J., Betten, J. M., & Duijm, N. J. (2006). The development of an audit technique to assess the quality of safety barrier management. *Journal of Hazardous Materials, 130*(3), 234-241.

Hale, A. R., Kirwan, B., & Guldenmund, F. W. (1999). Capturing the river: multi-level modelling of safety management. In J. Misumi, B. Wilpert & R. Miller (Eds.), *Nuclear safety: a human factors perspective*. London: Taylor & Francis.

Hofmann, D. A., Jacobs, R., & Landy, F. (1995). High reliability process industries: individual, micro, and macro organizational influences on safety performance. *Journal of Safety Research, 26*(3 (Fall)), 131-149.

Hofmann, D. A., & Stetzer, A. (1998). The role of safety climate and communication in accident interpretation: implications for learning from negative events. *Academy of Management Journal, 41*(6), 644-657.

Hofstede, G. R. (1991). *Cultures and organisations: software of the mind*. London: McGraw-Hill.

International Atomic Energy Agency. (2005). *SCART Guidelines. Guidelines for Safety Culture Assessment Review Teams. Unpublished report*. Vienna: IAEA.

James, L. R. (1982). Aggregation bias in estimates of perceptual agreement. *Journal of Applied Psychology, 67*(2), 219-229.

Jones, A. P., & James, L. R. (1979). Psychological climate: dimensions and relationships of individual and aggregated work environment perceptions. *Organizational Behavior and Human Performance, 23*, 201-250.

Mearns, K., Whitaker, S. M., & Flin, R. (2003). Safety climate, safety management practice and safety performance in offshore environments. *Safety Science, 41*, 641-680.

Neal, A., Griffin, M. A., & Hart, P. M. (2000). The impact of organizational climate on safety climate and individual behavior. *Safety Science, 34*, 99-109.

Reiman, T., & Oedewald, P. (2004). Measuring maintenance culture and maintenance core task with CULTURE-questionnaire – a case study in the power industry. *Safety Science, 42*(9), 859-889.

Rousseau, D. M. (1995). *Psychological contracts in organizations: Understanding written and unwritten agreements*. California: Sage Publications.

Schein, E. H. (1992). *Organizational culture and leadership* (2nd ed.). San Francisco: Jossey-Bass.

Schein, E. H. (1996). Three cultures of management: the key to organisational learning. *Sloan Management Review, Fall 1996*, 9-20.

Schuman, H., & Presser, S. (1981). *Questions and answers in attitude surveys*. Orlando: Academic Press.

Schwartz, S. H. (1992). Universals in the content and structure of values: theoretical advances and empirical tests in 20 countries. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. Vol. 25, pp. 1-65). San Diego (CA): Academic Press.

Schwartz, S. H., & Sagie, G. (2000). Value consensus and importance - a cross-national study. *Journal of Cross-Cultural Psychology, 31*(465-497).

Simard, M., & Marchand, A. (1996). A multilevel analysis of organisational factors related to the taking of safety initiatives by work groups. *Safety Science, 21*(2), 113-129.

Sorensen, J. N. (2002). Safety culture: a survey of the state-of-the-art. *Reliability Engineering and System Safety, 76*, 189-204.

Thompson, R. C., Hilton, T. F., & Witt, L. A. (1998). Where the safety rubber meets the shop floor: a confirmatory model of management influence on workplace safety. *Journal of Safety Research, 29*(1), 15-24.

Vredenburgh, A. G. (2002). Organizational safety: which management practices are most effective in reducing employee injury rates? *Journal of Safety Research, 33*, 259-276.

Walker, A., & Hutton, D. M. (2005, 30 June - 3 July). *Applying psychological contracts to workplace safety.* Paper presented at the 6th Industrial and Organisational Psychology Conference, Gold Coast, Queensland, Australia.

Williamson, A. M., Feyer, A.-M., Cairns, D., & Biancotti, D. (1997). The development of a measure of safety climate: the role of safety perceptions and attitudes. *Safety Science, 25*, 15-27.

Zohar, D. (2002). The effects of leadership dimensions, safety climate, and assigned priorities on minor injuries in work groups. *Journal of Organizational Behaviour, 23*, 75-92.

Afterword

Questionnaires are often mentioned in the same breath as safety climate research. As has been discussed in the afterword of Chapter 1, organisational (safety) climate research is concerned with the current organisational state of affairs, often to provide a stepping-stone for change or improvement(s). Because questionnaires supply mostly numerical results it is possible to attach a figure to this state of affairs and compare this figure with others. As far as I know, these numbers are always treated at the interval level of measurement, although they are actually at the ordinal level. In random, but as of yet unpublished, checks of this assumption I have compared data analysed at the ordinal level with data at the interval level[1] and it appears that subsequent PCAs (Principal Component Analyses) do not differ to the extent that they would lead to radically different conclusions about the underlying structure of the data. Nevertheless, it is remarkable that formal checks of this assumption have not been published so far.

Another point made in the chapter is that, although safety climate studies do not quite yield similar component or factor structures, a primary 'management' component generally appears in the bulk of these studies. Of course, this observation was already made by Flin et al. (2000) but subsequent safety climate studies did keep producing such a management component. In the chapter I have interpreted this component as representing 'affective evaluations of the workforce about its management', or, put in other words, the way the workforce 'feels' that their safety is being taken care of by management. I called this component 'affective' because the two other generic input processes to attitudes, i.e. cognitive (having specific knowledge about what is going on at the top) and behavioural (actually interacting with senior management) processes (e.g. Eagly & Chaiken, 1993), did seem less relevant to me.[2] Furthermore, I introduced the nine management delivery systems defined through various research projects at

1 Using SAS's PROC PRINQUAL it is possible to transform, i.e. re-quantify, numerical data to either an ordinal or nominal level of measurement. Importantly, such transformations are not absolute, but related to the data at hand, meaning that with different data different transformations could result.

2 In their impressive book on attitudes Eagly and Chaiken (1993, p. 14 ff.) mention three main inputs to attitude formation. A behavioural input would require some form of interaction with management and a cognitive input some specific knowledge about management. Both inputs seem less relevant to me at work floor level, which leaves affective inputs as the primary source for their attitude formation. However, if management inter-

Delft University (e.g. Guldenmund, Hale, & Bellamy, 1999; Guldenmund, Hale, Goossens, Betten, & Duijm, 2006; Hale, Guldenmund, Bellamy, & Wilson, 1999) as the major influences that basically shape these feelings, and I argued that these nine different management systems could be considered as objects for attitudes making up the safety climate. This might have been one of the first instances where safety climate has been combined with safety management. Up to now, this initiative has not seen much follow-up in the literature, neither from me nor anybody else.[3] This may be due to practicality, because concretising nine management delivery systems into clear survey questions could result in a questionnaire that is undesirably long and therefore I never actually made an attempt to do so.

Being more pragmatic, Zohar and Luria (2005) developed a questionnaire that focuses on (the formulation of) safety policies by management and the enactment of resultant procedures by supervisors to operationalise the safety climate construct. For their questionnaire they lean heavily on the British Standard Institute's description of benchmark safety management activities (OHSAS 18001). Both safety policies and the extent to which they are put into practice and enforced, clearly bring forward the assumptions and convictions of managers and supervisors regarding safety. Nevertheless, enactments also have a situational element attached to them less related to climate, or culture for that matter, so any *observational* data should be interpreted with a certain care.[4]

The correspondence between Zohar and Luria's and my operationalisation of the safety climate concept is that both positions focus on the general conditions that actually shape the safety climate of an organisation, which are, in essence, the perceived willingness or energy or enthusiasm or conformity or whatever perceived effort put into safety by executives in an organisation (e.g. Guldenmund, Hale, van Loenhout, & Oh, 2008; Hale, Guldenmund, van Loenhout, & Oh, 2008). Using this perceived effort, workers derive from it how much the organisation – that is, the organisational layers exerting power and responsibility – actually cares about the safety and well-being of its employees. And it is here also, that safety climate and safety culture share common borders, because this notion of caring will be grounded in the basic assumptions executives have about safety. However, as already noted above, it is not just culture that drives any demonstration of care, but also situational conditions. For instance, after a serious accident has occurred, the safety reins are typically tightened.

---

acts regularly with the work floor and also shares substantial information with them, of course, behavioural and cognitive inputs will be more pertinent.

3 It could be argued, though, that the Hearts & Minds matrix (Energy Institute, undated) does just that: combining safety management and safety culture in a questionnaire format.

4 It is for this reason that Schein (1992) does not consider behaviour part of the core of organisational culture.

Yet another important point made in the chapter is that levels of theory and levels of measurement should not be confused. Climate is a concept typically at the group or organisational level of theory and hence questions should address issues pertinent at these levels. Moreover, before some group is considered to share a climate, a formal check of perceptual agreement within this group should be made. In the chapter I mention two statistics for this purpose – i.e. ICC(1) and ICC(2)[5] – but I discovered later that more appropriate statistics have been developed to inspect group agreement, for single items as well as multiple item scales, for example r_{wg}, $r_{wg(j)}$ and $r^{*}_{wg(j)}$ (e.g. James, Demaree, & Wolf, 1984; Lindell & Brandt, 1997; Lindell, Brandt, & Whitney, 1999). Indeed, ICC(1) and ICC(2) provide estimates of *reliability*, not *agreement* (e.g. Shrout & Fleiss, 1979). Bliese's multilevel package for R (2006) provides multiple coefficients for agreement as well as ICC(1) and ICC(2).

In a setting in which order is primarily realised by management it is to be expected that a high proportion of variance in questionnaire data will be accounted for by attributions about management, notwithstanding the noise created by measurement technicalities described above. In 72% of the safety climate studies a management component is indeed identified (Flin et al., 2000), often taking account of most of the variance in the data (Guldenmund, 2007). Therefore, I think this management component, as I already stated above, primarily reflects an (affective) evaluation of management. This evaluation can be quite global, for instance, when the component contains mostly items aimed at quite general organisational safety aspects or activities. Examples of such items are: 'In this company managers care a lot about safety', or, 'Managers in this company encourage me to …'. However, this evaluation of management can be more specific as well, meaning that the component contains more items having a specific safety object, like personal protection equipment, training or accident investigations. In that case, management is judged on the way they deal with these more specific safety objects.

The validity of the safety culture concept has been subject of various research papers (e.g. Mearns, Whitaker, & Flin, 2003; Neal & Griffin, 2006; Zohar, 2002) and at least two meta-studies, i.e. Clarke's (2006) and Nahrgang et al.'s (2006). It appears that the influence of safety culture on safety performance is moderated by workers' compliance – i.e. workers' willingness to comply with required safety regulations – *and* participation – i.e. workers' willingness to contribute to safety beyond what is required of them. However, according to e.g. Cronbach (1971), validity first and foremost relates to the quality of the decisions or judge-

5 ICC stands for intraclass correlation coefficient. ICC(1) and ICC(2) are derived from an ANOVA where the grouping variable is the IV and some variable of interest, e.g. some component of safety climate, is the DV. Both coefficients are proportions and provide an omnibus analysis. A large ICC(1) indicates that the groups (defined by the grouping variable) are tightly clustered with little individual variability (Bliese, 1998). ICC(2) is the overall group-mean reliability. Agreement coefficients are calculated per group and focus on the dispersion amongst the group scores.

ments that can be made based on test results. Interestingly, within the safety climate field not many studies report such decisions or judgements, let alone additional interventions based on these (e.g. Guldenmund, 2008). However, the case study presented in Chapter 4 of this book and the subsequent afterword both discuss a diagnosis and recommendations based on this.

Because surveys can be conducted entirely from behind a desk, the temptation is strong to actually do so and remain there. The resulting numbers and relations between them start to replace the people, the context and the dynamics within the organisation (cf. Denison, 1996). If the study remains confined to the researcher's office, this would yield an undesirable result for culture research, because an organisational culture also has to be experienced, tasted, appreciated (ibid.). However, considering climate data as another source of raw data on the basis of which basic assumptions are deciphered is still an alternative, more fitting, application of this type of method within the context of organisational safety culture research.

In line with Cronbach referred to earlier, validating the safety climate concept by making diagnoses and decisions for intervention based on these, will be another useful step forward. Given the critique on solely desktop research expressed above, a requirement will be that such validation is carried out in the field to check and confirm that conclusions are justified, recognised and are supported by the company under study.

References

Bliese, P. D. (1998). Group size, ICC values, and group-level correlations: a simulation. *Organizational Research Methods, 1*(4), 355-373.

Bliese, P. D. (2006). *Multilevel modeling in R (2.2). A brief introduction to R, the multilevel package and the nlme package.* Washington, DC: Walter Reed Army Institute of Research.

Clarke, S. (2006). A meta-analytic review of safety climate and safety performance. *Journal of Occupational Health Psychology, 11*(4), 315-327.

Cronbach, L. J. (1971). Test validation. In R.L.Thorndike (Ed.), *Educational measurement* (2nd ed.). Washington, D.C.: American Council on Education.

Denison, D. R. (1996). What *is* the difference between organizational culture and organizational climate? A native's point of view on a decade of paradigm wars. *Academy of Management Review, 21*(3), 619-654.

Eagly, A. H., & Chaiken, S. (1993). *The psychology of attitudes.* Fort Worth: Harcourt Brace Jovanovich.

Energy Institute (undated). Hearts and Minds programme. Retrieved March 10, 2008, from http://www.energyinst.org.uk/heartsandminds/index.cfm.

Flin, R., Mearns, K., O'Connor, P., & Bryden, R. (2000). Measuring safety climate: identifying the common features. *Safety Science, 34*, 177-192.

Guldenmund, F. W. (2007). The use of questionnaires in safety culture research - an evaluation. *Safety Science 45*, 723-743.

Guldenmund, F. W. (2008). Safety culture in a service company. *Journal of Occupational Health and Safety - Australia and New Zealand, 24*(3), 221-235.

Guldenmund, F. W., Hale, A. R., & Bellamy, L. J. (1999, November 10-12, 1999). *The development and application of a tailored audit approach to major chemical hazard sites.* Paper presented at the SEVESO 2000. Risk Management in the European Union of 2000: The Challenge of Implementing Council Directive 96/82/EC "SEVESO II", Athens.

Guldenmund, F. W., Hale, A. R., Goossens, L. H. J., Betten, J. M., & Duijm, N. J. (2006). The development of an audit technique to assess the quality of safety barrier management. *Journal of Hazardous Materials, 130*(3), 234-241.

Guldenmund, F. W., Hale, A. R., van Loenhout, P., & Oh, J. (2008). *The secret of successful safety interventions*. Paper presented at the Bi-annual Conference 'Working on Safety' (WOS), Crete, 30 September - 3 October.

Hale, A. R., Guldenmund, F. W., Bellamy, L. J., & Wilson, C. (1999). IRMA: Integrated Risk Management Audit for major hazard sites. In G. I. Schueller & P. Kafka (Eds.), *Safety & Reliability* (pp. 1315-1320). Rotterdam: Balkema.

Hale, A. R., Guldenmund, F. W., van Loenhout, P., & Oh, J. (2008). *Evaluating safety management and culture interventions to improve safety: quantitative results*. Paper presented at the Bi-annual Conference 'Working on Safety' (WOS), Crete, 30 September - 3 October.

James, L. R., Demaree, R. G., & Wolf, G. (1984). Estimating within-group interrater reliability with and without response bias. *Journal of Applied Psychology, 69*, 85-98.

Lindell, M. K., & Brandt, C. J. (1997). Measuring interrater agreement for ratings of a single target. *Applied Psychological Measurement, 21*, 271-278.

Lindell, M. K., Brandt, C. J., & Whitney, D. J. (1999). A revised index of interrater agreement for multi-item ratings of a single target. *Applied Psychological Measurement, 23*, 127-135.

Mearns, K., Whitaker, S. M., & Flin, R. (2003). Safety climate, safety management practice and safety performance in offshore environments. *Safety Science, 41*(8), 641-680.

Nahrgang, J. D., Morgeson, F. P., & Hofmann, D. A. (2006). *Predicting safety performance: a meta-analysis of safety and organizational constructs.* Paper presented at the 21st Annual SIOP Conference, May 5-7, 2006, Dallas (TX).

Neal, A., & Griffin, M. A. (2006). A study of the lagged relationships among safety climate, safety motivation, safety behavior, and accidents at the individual and group levels. *Journal of Applied Psychology, 91*, 946-953.

Schein, E. H. (1992). *Organizational culture and leadership* (2nd ed.). San Francisco: Jossey-Bass.

Shrout, P. E., & Fleiss, J. L. (1979). Intraclass correlations: uses in assessing rater reliability. *Psychological Bulletin, 86*, 420-428.

Zohar, D. (2002). The effects of leadership dimensions, safety climate, and assigned priorities on minor injuries in work groups. *Journal of Organizational Behaviour, 23*, 75-92.

Zohar, D., & Luria, G. (2005). A multilevel model of safety climate: cross-level relationships between organization and group-level climates. *Journal of Applied Psychology, 90*(4), 616-628.

Chapter 3

The safety culture research process: steps and tools

Introduction to Chapter 3

After reviewing safety climate research, which is questionnaire based and also the most prevalent research strategy around in the field of safety culture, it made much sense to discuss the various other approaches in a subsequent paper, which has been specifically written for this book. Starting out as an ordinary 'toolbox' paper, it gradually gained more weight on the research process side. The particular choice of tools is just the end product of this process, and several decisions come before that. The chapter describes this research process and it appears not as deterministic as it is sometimes portrayed. For instance, a positivistic viewpoint does not necessarily lead to a quantitative study or (semi-) quantitative data can be used in a qualitative way, i.e. unequal numbers then express difference but no magnitude. Regarding the study of safety culture research, an eclectic approach is overall advocated, preferably in close collaboration with the researched.

Although the focus of this book is exploring and understanding organisational safety culture, this is usually not done for its own sake. An assessment phase is often part of a more extended agenda, usually aimed at change or improvement, that is, change for the better. According to Schein, these attempts at change often also provide an excellent opportunity to study culture, because the resistance that such change programmes evoke is indicative of the things members of the organisation cherish and protect, which are also often the things that a culture is made of (cf. Schein, 1992, p. 30).

This is not to say that a study of organisational safety culture is only aimed at or initiated by culture change. An organisation can run repeatedly into the same or similar problems, not understanding why this is the case. For instance, it might be that most of a company's accidents occur in the evening or night shifts and these accidents do not appear to be related to either a particular team, fatigue or lighting. A subsequent study of the organisational culture could focus on the absence during the night shift of closer monitoring by daytime staff and the shared assumptions related to this type of supervision. In this case, it is not change that initiates the study, but a persistent problem. In his book, Schein describes that he had been called in by the 'Action' company because their staff meetings were very emotional and often ended up in conflict. His suggestion to be 'nicer' to each other did not seem to work. In the end, he decides that these meetings and the overall way they are conducted are, in fact, highly functional for this company because they help to establish 'truth' between the staff mem-

bers. However, by shifting the focus more on the task process rather than interpersonal relations, the meetings also became more effective (ibid., p. 32 ff.).

Overall, the following chapter is not meant to be a cookbook for doing organisational (safety) culture research. It aims simply to provide the ingredients for such research along with some important (philosophical) considerations. Hence, no explicit research strategy is described as this is left strictly to the research team's mission and, hence, discretion. As such, it can be compared to certain television cooking shows, where (master) cooks are provided with a set of ingredients with which they must prepare a truly eclectic meal.

References

Schein, E. H. (1992). *Organizational culture and leadership* (2nd ed.). San Francisco: Jossey-Bass.

Abstract

For more than two decades safety culture has been explored, described, explained, diagnosed and otherwise dealt with by both researchers and practitioners. Up to now no general agreement has been attained on the methods for performing these tasks and therefore a plethora of disparate routines have been developed by academic institutions and practitioners alike. Firstly, the rationale and depth as well as the philosophical underpinning of a safety culture study are talked about. Thereupon, following Schein's conception of culture (1992), methods for exploring artefacts, espoused values and basic assumptions are successively discussed and outlined based on results published so far. Any team embarking on a safety culture research mission should critically consider various methods given the primary problem at hand. This also requires however, that a team addresses its ontological and epistemological position regarding organisational safety culture. The paper provides guidance on the consecutive steps of safety culture research as well on the selection of tools. Overall, a participatory approach is advocated, relying on multiple tools. Impact on industry: given the importance attached to the construct of safety culture, this paper supports research teams and practitioners in putting together a comprehensive and efficient assessment toolbox.

The safety culture research process: steps and tools

1 Introduction

Safety culture has been an object of research for more than 20 years and the time seems ripe to make an inventory of the methods and techniques that have been employed to describe, assess and diagnose it. However, the selection of a research method or the development of a tool are just two in a series of steps that together describe all research activity before the actual collection of data. As it is, most of these steps are often taken implicitly or, perhaps, even blindly. However, the assumptions that are made along the way determine how any final results should be considered and interpreted. For that reason, these steps will be discussed in more detail below.

In a paper by Guldenmund (2000) a framework for safety culture has been proposed that will be used for the current discussion of methods for safety culture assessment. This framework follows the general layout of culture provided by Schein (1992) consisting of an outer layer of artefacts, a middle layer of espoused values and a core of tacit basic assumptions shared amongst (groups of) people within the organisation. What is observed at the two outer layers might be an expression of the inner core, but this is certainly not always the case. Furthermore, although the core represents the nature of a culture, it is also impossible to grasp directly and therefore should be deciphered from data gathered from its periphery. Unsurprisingly then, all safety culture assessment tools collect data only about these outer layers.

In this paper, safety culture is not used as a qualifier, as something an organisation (rarely) has or (mostly) does not have, like the 'Calvinistic vapour' mentioned in Davies et al. (2003, p. 14) that seems to permeate an organisation when they actually 'have it'. Some scholars like Reason (1997) indeed hold such a view: 'like a state of grace, a safety culture is something that is striven for but rarely attained' (p. 220). On the contrary, safety culture is considered here the part of organisational culture that is related to safety and risks (Guldenmund, 2000; Meijer, 1999) and which is, therefore, always present when the primary process carries (occupational, environmental, process safety) risks. Additionally, culture is also considered one of the anchors for behaviour, next to particular situational and personal parameters.

The current discussion primarily focuses on *practical* or *applied research*, that is, research commissioned by a company in order to resolve a particular dif-

ficulty they have, not on *theoretical research*, meaning research primarily aimed at the development of theory or its supporting methods. Hence, the focus here is on organisational *improvement* rather than *proving* or generalising a particular theoretical point in safety culture research.

At this moment several safety culture toolboxes are already on offer, e.g. see Cheyne (undated), Energy Institute (undated) or Human Engineering Ltd. (2005a; 2005b). As these are described extensively by their developers they will not be considered here further. In the following various safety culture assessment tools will be discussed according to the layers of the Schein-based framework for organisational culture; that is, tools for artefacts and for espoused values. However, before covering the various tools with which a safety culture toolbox can be equipped, the steps *preceding* the selection of various tools will be considered firstly, followed by a short summary of the safety culture framework.

2 Safety culture research

When deciding on a safety culture study, which is often challenging and time consuming, it is prudent to consider both the actual relevance and possible depth of such an enterprise. These two issues will be taken up separately below.

2.1 Relevance of safety culture research

The expression 'safety culture' was initially used in the context of major disasters, such as Chernobyl (1986) and Piper Alpha (1988). Subsequent research however, mainly focussed on occupational safety, like injuries (e.g. Zohar, 2000, 2002), lost-time accidents (e.g. Mearns, Whitaker, & Flin, 2003; Varonen & Mattila, 2000) or safe behaviour (e.g. Cooper & Phillips, 2004; Johnson, 2007; Zohar & Luria, 2004). These studies had various degrees of success in showing a relationship between one and the other. In the scientific literature process safety or environmental safety is hardly, if ever, discussed in relation to safety culture and climate, possibly because statistics are limited and comparisons are therefore impractical. Overall, safety culture is predominantly used in relation to negative consequences, hence a prime reason for conducting safety culture research could be persisting occupational, process or environmental safety problems, in absence of any obvious or lasting solutions. This would also provide the research with a certain focus and urgency that is considered quite essential (cf. Schein, 1992; Steijger, 2005). Such urgency creates commitment from (top) management and, therefore, also more willingness to expose themselves to scrutiny. Schein advocates the study of organisational culture in the context of intervention or change, where cultural assumptions particularly show themselves through the resistance the intervention arouses (ibid., p. 30). However, this is not to say that this sense of urgency should disappear after finishing the research or intervention. Indeed, a particular level of neurotic vigilance or 'creative mistrust' (Hale,

2000) is considered to be quite beneficial for safety and should prevent the organisation becoming complacent and, even worse, incautious.

However, other occasions can elicit a need for safety culture research as well. For instance, some research is aimed at assessing the level of development of a company's safety culture to decide whether it is ready for (a) particular intervention(s). When considering (an) intervention(s), it is often prudent to adapt these to local conditions and a study of culture can be very helpful then. Finally, when considering significant changes in values, companies might consider a 'before' and 'after' design to see whether changes have actually caught on and have become part and parcel of 'the way we do (and perceive) things around here' and have had an effect on safety or other performance.

The current discussion seems to beg for yet another question, namely, what is the relationship between safety culture and, for instance, major accidents, injuries, incidents and unsafe behaviour? In this paper, culture, and therefore also safety culture, is conceived as consisting of a core surrounded by two layers, which can be considered manifestations or *expressions* of the underlying core (Schein, 1992, 1999). Yet, for the members of a culture it is not the actual expression *per se* that is relevant but the *meaning* the particular expression has within the culture that will make it significant (or not) for them (cf. Geertz, 1973). However, expressions like behaviour are only partly determined by an underlying culture; more often than not, they are also partly determined by circumstance.

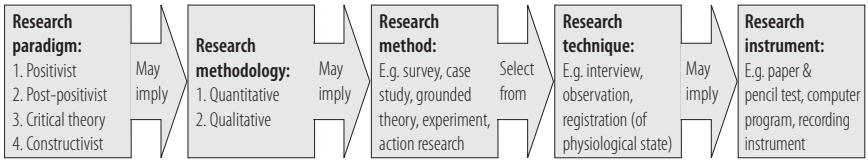
Another way of looking at the influence of culture might be as follows. Nowadays, accidents are modelled as escalation pathways going through a series of failures of 'barriers' that somehow have become aligned in such a way that the accident process can develop undisturbed to its unwanted, yet foreseen, outcome; a well-known example being Reason's appealing Swiss cheese model (1990). One of the underlying causes of the failing barriers might be the influence of local basic assumptions. The actual alignment of the failing barriers is very often circumstantial, i.e. accidental but, again, cultural assumptions can come into play as well.

Summarising, the relationship between culture and its manifestations is best described as 'fuzzy' (Spencer-Oatey, 2000) and interpretative rather than determinative. According to Wiegmann et al. (2007) it would, however, be 'silly and futile' to study safety culture but not ascribe any (causal) importance to it. Nevertheless, safety culture being a social-scientific construct, its empirical relationship with other concepts or phenomena is very much dependent on how it is actually operationalised, that is, made empirically tangible (cf. De Groot, 1961). The particular operationalisation of safety culture is, again, dependent on the paradigm the research operates in. This issue will be taken up next.

2.2 *Steps in safety culture research*

As has been mentioned above, culture, and therefore also safety culture, manifests itself at various levels. Although most scholars would argue that all culture research should be aimed at the inner core, neither the exact road towards this end nor the particular vehicle to accomplish it with, are given at the start of the mission. Following the sequence of steps involved in carrying out research (Fig. 1, adapted from Pickard & Dixon, 2004), there are several moments of decision, which could lead to different roads and therefore different research tools.

Figure 1



The first decision a research team faces, is a choice of paradigm; i.e. the fundamental choice between positivism and constructivism (or interpretivism), between realism and relativism (Creswell, 2007; Pickard & Dixon, 2004).[1] Briefly, the positivistic stance assumes that an objective and knowable reality exists independent from the researcher, whereas the constructivist believes that this is not the case; the outcome of research primarily becomes the product (i.e. construction) of a particular researcher. Pondering this choice of paradigm raises an important question, which is – What is the relevance of this issue for safety culture research? (cf. Dobson, 2002).

First of all, when the constructivist paradigm is taken to imply that the results of a safety culture study are a personal expression of subjective perception, the client company might consider this result too arbitrary, idiosyncratic even, and could therefore decide to dismiss the final outcome. Hence, a constructivist research approach bordering on solipsism can be considered pointless,[2] not only for safety culture but for social science in general (cf. Heron & Reason, 1997).

On the other hand, various allusions already have been made to an interpretative and qualitative approach. This also appears to be the approach advocated by Schein, who refers to it as 'clinical research' (Schein, 1992, p. 28 ff.), putting

1 Guba & Lincoln (1994) actually distinguish four paradigms: positivism, post-positivism, critical theory and constructivism. Post-positivism and critical theory could be considered reactions to the other two paradigms, resulting in more or less hybrid compromises, inclining to one or the other side of the realist – relativist spectrum. Moreover, other paradigms have been coined; for instance, participative inquiry (Heron & Reason, 1997) and critical realism (Dobson, 2002). However, for the present purpose all these are left out of the discussion.

2 Solipsism is an epistemological perspective stating that knowledge of anything outside the mind is basically unwarranted.

much emphasis on close participation with the client organisation and relying on qualitative techniques, like interviews, observations and focus groups.

However, when the leading paradigm is not explicitly addressed, does this necessarily result in bad research? Actually, not many research teams spell out their assumptions regarding ontology – that is, the nature of reality (e.g. safety culture) – and epistemology – that is, the nature of knowledge (e.g. how knowledge about safety culture can be attained) – but, rather, proceed directly to matters of methodology or method. Nevertheless, as Archer points out, 'What social reality is held to *be* also *is* that which we seek to explain' (Archer, 1995, cited in Dobson (2002)). Furthermore '[a]n ontology without a methodology is deaf and dumb; a methodology without an ontology is blind. Only if the two go hand in hand can we avoid a discipline in which the deaf and the blind lead in different directions, both of which end in cul de sacs' (ibid.). Ultimately, researchers have to be clear what it is they explore and be able to explain how this can be experienced, grasped and represented; or, more to the point, is there a safety culture 'out there' that can be grasped by methods and caught in propositions, describing its nature and relationships with other concepts, and to what extent is this representation dependent on the particular researcher construing it?

Leaving these philosophical considerations momentarily aside, the next step in the sequence concerns a choice for methodology. Traditionally, the choice for either a quantitative or qualitative research methodology follows from the choice of paradigm (Pickard & Dixon, 2004), but various authors challenge this notion and advocate more eclectic research (e.g. Glaser, 1998; Krauss, 2005; Myers, 1997). Hence, after the initial choice for paradigm and research methodology, the subsequent options for methods and techniques are basically still open (Fig. 1), although some research methods are, again, traditionally associated with one or the other methodology. The issue of paradigm stance and the subsequent choice for methods and techniques will be taken up in a later paragraph, when the toolbox is opened and equipped.

Clearly, all data can be assigned to one of the two layers surrounding the cultural core, which is assumed to contain the implicit basic assumptions organised in coherent patterns. In later paragraphs research techniques that have been applied so far to elicit or tap cultural manifestations are considered successively following the order of the cultural layers. Firstly, however, the conceptual framework will be outlined.

3 A framework for safety culture

In Table 1 the framework presented is that used in Guldenmund (2000). In the first column the framework's three main elements or layers are specified: the highly observable artefacts (the *what?* of safety culture), the espoused values (the *why?* of safety culture) and the tacit basic assumptions (the underlying shared convictions regarding safety).

Table 1 Framework for safety culture adapted from Guldenmund (2000)

Levels of culture	Visibility	Examples
1. Outer layer – artefacts	Visible, but often hard to comprehend in terms of an underlying culture	Slogans/ logos, buildings, dress codes/ personal protective equipment, posters/ bulletins, reports (accident, incident, inspection), minutes, training manuals, job descriptions, procedures, celebrations, rituals
2. Middle layer – espoused values	(Relatively) explicit and conscious	All spoken statements/ justifications, attitudes* (e.g. as determined through surveys), interview and focus group data, ambitions/ intentions, all perceptions
3. Core – basic assumptions regarding: 1. The nature of reality and truth 2. The nature of time 3. The nature of space 4. The nature of human nature 5. The nature of human activity 6. The nature of human relationships	Mainly implicit: • Obvious to the members • Invisible • Pre-conscious	Have to be deciphered from artefacts and espoused values

* Attitudes e.g. regarding hardware/ (safety) measures, software/ systems, people (self, colleagues, supervision, management) and risks (hazards, scenarios). However, other classifications are also possible, for instance, attitudes regarding the nine safety management elements as suggested in Guldenmund (2007).

Although artefacts are readily observable, they are quite difficult to understand in terms of an underlying culture. Artefacts can be present for many different reasons or purposes, each of which can reflect different cultural dispositions or, sometimes, have little relevance to culture. Organisations occasionally uncritically adopt artefacts in the form of 'best practices' or various other routines taken from other organisations where these have worked well but which, in unaltered form, are often less effective when used elsewhere (cf. Hofstede, 1991).[3] It is therefore important whether the artefacts actually have significant meaning for the members of an organisation, that is, are rooted in their convictions or basic assumptions. Despite these complications, artefacts usually act as a starting point for studying an organisational culture and provide an answer to the question: What is this culture telling me?

After a first encounter with an organisational culture it is time to meet some representatives and ask the *why?*-question: Why do I see these artefacts and what is their meaning within this culture? Answers to this question are considered espoused values in that they 'predict well enough what people will *say* in a variety of situations but which may be out of line with what they will actually *do* in situations where those values should, in fact, be operating' (Schein, 1992, p. 21).

Using the artefacts and espoused values as raw material the basic assumptions have to be deciphered looking for 'patterns' in the data or inconsistencies between the artefacts and espoused values or amongst the espoused values themselves. According to Schein (ibid.) the basic assumptions can be ordered along six dimensions (Table 1, lower left), which provide guidance for the deciphering process (cf. Brooks, 2008), although not all dimensions might apply in every cultural setting.

The borders between the two layers and the core might not be identified unequivocally in all cases. The distinction between these levels is made from a researcher's or observer's point of view and a member of the organisation might interpret the same organisational features somewhat differently (see Kaplan, 1964, p. 126 ff., for an insightful discussion on observation). Another important point is – What actually constitutes culture in this model? Is it the core, or is it the core plus its surrounding layers? This issue brings us back to the definition and conceptualisation of culture and all the confusion that comes along with it (Hale, 2000). For the present purpose it is enough to state that (the essence of) culture will be defined following Schein and therefore will be equated with basic assumptions, or shared convictions operating in an organisation or group within the organisation. The outside layers are considered, at least, potentially as manifestations of culture. However, this is certainly not always the case, because situational conditions can elicit particular expressions as well as basic assumptions can.

3 For instance, the introduction of behaviour based safety programmes, various key performance indicators for management regarding safety or a new housekeeping regime.

Schein's model is basically a research model, providing structure to the data collection and the subsequent process of understanding the culture. While the basic assumptions are covert and largely subconscious, all data will be either artefacts or espoused values. These have to be processed further to arrive at the basic assumptions. Conceptualising culture this way one enters a highly subjective and controversial realm. For instance, how can a basic assumption be established and how can it be ascertained that it is held and shared when the only point of departure are various (visible) behaviours which can also be determined by situational constraints? The plain answer to this question is to conduct sufficient (unobtrusive) observations of various situations in which the hypothesised assumption(s), in fact, should be operating and subsequently confirm, adjust or reject the relevant basic assumption(s).

In this short review of the culture framework not much effort has been made to distinguish organisational culture from safety culture. As already stated above, safety culture as a shared set of basic assumptions related to safety is just a specific part of organisational culture. It will probably be more pertinent in high profile organisations where safety has top priority; operating sites with the potential for catastrophic accidents, such as those in the chemical and petrochemical industries, the heavy industries and nuclear industry. In fields like construction (e.g. Choudhry, Fang, & Mohamed, 2007; DeDobbeleer & Béland, 1991; Mohamed, 2002), hospitals (e.g. see Flin, 2007; Mark et al., 2007; Waring, 2005), aviation (e.g. see Ek, Akselsson, Arvidsson, & Johansson, 2007; Gill & Shergill, 2004), traffic (Anon., 2007), or the (Dutch) army (e.g. Tijdelijke Commissie Ongevallenonderzoek Defensie, 2004) the notion of safety culture is yet emerging and these organisations still struggle with forces the high-hazard industries struggled with some decades ago: how to work safely and still run a profitable and effective business.

In the following paragraphs the discussion moves to the methods that have been designed to uncover the layers of culture and decipher its central core. For each layer firstly the *what?* – content and definition – will be explored and then the *how?* will be discussed in terms of tools or techniques available to describe it.

4 Collecting artefacts

Merriam-Webster's Online Dictionary (undated) defines art[e]fact as:

> a: something created by humans usually for a practical purpose; especially: an object remaining from a particular period; b: something characteristic of or resulting from a particular human institution, period, trend, or individual.

It is, of course, the second definition which is especially relevant to the current discussion. Schein's definition of artefacts is as follows (1992, p. 17):

> [All] the phenomena that one sees, hears, and feels when one encounters a new group with an unfamiliar culture. Artifacts would include the visible products of the group such as the architecture of its physical environment, its language, its technology and products, its artistic creations, and its style as embodied in clothing, manners of address, emotional displays, myths and stories about the organization, published lists of values, observable rituals and ceremonies, and so on. For purposes of cultural analysis this level also includes the visible behavior of the group and the organizational processes into which such behavior is made routine.

Hence, artefacts are all the things one (especially) notices when encountering a new and unfamiliar organisational culture: the architecture of the buildings, the layout of the offices, the formalities at the front desk, the way one is received and greeted, the decorations and smells in the building, the organisation of meetings, celebrations, meals and so on. Artefacts are easily accessible, yet they are less easy to understand in relation to an underlying culture, if they are, in fact, a manifestation of this culture (ibid., p. 17).

Within organisational culture research organisational symbolism has received considerable attention. As symbols are often the first encounter with an organisation, special attention has been given to the particular message such symbols seem to convey. Rafaeli and Worline (2000) state that 'physical cues in organizations integrate feeling, thought and action into shared codes of meaning' (p. 72), thus already coming very close to Schein's patterns of basic assumptions. Yet artefacts alone do not provide any insights into the thought processes or motivation behind them. It is nevertheless very tempting to understand an artefact in one's own terms and meanings (Rafaeli & Worline, 2000). Because of this, some artefacts are often considered indicative or symptomatic of an organisation's culture. Indeed, some professional auditors use certain rules of thumb exactly based on such initial impressions when assessing a client; for example, the state of the washrooms as a sign of health and welfare management.

The field of safety is, of course, littered with numerous symbols such as warnings, signs, pictograms and on and on (e.g. see Wogalter, 2006). The symbolism of such symbols for particular groups is meaningful for organisational culture research, e.g. their particular choice, the amount and placement. Luria and Rafaeli (2008) asked workers whether safety signs either expressed a compliant or a committed stance towards safety from management and correlated these judgements successfully with low and high safety climate scores, respectively.

Hence, artefacts form an essential part of safety culture research. They yield the raw material that is combined with other artefacts or with espoused values to construct (patterns) of basic assumptions. Apparently, the extent to which an artefact is considered to be a manifestation of a particular culture introduces a highly subjective element in the data collection process. It pertains to the inclusion or exclusion of data in the subsequent analysis and it is mostly left to the researcher's discretion. While quite basic, not many safety culture research teams systematically report artefacts as such. Below, some research will

be reviewed that reports artefacts, where behaviour will be distinguished from other artefacts.

4.1 Observation of behaviour

Observation is the most obvious technique to collect data about artefacts. On entering the premises of any organisation one cannot help being struck by these. Meijer (1999) used the method of *participative observation* during his research at two large Dutch construction companies and recorded extensive observations in a diary. Apart from issues related to safety he focussed on the way people interacted and how priorities were set (ibid. p. 47). In the observation phase he worked together with a student with whom he compared notes regularly to obtain a certain degree of inter-subjectivity. However, Meijer does not provide any systematic observations lists but utilises illustrative anecdotes. His work will be discussed again at a later point in this paper.

Glendon and Litherland (2001) used *observation lists* as a behavioural measure and correlated these with a safety climate questionnaire. They provide a list of the observations they have rated in their study of road construction workers. Unfortunately, the two measures did not correlate significantly.

In their research at a Dutch dairy products factory Ellenbroek and van den Hende (2003) observed the installation of a large new machine and made photographs of various situations that occurred during this process. Their observations produced inconsistencies with statements collected from manuals outlining the safety management system. For instance, the statement 'We supervise any activity done by others for us' was not demonstrated during the installation of the machine.

Cooper and Phillips (2004) used *behavioural safety checklists* as part of a behaviour based safety programme (BBS) in a manufacturing facility. Specified behaviours were scored either 'safe' or 'unsafe' based on the observed group's behaviour. These checklists were revised every 20 weeks, where 100% safe behaviours were deleted in favour of behaviours identified during observation rounds or taken from incident records. An example of their checklist is given in the paper.

Guldenmund and Baal (2004) used a *diary* format for three months during a research project at two service departments of a Dutch steel company, but no systematic observation lists were provided. The diary entries were meant to generate hypotheses as well as confirming findings from other sources like document analyses, questionnaires and interviews. For instance, some workers claimed that supervisors hardly left their rooms but rather stayed there to answer e-mails and conduct internet searches. To investigate this claim several extensive observations were made at different points of day.

Brooks (2005) spent overall ten weeks on board of five (lobster) fishing vessels to observe and audit the (safety) behaviours of the crew. Some of these results

were compared with the crews' self assessments resulting in a few remarkable perceptual differences.

Steijger (2005), building on Heming and Guldenmund (1999), has developed an observation protocol as part of a safety culture assessment tool. The protocol is meant to provide standardised observations which can then be delivered by multiple researchers. While standardisation increases reliability it also limits observations falling outside the protocol; arguably, this should be avoided in artefacts collection. Especially in advanced safety management systems, where people have been conditioned well through training and reward systems, it is the little things that are telling, not the ostentatious or obvious ones.

Johnson (2007) reports observations by safety professionals over a five month period using a standardised behaviour checklist. The observed behaviours were associated with the prevention of injuries and had been explicitly defined. However, neither details of the specified behaviour nor a checklist are provided in the paper.

Finally, Andersen and Mikkelsen (2008) compared daily self-reports of injuries with retrospective reports and found an underreporting of 63% in the latter. They conclude that retrospective injury data should be adjusted accordingly to come to more realistic estimates.

4.2 Document analysis

Documents usually offer a plethora of published values, like mission statements, strategies, job descriptions, reports, procedures, or any other published means the organisation uses to articulate a value. Such values often reflect ambitions, aspirations and intentions (things the organisation would like to be or aspire to have), or rationalisations (plausible and otherwise attractive explanations which do not necessary reflect a proven relationship or theory).

Not much has been published on the topic of systematic document analysis in the area of safety culture. Swuste et al. (1994) counted the amount of times the word 'safety' was mentioned over a period of several years in the minutes of team meetings and used this count as an argument that safety did not occupy a prominent place on the agenda. To the extent that safety is central to or indeed a value in an organisation, one would expect the word to appear regularly during meetings.

Hale et al. (2004) found that employees (managers, supervisors and workers) generally received 'satisfactory' or 'good' assessments at annual appraisals, despite persistent shortcomings in the safety performance of the investigated plant. They also found that, although much time was spent on discussing safety at various meetings, this was hardly translated into comprehensive rules and/or daily practices.

Both Hale et al. (2004) and Ellenbroek and van den Hende (2003) extensively investigated manuals, reports, records and minutes for artefacts related to safety. Following Guldenmund et al. (1998) they classified measures follow-

ing incidents and accidents according to the Hazard-Barrier-Target model (c.f. Haddon, 1980). Measures were judged as being hazard or energy source directed, barrier directed or aimed at protecting the target(s) at risk. Such classifications readily show whether the organisation has a tendency to put the burden of safety protection on either the organisation (hazard or barrier directed measures) or on the (potential) victim(s) (target protective measures). The method was again quite successfully repeated in Guldenmund and Baal (2004) where it supported the finding that the service organisations under scrutiny rather blamed the victim(s) than solved their safety problems in more structural ways.

Brooks (2005) studied historical data for accidents and other important issues within the local fishing community to complement his observation studies. As part of his toolkit, Steijger (2005) also scrutinises documents and provides a protocol for a more structured analysis of these. Unfortunately, at the time of writing, his full assessment tool has not been tested in the field yet, so any of its scientific properties (reliability and various forms of validity) are indeterminate.

The link between safety culture, incident and accident reporting and (organisational) learning has been acknowledged by several authors (e.g. see Brooks, 2005; Hopkins, 2006; J.T. Reason, 1997; Ten Hove & Meems, 2006; Westrum, 2004). Ten Hove and Meems (2006) assessed the processes Dutch major hazard companies formally use to learn from their incidents and accidents and developed a short checklist to address this aspect. Hopkins (2006) used material from public inquiries into major accidents to develop an image of the organisational culture of two companies and its effect on safety. Moreover, he suggests that his approach is not limited to the material of public inquiries. Researchers can also investigate 'the organisation's reporting practices […] and its strategies for learning' (ibid., p. 13) from companies that have not been the subject of an inquiry.

4.3 Collecting other artefacts

Schulte (2006) explored the organisational culture of an inland shipping company in three consecutive workshops with captains, first mates and boatmen. He asked them to make photos beforehand on board of artefacts related to safety (e.g. recurring or nagging problems, housekeeping or dangerous situations). At the workshops the photos were ranked by the participants according to the risks involved, as they perceived it. Both the orderings and the discussions were recorded for later analysis.

Schein works extensively with both behavioural and non-behavioural artefacts in a workshop carried out to explore some organisation's culture (Schein, 1992, p. 147 ff.). Participants successively generate artefacts and explanations or justifications – i.e. espoused values – for these. Through an iterative process of ordering and 'patterning' underlying basic assumptions gradually start to emerge, which may explain the artefacts and espoused values that have been generated during the workshop. It is in this process of 'deciphering' that arte-

facts play an important and crucial part. However, artefacts cannot be taken at face value and it is for this reason that Schein considers behaviour not part of the core of a culture (ibid., pp. 13-14), while, like all artefacts, behaviour can be either an expression of basic assumptions or it can be elicited by situational conditions unrelated to a culture.[4] Also Seel (undated) has published a broad organisational culture check list containing both behavioural and non-behavioural artefacts which contains many key points already suggested by Schein (1992).

Overall, a standardised approach regarding the collection of artefacts is recommended (Creswell, 2007, pp. 134-135) and preferred when working in teams. Moreover, more detailed descriptions of protocols are wanted when such research is eventually published.

4.4 The relevance of artefacts for safety culture research

Concluding, artefacts in safety culture research are indispensable but highly ambiguous. Not appreciating this ambiguousness and taking artefacts at face value can therefore be misleading. The focus of a culture research determines which artefacts should be concentrated on, although this choice should not be too narrow. Artefacts can be used at the beginning of a culture research project but also later, during verification phases. Parts of the study of artefacts can be standardised quite easily, like particular observations or the choice of sources to collect artefacts from, however not many research teams have published proof of doing so. As will be discussed below, such standardisation will be more important when culture research is carried out by a research team (Yin, 2003, p. 99 ff.). From a methodological point of view a research *team* rather than *one* person is much more desirable to counterbalance both subjectivity and bias. Finally, the observation of behaviour is often part of a BBS program. Correlations with behaviour recorded in this context and espoused values will be taken up further below.

Finally, observation and participant observation can be time consuming. When the involvement becomes too strong, the latter can also become quite demanding to the extent that particular scientific requirements like objectivity and a certain breadth of scope are at risk (Yin, 2003, pp. 94-96).

5 Collecting espoused values

Espoused values are all values that are *verbally* propagated by the organisation. These include the statements members of the organisation are apt to make when asked about the position an organisation takes regarding work, rules, or any

4 That is, conditions unrelated to a group or its history; e.g. external conditions like the weather or specific local circumstances, or internal conditions like psychological states or other personal situations.

other organisational issue. Basically, this is the 'official' answer to the *why?*-question. – Why do you do the things the way you do?

Espoused values are generally explored using either surveys or interviews. The former are usually self-administered whereas the latter are often standardised. In a previous paper (Guldenmund, 2007) many aspects of the questionnaire have been discussed already, so only the main points will be summarised here. Incidentally, research of safety culture relying solely on self-administered questionnaires is better referred to as safety climate. To study the influence of safety climate as predictor, mediating or outcome variable various related concepts are sometimes added to the questionnaire and some of these will be discussed below. Focus groups are used more frequently as a way of eliciting espoused values and therefore will be deliberated briefly too.

5.1 Questionnaires

The questionnaire is the most popular strategy amongst researchers of organisational culture (A. M. Collins & Gadd, 2002). Although it is quick and dirty – that is, one can collect substantial but often imprecise amounts of data rather quickly – it is also quite efficient; the results of questionnaires are easy to quantify which makes comparisons within and between organisations to a certain extent possible. However, because the level of measurement is, arguably, not numeric and in absence of any norms this potential for comparison is limited (Guldenmund, 2007).

There are numerous questionnaires around (for extensive overviews see e.g. F. Davies, Spencer, & Dooley, 2001; Flin, Mearns, O'Connor, & Bryden, 2000; Guldenmund, 2000, 2007), which have resulted in many underlying scales, factors and dimensions. Practically, these sets have much overlap and they ultimately reflect broad evaluations of management and group variables, like how general management commits itself to safety or to what extent the respondent's working group is dealing with daily safety issues (Guldenmund, 2007).[5]

Questionnaires are either self-developed or adapted from other questionnaires devised elsewhere. Not many questionnaires have an underlying theory or model so it is not clear to what extent questionnaires have content or construct validity (Guldenmund, 2000). The most important point however is, that questionnaires provide espoused values at best and hence do not offer a direct window into the way a culture works (J. Davies et al., 2003, p. 14). Moreover, because culture is something that is broadly shared within a group of people, the responses on a questionnaire should be homogeneous otherwise a key attribute of culture will not be satisfied. Surprisingly, a number of safety climate studies is still conducted over several organisations with aggregated data without some check of agreement (examples can be found in e.g. Fullarton & Stokes, 2007;

5 However, the current trend is not to distinguish dimensions anymore but, rather, use one dimension labelled safety culture (e.g. Johnson, 2007; Zohar & Luria, 2005).

Huang, Ho, Smith, & Chen, 2006; Johnson, 2007). Here, the implicit assumption apparently seems to be that safety climate is something all organisations generally have and that the questionnaire collects pertinent information about it. When underlying dimensions have been established previously, the questionnaire positions a particular company in this multidimensional space (cf. Hofstede, 1991; Hofstede, 2001); however, others would contend that such a general culture space is non-existent (cf. Schein, 1992).

How to use the results of a questionnaire is not straightforward. Important drawbacks concern relevance, validity and establishing a norm. First of all, to what extent the issues raised in a standardised questionnaire are relevant for a particular company is yet not entirely clear; this is the objection Schein also brings up against this method (1992, p. 185). Moreover, there are more ways of getting to a particular answer, which do not necessarily coincide with the reason the researcher had in mind when deciding on this particular question. Finally, in the absence of any norms or validity studies the meaning of the results of a questionnaire study is highly ambiguous. Overall, whether organisations can be distinguished on a limited set of common characteristics and the extent to which particular scores can be normalised to express development or another value judgement rather seems to relate to paradigms and preference than to something which can established conclusively.

Comparing questionnaire outcomes with data from outside the questionnaire has yielded mixed results ranging from successful[6] (e.g. Huang et al., 2006; Johnson, 2007) to moderate[7] (e.g. Cooper & Phillips, 2004; Fullarton & Stokes, 2007; Varonen & Mattila, 2000) to somewhat futile (e.g. see S. Clarke, 2006a for a meta analysis; 2006b; Glendon & Litherland, 2001). Rather than providing (final) assessments, the results of questionnaire studies have to be deciphered and interpreted as is the case with other espoused values and artefacts.

Summarising, because of their numerical and quasi-numerical output, questionnaires can be useful when comparisons have to made, e.g. between teams or departments, or before and after an intervention program. Furthermore, because most questionnaires have scales underlying them, the scores on these scales can be used to pinpoint specific weaknesses and suggest remedial interventions. When research time is quite limited, questionnaire surveys provide particular answers relatively fast.

6 Both Huang et al. (2006) and Johnson (2007) do not assume a direct link between safety climate and incidents but propose a mediating variable through which this influence is exerted. For Huang et al. this intervening variable is 'safety control' whereas Johnson puts forward 'safe behaviour'. Moreover, measures in Huang et al. are collected through the same instrument (questionnaire) whereas Johnson uses different sources.

7 Cooper and Phillips (2004) report high correlations between safety climate scores and percentage safe behaviour. However, a change in safety climate scores was not matched with a change in safe behaviour. Additionally, Fullarton and Stokes (2007) find company size to be a better predictor of injury rate than safety climate.

5.2 Additions to questionnaires

Often, safety climate questionnaires are expanded with additional questions, for instance to study the relationship of safety climate with other constructs or indicators. Examples of such constructs are leadership (e.g. Barling, Loughlin, & Kelloway, 2002; Hofmann, Morgeson, & Gerras, 2003; Zohar, 2002), risk perception (e.g. Rundmo, 1992, 1996), personality (S. Clarke, 2006a; S. Clarke & Robertson, 2007), safety control (e.g. Huang et al., 2006) and values (e.g. Reiman & Oedewald, 2004; Silva, Lima, & Baptista, 2004).

As has been indicated above, concurrent and/or predictive validity of safety climate is often explored using some indicator of safety performance; in this case, safety climate scores precede safety outcomes and the accompanying reasoning is, that safety climate influences behaviour, which then impacts safety outcomes.[8] These outcomes could be historical accident data (Fullarton & Stokes, 2007; Zohar, 2000, 2002), (percentage) safe behaviour, either observed (Cooper & Phillips, 2004; Johnson, 2007) or perceived (Prussia, Brown, & Willis, 2003) or self-reported incidents or accidents (Donald & Canter, 1994; Huang et al., 2006; Mearns, Whitaker, & Flin, 2001). Only the latter two of these indicators are questionnaire-based and, therefore, possibly also subject to common method bias (but see Spector, 2006, for a thoughtful discussion on this bias). Cooper and Phillips (2004) argue that, because accident data generally predate climate data, a direct relationship is not to be expected. Therefore using concurrent observational data should yield better results, which in their case indeed it did.

5.3 Personal interviews

Next to questionnaire studies, personal interviews are frequently employed in safety culture research, although the purpose of the interviews differs significantly between studies. In general, these interviews are held for three kinds of reason.

1. The information gathered with the interviews is used to complement other data sources, or as a means to confirm such sources.
2. The information from the interviews is judged and used in an assessment.
3. The interviews are used as building blocks for a theory (e.g. about the organisation, about culture).

Ad 1. The first purpose is mentioned frequently in the literature (e.g. Hale et al., 2004; Heming & Guldenmund, 1999; Mearns et al., 2001). Interviews then run in unison with other data collecting techniques. For instance, interviews are used to check some preliminary finding from a questionnaire study. In their questionnaire study Guldenmund and Baal (2004) found that one of their fac-

8 The opposite is also possible, in that accidents influence safety climate. This is called 'reverse causation' but is less supported by literature than the predictive design (S. Clarke, 2006b).

tors (Communication about safety) scored highest compared to other factors. Initially, this finding was considered a positive sign, but additional interviews revealed that the workforce had wanted to give off a signal that there was too much talking about safety and they were getting fed up about it.

Ad 2. Additionally, in audit or assessment studies interviews serve as a basis for an overall judgement of the organisational or safety culture. An example of this approach might be the SCART methodology developed by the I.A.E.A. (2005; undated-b). For this review an international team of safety culture experts is assembled by the I.A.E.A., which will investigate a nuclear installation's safety culture over a period of one or two weeks. During the review five interrelated characteristics or themes are explored: (1) if safety is indeed a 'clearly recognised value' all through the organisation; (2) whether leadership and (3) accountability for safety are clear; (4) to what extent safety is learning driven and (5) integrated into all activities. The team is supported by a manual which specifies each characteristic with several attributes and guiding questions to explore these in ample detail. An audit approach has also been employed by Ludborzs (1995) and Grote and Künzler (2000).

Ad. 3. Finally, interviews are used to develop a theory about the (safety) culture of some organisation or organisations in general. Often, these studies are rooted in what is known as 'grounded theory' (Glaser, 1998; Glaser & Strauss, 1967) or are aimed at defining sensitising concepts (e.g. Blumer, 1954; van den Hoonaard, 1997). Although grounded theory is not solely restricted to interviews, they commonly form the main source of data (Creswell, 2007; Dick, 2005). Grounded theory helps the researcher build a theory about his research object through a process of data collection, coding, constant comparison and 'saturation' of categories and their properties (Glaser, 1998).[9] Or, put in other words, in using grounded theory the researcher assumes a theory is hidden in the data and it is his task to bring it to the surface.

Berends (1995) used principles of grounded theory to develop his model and an accompanying questionnaire, which basically consisted of quotes from his interviews. Also applying grounded theory, Stave and Törner uncovered some preconditions underlying various accidents in Swedish food processing industries and based a subsequent model on these (Stave & Törner, 2007). Farrington-Darby et al. (2005) proceeded along similar lines although they did not ground their framework in interviews but developed it from the literature. However, they used the framework to code 'chunks' of interviews and eventually produced a list of forty factors influencing the behaviour of railroad maintenance workers.

There are various issues related to (the art of) interviewing, many of which pertain to the relationship of the interviewer and interviewee (e.g. P. Collins, 1998). Obviously, this relationship should facilitate the provision of relevant and useful data that contribute to the research aims (Yin, 2003, pp. 89-92). However,

9 Saturation is reached when information, often from interviews, ceases to have any additional value to what is already known.

these issues fall beyond the scope of this paper and will not be discussed here any further.

5.4 *Focus group interviews*

Whereas personal interviews are held with one individual, a focus group interview is a structured group process used to obtain data about a certain topic. Schein works extensively with in-company (focus) groups when 'deciphering culture for insiders', following a procedure that leads the group from the tangible to the intangible aspects of their culture (Schein, 1992, 1999). Also the Keil centre's Safety Culture Maturity assessment (Lardner, 2004; Lardner, Fleming, & Joyner, 2001) and the Energy Institute's Hearts & Minds programme (undated) use (focus) groups for their assessment sessions. In their UK nuclear power station study, Lee and Harrison (2000) conducted focus groups to streamline and subsequently pilot their initial questionnaire. Farrington-Darby et al. (2005) employed focus group interviews next to personal interviews to gather their qualitative data. In a comparative research technique study, Guldenmund (2008) also used focus groups next to interviews, questionnaire data and behaviourally anchored rating scales, partly to cross validate these different data sources. Finally, Reiman and Oedewald (2004) used one focus group as a source of data as well as a source of validation.

Obviously, working with groups has the advantage of satisfying the requirement of 'sharedness' of culture, indeed if group opinions converge. However, groups can also bring along certain response biases, such as acquiescence, or other dysfunctional behaviours that should be managed by a competent facilitator (Churchill, 1995, p. 153 ff.).

5.5 *The relevance of espoused values for safety culture research*

As has been explained above, espoused values are unique to Schein's model. Other culture models do not make such a distinction between, on the one hand, governing values that are hidden to those who keep them and, on the other, values that are freely expressed. As a (clinical) psychologist Schein does not take statements about values for granted.[10] From all three components of Schein's model espoused values are the data that can be recorded most objectively. While most artefacts and basic assumptions are designated and/or constructed by the researcher, espoused values are put forward by the client, albeit on the researcher's request. This very quality makes them attractive for empirical research.

Both Schein and Argyris and Schön (1978; 1996) use comparable concepts in their theories on organisational culture and organisational learning, respectively. According to Argyris and Schön there are two types of theory at work in organi-

10 This is especially the case with regard to safety and therefore 'espoused values' is such a valuable concept in this field.

sations: theories-in-use and espoused theories. The espoused theories are, similar to Schein's espoused values, the official models, rules and systems according to which the organisation is supposed to operate, whereas the theories-in-use determine the way things actually operate in the organisation. A theory-in-use clearly corresponds to a pattern of basic assumptions of Schein. According to Argyris and Schön substantial organisational learning can only take place when the governing variables are changed, which is comparable to changing the basic assumptions in an organisation, i.e. changing the organisational culture.

Making a distinction between artefacts and espoused values on the one hand and basic assumptions on the other is not to say that these always differ. According to Schein, these aspects can be either congruent or incongruent. Interestingly, these are the same terms clinical psychologist Carl Rogers uses to describe the overlap between a person's self-concept and actual experience (Rogers, 1961). In the next paragraph, the use of such overlap as well as the use of other features is described in more detail to come to a description of an organisation's basic assumptions.

6 Deciphering basic assumptions

The task of deciphering of organisational basic assumptions is not straightforward (Meijer, 1999; Pederson & Sorensen, 1989) and the description as to how it is done is practically absent in safety research (Brooks, 2005, 2008; Guldenmund, Ellenbroek, & van den Hende, 2006; Heming & Guldenmund, 1999; Meijer, 1999 are notable exceptions). The researcher is faced with the challenge of combining the data – i.e. the artefacts and espoused values – into a pattern of underlying assumptions. The basic approach is neither fact finding nor summarising and classifying these, but, rather, processing the data and uncovering an underlying rationale.[11] There is no cookbook description available, although a few authors have described the process they have employed in detail (e.g. see Brooks, 2008; Meijer, 1999). It is a process of constantly comparing hypotheses about (basic) assumptions with espoused values and artefacts to match theory with empiricism and therefore the result could also be considered a *theory* about the organisation's culture. It is also a creative and rather subjective process which should be described in substantial detail to make it transparent to outsiders (Brooks, 2005). Therefore, research teams are best advised to leave behind an audit trail (Yin, 2003) to avoid the criticism of mysticism (cf. Krauss, 2005).

Meijer (1999) portrayed the process as pouring raw data – in his case (participant) observations, interviews and diary notes – through a funnel, producing assumptions at the other end. He started with various (participant) observations which were written down in notebooks and diaries. He then conducted a series of in-depth interviews. Observations and interviews were written out fully

11 According to Kaplan (1964, p. 308), this is neither the spider's nor the ant's labour but rather the bee's activity.

and a list of significant or important statements was produced based on these. This list was thereupon discussed with a, what Schein calls, 'motivated insider' (Schein, 1992, p. 172) and additional statements were added to the list.[12] Based on this final list a theory about the company's culture was formulated, combining statements into patterns and contrasting statements into areas or variations on similar themes. Similarly, Brooks applies his 'Hermeneutical Canons of Interpretation' (2005; 2008) to assembled artefacts and espoused values peppered with his own thoughts to derive sensitising concepts using the six dimensions of Schein (e.g. time, space, etc., see Table 1) as steppingstones.

In their analyses, both Meijer and Brooks approach the method of grounded theory mentioned briefly above, which does not have to rely on interviewing and observations alone (Glaser, 1998). The data collection continues until saturation is reached and further data stop having additional value. Various transcripts are then coded for categories and properties and emergent themes and hypotheses are then written down on cards and sorted into groups. This overview is combined into a theory about the research situation, again by both joining and contrasting.

There is also the possibility of a self-analysis. This is basically the purpose of the workshop Schein describes and which has been discussed above. Recently, more structured methods have been developed to that effect (e.g. see Energy Institute, undated; Lardner, 2004; Parker, Lawrie, & Hudson, 2006). Again, a group of company people is assembled and together – either individually or in duos – behaviourally anchored ratings scales (BARS) are filled in covering various safety areas such as leadership, conflicting goals, contractor management and follow-up after accidents. Subsequent answers are given on BARS that describe progressive stages of development in dealing with safety issues. Both methods mentioned above use five stages ranging from 'pathological' or 'emerging' to 'generative' or 'continually improving'. Sessions are led by somebody external to the company who is familiar with the theory behind the questionnaire and the development model. After the questionnaire has been completed tabulations are made. Subsequently, attention is given to those questions that elicit divergent responses. An ensuing discussion can provide insight into the reasons behind these different perceptions. It is the role of the facilitator to distinguish reality from ambition, fact from fiction; in this way a group can uncover stumbling blocks and formulate measures to overcome these. It can be debated to what extent sessions such as these truly uncover basic assumptions as these are already assumed both with the stages and behind the rating scales. The aim appears to be to obtain agreement on the current situation and together define a desired future state and (personal) steps towards it.

Quoting Schein, 'one can understand a system best by trying to change it' (Schein, 1992, p. 30). So, an ideal setting for a culture analysis is a critical situation creating a sense of urgency and a research team actively trying to change this predicament together with the client. The resistance such attempts at change might

12 Meijer used a rather critical person for this position.

trigger can reveal information about basic assumptions the client company apparently does not want to change. The issue of change, which might follow the organisational or safety culture diagnosis, will be taken up briefly in the next paragraph.

6.1 The relevance of basic assumptions in safety culture research

The existence of sets of basic assumptions which, on the one hand, are shared amongst a group of people, but which, on the other, are still there even when various people leave the group is a complex issue to study. In undertaking this type of study the research team (or researcher) should ultimately address a few ontological and epistemological questions (cf. Mills, Bonner, & Francis, 2006). For one thing, they should be clear about the existence of a true culture, which can be deciphered objectively.[13] Or, are the basic assumptions just a creative product of the research team's imagination? And how should the team come to its description? How do the various sources of data contribute to the analysis and what is their relative importance, e.g. how should artefacts and espoused values mutually be compared and weighted? In doing this type of research many findings will be discarded in favour of other data. Also, should the research be conducted independently of the client organisation or in (close) connection with it, aiming for either 'objectivity' or inter-subjectivity? This last issue brings the notion of action research to the fore (e.g. Dick, 2003, for references; Lewin, 1946) and how the research team is related to the researched. The team's assumptions about these issues also determine to a large extent what can be done with the final outcome. If the team assumes that basic assumptions are static and resistant to change, subsequent interventions will have to be adapted to these assumptions and not vice versa. However, if the basic assumptions are constructed by the team, ultimately they could be constructed otherwise, leaving more room for changing them. Unfortunately, there is not much research in the field of safety published yet on the implementation of any of these alternatives.

Moreover, any research design would require an evaluation instrument that is able to pick up change over time. It would be even better if such an instrument could evaluate if the basic assumptions have 'improved'. Unfortunately, such an instrument does not exist, as there are no normalised or validated measurement tools around for this purpose.[14] Organisational research is not exceptional in this respect. Other social scientific research fields are bothered by the same difficulty, i.e. it is very hard to objectify the effectiveness of an intervention, although clients may report both progression and satisfaction.

13 What is meant here is that the 'true' construct culture can be distinguished meaningfully from other constructs and assessed accordingly, that is, validly and reliably (repeatedly), independent from the actual assessor.

14 Basic assumptions are descriptive and have no value judgement attached to them. However, the influence of these on safety can be considered unfavourable and, consequently, judged in a particular way.

What can be found in the current literature, though, are evaluations of intervention programs that will also exert an influence on the artefacts and espoused values of a company. For instance, several evaluations of behaviour based safety (BBS) programs can be found (e.g. Cox, Jones, & Rycraft, 2004; Health and Safety Executive, 2000; Williams & Geller, 2000) or the introduction of new organisational structures and processes (Guldenmund & Booster, 2005; Hale & Guldenmund, 2008; LaMontagne et al., 2004; Lehtola et al., 2008; Robson et al., 2007; Shannon, Mayr, & Haines, 1997). Such intervention programs often show positive results on what they intend to change, e.g. lower accident rates, better housekeeping, more incident reporting, more talk about safety during meetings, *et cetera*. It is expected that, in the long run, such interventions might also change underlying basic assumptions, even if they are initially not in line with the artefacts and espoused values.[15]

To conclude, the main purpose of applying tools as described in this paper is to come to a description of (sets of) basic assumptions of an organisation and to contemplate the influence of these on safety and risk. This could be considered a theory about the culture of an organisation and its assumed influence on safety and behaviour. Whether the quest for basic assumptions is the ultimate aim of (safety) culture research however, is not a matter of fact but rather a matter of choice. The tools discussed in this paper have been aligned to this particular goal but their results could also be an aim in itself. For instance, observations could provide useful information about current safety practices or the use of procedures, questionnaires yield data about how people feel in relation to many organisational issues (Cooper, 2000), and so on. However, the more a particular tool is standardised, the more it provides results according to the assumptions and choices of its particular developer.

7 Conducting safety culture research

Any researcher or research team embarking on a safety culture study is well-advised to ponder a few issues before starting to equip their toolbox and depart for the client organisation. Ideally, the successive steps depicted in Fig. 1 all are taken to arrive at an informed choice of safety culture assessment techniques.

The first choice of paradigm – positivist versus constructivist – is important, not only for the way safety culture is perceived by the research team, but also for the final outcome and the scientific standard applied. Table 2 provides a brief overview of the ontologies and epistemologies of three relevant paradigms, the most obvious methodology, the nature of the outcome as well as applicable scientific criteria (see Guba & Lincoln, 1994; Heron & Reason, 1997).

15 Following dissonance theory, it is assumed that people, when their actions and thoughts about their actions are not in line, they will adapt one or the other to regain consonance again.

Table 2 Comparison of paradigmatic stances of positivism, participatory inquiry and constructivism on various aspects of research

	Positivism	**Participatory**	**Constructivism**
Ontology	Realist, singular apprehensible reality.	Participative reality, i.e. subjective-objective reality, co-created by mind and given surroundings (i.e. cosmos).	Relativist. Multiple local realities constructed by individuals. Holistic.
Epistemology	Objectivist and dualist (knower can be independent of the known). Findings are 'true'.	Critical subjectivity in participatory transaction with surroundings. Extended epistemology of experiential, propositional and practical knowing. Co-created findings.	Subjectivist and transactional/interactive (researcher and subject are interdependent). Created findings.
Methodology	Experimental, manipulative. Verification/falsification of hypotheses. Chiefly quantitative methods.	Political participation in collaborative action in inquiry; primacy of the practical. Use of language grounded in experiential context.	Hermeneutic, dialectical. Empathetic interaction between researcher and subject. Interpretation and interaction.
Quality criteria	Conventional 'rigourness': validity (internal and external), reliability, objectivity.	Congruence of experiential, presentational, propositional and practical knowings. Leads to action to transform the world.	Trustworthiness/credibility, transferability, dependability, confirmability.
Outcomes of the research	Context and time independent generalisations leading to 'natural' immutable laws or predictions.	Primacy of practical knowing, i.e. living knowledge.	Context and time dependent working hypotheses leading to understanding.
Voice	'Disinterested scientist' as informer of decision makers, policy makers, and change agents.	Primary voice manifest through aware self-reflective action. Secondary voices present in various illumination presentational forms.	'Passionate participant' as facilitator of multi-voice reconstruction.
Starting references	Cook & Campbell (1979); Kirk (1995); Schein (1999); Miller & Salkind (2002); Yin (2003); Creswell (2007)	Heron & Reason (1997); Seel (2001); also: Cooperrider et al. (2007)	Pickard and Dixon (2004); Charmaz (2006); Bryant & Charmaz (2007); Holstein & Gubrium (2008)

However, in the end the paradigm chosen should not function as blinkers, meaning that choices for various methods and techniques should ultimately be made dependent on the particular study at hand and not on dogma. Therefore, what is advocated here is that the imminent problem should be the guiding force, and a careful problem analysis should resolve what methodology is most appropriate and how deep the subsequent study should be. For instance, when the problem requires that the *meaning* of either artefacts or espoused values for a particular group is deciphered, a search for basic assumptions seems appropriate. However, when the current *status* of various artefacts or espoused values is required, a subsequent study can be more superficial.[16]

Given this advocacy for a mixed methodology, the next important step seems not to be *which* data to collect but *what* to do with them, that is, how to interpret these data. Consequently, in accordance with Glaser's maxim 'all is data' (Glaser, 1998), one needs a sensitive sieve to separate the telling from the useless. Following Schein, it makes sense to work from the outside to the inside of the framework, i.e. from artefacts to espoused values to basic assumptions (Schein, 1999). Moreover, the application of multiple tools or techniques to collect various data is encouraged (Yin, 2003, p. 97 ff.); this is generally known as data triangulation (e.g. see Patton, 2001). Such triangulation of multiple sources could lead to convergence and therefore to construct validity and credibility (Yin, 2003), but not necessarily so. Actually, divergence is also considered quite illuminative and can deepen the understanding of the culture under study (Patton, 2001, p. 248) as well as provide sufficient variety in viewpoints.

Summarising, regarding the contents of the safety culture toolbox it is clear there are multiple methods and techniques available with which to equip it, dependent on a few key issues discussed above. Answers to these questions will provide guidance on the content of the toolbox as well as direction to the research:

- What are the researchers' ontological and epistemological positions on safety culture?
- What is the primary cause or reason for the safety culture study and what is its intended goal?
- What resources are available (time, people, money)?
- Is it necessary to decipher the client's basic assumptions or is a status report of (parts of) the outer layers sufficient?

Table 3 provides a summary overview of the various techniques discussed in this paper, along with an indication of their strengths and weaknesses (adapted from Yin, 2003, p. 86); this table might be helpful in picking the techniques appropriate for the problem at hand.

16 Actually, the paradigm propagated here is called 'pragmatism' or 'instrumentalism', which is an eclectic mix of methodologies and primarily aimed at applications and solutions (Creswell, 2007, p. 22 ff.).

Table 3 Overview of safety culture assessment tools ordered according to the general framework, along with their strengths and weaknesses

Layer	Focus	Technique	Strengths	Weaknesses
Artefacts	Behaviour	Observation	Covers events in real time (reality) and within their context (contextual)	Time-consuming and hence costly; can be (too) selective; events may proceed differently because of observation (reflexivity)
	Behaviour	Participative observation	*(Same as observation, plus)* Provides insight into (inter)personal behaviours and underlying motives	*(Same as observation, plus)* Bias because of researcher's involvement and possible manipulation
	Behaviour	Structured observation (checklists)	*(Same as observation, plus)* Can be conducted by multiple observers	*(Same as observation, plus)* Selectiveness; limited scope
	Behaviour	Diary	Can provide a chain of evidence; chronological; unfiltered	Has to be kept conscientiously otherwise less useful; can become time-consuming
	Behaviour	Self-reports	Come directly from subjects	Reporting bias; selectiveness
	Behaviour	Photographs	Can provide much information/ evidence at the same time	Selectiveness
	Symbols	Possible techniques are: photographs, video, descriptions	Provide input for exploration of espoused values; availability; visibility; unobtrusive (not created because of study)	Selectiveness; misunderstanding/ misinterpretation
	(Company) documents	Document analysis	Can be viewed more than once; unobtrusive; exact; broad coverage (time, events, settings)	Not always easy to retrieve or access; vulnerable to various biases (reporting, selectivity); non-reactive
	Documents	(Public) inquiries	Can be viewed more than once; thorough; objective; unobtrusive	Focus does not have to be the same as research; non-reactive
	Safety conditions	Photographs	(Same as photographs above)	(Same as photographs above)

Layer	Focus	Technique	Strengths	Weaknesses
	Artefacts	Focus group	Shared views, consensus; rich data; participants build upon other responses	Various response biases (acquiescence, social desirability; peer pressure); limited range of topics covered; moderator/facilitator bias; can be difficult to control
Espoused values	Values	Questionnaires	Standardised; large samples possible; quantification and comparisons possible; much data is short time period	Various response biases (acquiescence, social desirability); limited range of topics covered
	Values	Interviews (audit)	Targeted/ focussed on study; systematic	Various response biases (social desirability, interviewer-interviewee dynamics); limited range of topics covered; reflexivity (interviewee answers what interviewer wants to hear)
	Values	Interviews (open)	Targeted/ focussed on study; insightful (e.g. perceived causal inferences); rich data (views in participants' own words)	Bias due to bad questions/ questioning; response bias (e.g. interviewer-interviewee dynamics); poor recall/ anchoring; reflexivity
	Values	Focus group	Work with existing groups/ teams; rich data (views in participants' own words); participants build upon other responses; opportunity to obtain shared views	(Often) not random; small sample size; participants influence each other/ peer pressure; moderator/facilitator bias; can be difficult to control
Basic assumptions	(Patterns of) basic assumptions	Matrix	Provides overview of data sources and results.	Too much data reduction. Too general/ trivial conclusions.
	(Patterns of) basic assumptions	Visualisation	Provides overview of what is congruent and incongruent with (possible) basic assumptions.	Too much data reduction. Too general/ trivial conclusions.
	(Patterns of) basic assumptions	Software	Integrates various sources of (qualitative) data. Relieves the researcher of data burden.	Software cannot do the interpretive work of researcher; is only a tool. Might lead to laziness.

If the study is conducted by more than one person, there are a few issues that merit attention, related to the epistemological view of the team and the intended outcome of the study. First of all, the team could be composed of multiple researchers working independently from the company. This arrangement will increase the reliability and objectivity (inter-subjectivity) of the findings; research is done *on* or *about* the company (Heron & Reason, 1997). However, another arrangement is possible, where emphasis is shifted to close collaboration *with* the client rather than working independently. A danger of the former approach is that findings sometimes surprise or overwhelm the client company and that they become defensive and do not accept the results (e.g. Polling, 1999). The alternative is to embark on the search for basic assumptions together. In that case it is even recommended to have people from the client company *in* the research team. This is, for instance, common practice in OSART-missions (International Atomic Energy Agency, undated-a) and a comparable strategy can be found with Heron and Reason (1997), Hendriks (2001), Seel (2001) and Farrington-Darby et al. (2005). Both Heron and Reason and Seel in fact speak of 'participative inquiry'. Another advantage of such an approach is that company people who are also research team members can translate the findings more easily into the company's idiom and convince their colleagues of their trustworthiness. Research teams also often develop their own vocabulary and jargon which is not immediately obvious for outsiders. Participative inquiry provides one way of solving such (communication) problems.

When including company people in a research team some issues demand specific attention, for instance the choice of people and their availability. For a large organisational change process Booster advocates having informal leaders in the change teams and to involve workers' representatives from the start. Preferably, all team members should be released from their regular duties to be able to commit themselves fully to the task at hand (Booster, 2004; Guldenmund & Booster, 2005). See also the results of Hale et al. (submitted) where sounding board teams were a success factor in stimulating the reporting of dangerous situations and, ultimately, reducing lost-time accidents.

In general, the subsequent qualitative process can be outlined as follows (Creswell, 2007, p. 151):[17]

- a phase of rather uncritical *data collection*, during which (various kinds of) data are collected without reservation, either structured or unstructured (with some researchers preferring one above the other);
- a phase of data managing;
- a phase of data reading and memoing;
- a phase of *describing, classifying and interpreting*, in which the raw data are coded into a limited amount of categories and properties;

17 A quantitative approach generally follows the more traditional steps of: collection of numerical data – statistical treatment of data (descriptive, inferential) – conclusions.

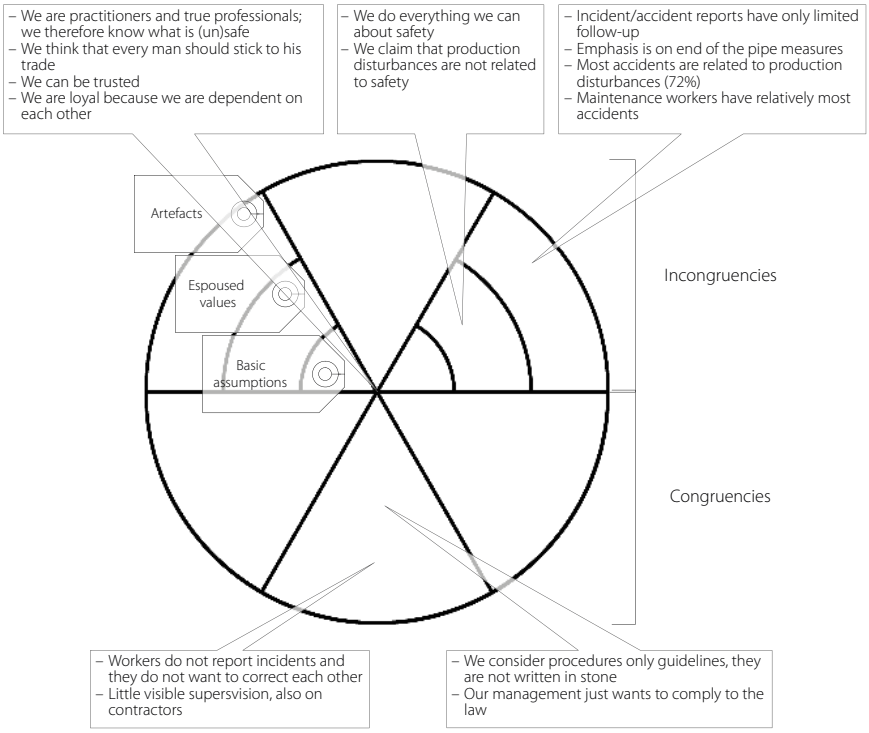
- a phase of *representing and visualising*, during which the categories are grouped into core themes or subjects; and
- a final phase of writing the *account*, in which the central themes are woven together into a meaningful whole, staying close to the respondents' statements;
- lastly, to be able to meet the standards of science (Table 2) it is required to maintain an 'audit trail' (Pickard & Dixon, 2004) or 'chain of evidence' (Yin, 2003) throughout all these phases.

Representation and visualisation of data is helpful and is also advocated by, for instance, Strauss and Corbin in their approach of grounded theory (Strauss & Corbin, 2007, p. 117 ff.) or the situational analysis of Clarke and Friese (2007). After a period of data collection – involving e.g. observations, questionnaires, interviews, focus groups and document analysis – the raw data can be summarised and placed in a matrix according to data type (e.g. interviews, questionnaire, focus group) and another categorising variable, such as Schein's six dimensions mentioned in Table 1 above. This matrix can help uncovering the important categories by looking, for example, at congruencies, discrepancies and empty cells, or missing data. (In)congruencies can appear between data types but also between dimensions, which then can be traced back to discrepancies between the three layers of the basic model.

Another helpful visual aid is the use of the onion model, depicting the three layers of culture – artefacts, espoused values and basic assumptions. Congruencies are written down in continuous parts of the onion while the discrepancies are written down in interrupted parts. For example, in Fig. 2 artefacts, espoused values and hypothesised basic assumptions collected in a Dutch dairy product factory are compared and congruencies and discrepancies are contrasted (Guldenmund et al., 2006).[18] Also some qualitative data analysis computer programs enable research teams to draw diagrams, count categories and test hypotheses about these.

18 The overall conclusion from this study was, that this particular organisational culture was a mere reflection of the regional and national culture. Neither the founders/ leaders nor any organisational upheaval had managed to make a lasting imprint on the company.

Figure 2



Although aids such as a matrix, an onion model or computer programs can be of help, deciphering basic assumptions – when required by the research – remains a challenging task. As proposed above, this task can be relieved by working in close connection with the company, or better still, to fully involve the client in the research process. In that case, one embarks together on the search for shared convictions held by the members of the company. This also aids in the action part of the programme when changes are proposed, developed and implemented.

8 Conclusion

In this paper various techniques have been discussed which can be applied in the study of organisational safety culture. These tools have been outlined following a framework based on Schein's model of organisational culture. Importantly, researchers should address some philosophical (or theoretical) issues, before they embark on a culture study, as well as the more practical ones. This is because a craftsman is far more than a person with a toolbox; tools should not be applied uncritically or, even worse, blindly. Even when the research intentions

are purely practical, such as when helping an organisation to overcome a problem, researchers should be aware that their paradigm stance already determines what they see as 'the' problem. Even the tools themselves cannot be regarded as philosophically neutral: instruments invariably bear the paradigm mark of their developer(s), often in a less-than-obvious way. Moreover, to a hammer everything looks like a nail in need of some serious pounding, for this reason the dogmatic application of research instruments as either 'badges of honour' (Pawson & Tilley, 1997) or 'Philosopher's stones' is discouraged.

Overall, the exploration of safety culture is highly recommended. However, safety culture may sometimes be more of an incantation, being coined regularly in instances when a more straightforward explanation for poor safety performance seems absent. On such occasions, an organisational safety culture study might be more like a ritual to invoke the 'God of the Gaps' than a rational inquiry based on scientific insight and method.

Acknowledgements

The author wishes to thank Judith Klungers and especially John Kingston for their thoughtful and constructive comments on earlier drafts of this paper.

References

Andersen, L. P., & Mikkelsen, K. L. (2008). Recall of occupational injuries: a comparison of questionnaire and diary data. *Safety Science, 46*(2), 255-260.

Anon. (Ed.). (2007). *A review of safety culture theory and its potential application to traffic safety*. Washington, DC: AAA Foundation for Traffic Safety.

Archer, M. (1995). *Realist social theory: the morphogenetic approach*. Cambridge: Cambridge University Press.

Argyris, C., & Schön, D. (1978). *Organizational learning: a theory of action perspective*. Reading, Mass: Addison Wesley.

Argyris, C., & Schön, D. (1996). *Organizational learning II: theory, method and practice*. Reading, Mass.: Addison Wesley.

Barling, J., Loughlin, C., & Kelloway, E. K. (2002). Development and test of a model linking safety-specific transformational leadership and occupational safety. *Journal of Applied Psychology, 87*(3), 488-496.

Berends, J. J. (1995). *Developing and using a widely applicable measurement tool for safety culture.* Unpublished interim report. Eindhoven: Eindhoven University of Technology.

Blumer, H. (1954). What is wrong with social theory? *American Sociological Review, 18*, 3-10.

Booster, P. C. (2004). *Without structure, no safety culture. Final course work for Management of Safety, Health and Environment (MoSHE) (in Dutch).* Technische Universiteit Delft, Delft.

Brooks, B. (2005). Not drowning, waving!: safety management and occupational culture in an Australian commercial fishing port. *Safety Science, 43*(10), 795-814.

Brooks, B. (2008). The natural selection of organizational and safety culture within a small to medium sized enterprise (SME). *Journal of Safety Research, 39*(1), 73-85.

Bryant, A., & Charmaz, K. (Eds.). (2007). *The SAGE handbook of grounded theory*. Thousand Oaks, CA: Sage Publications Inc.

Charmaz, K. (2006). *Constructing grounded theory. A practical guide through qualitative analysis*. London: Sage Publications Ltd.

Cheyne, A. (undated). Safety climate measurement. User guide and toolkit. Retrieved April 3, 2008, from http://www.lboro.ac.uk/departments/bs/safety/document.pdf.

Choudhry, R. M., Fang, D., & Mohamed, S. (2007). Developing a model of construction safety culture. *Journal of Management in Engineering, 23*(4), 207-212.

Churchill, G. A. (1995). *Marketing research. Methodological foundations* (6th ed.). Fort Worth, TX: The Dryden Press.

Clarke, A. E., & Friese, C. (2007). Grounded theorizing using situational analysis. In A. Bryant & K. Charmaz (Eds.), *The SAGE handbook of grounded theory* (pp. 363-397). Thousand Oaks, CA: Sage Publications Inc.

Clarke, S. (2006a). Contrasting perceptual, attitudinal and dispositional approaches to accident involvement in the workplace. *Safety Science, 44*(6), 537-550.

Clarke, S. (2006b). A meta-analytic review of safety climate and safety performance. *Journal of Occupational Health Psychology, 11*(4), 315-327.

Clarke, S., & Robertson, I. (2007). An examination of the role of personality in work accidents using meta-analysis. *Applied Psychology, 57*(1), 94-108.

Collins, A. M., & Gadd, S. (2002). *Safety culture: a review of the literature*. Sheffield: Health and Safety Laboratory, Human Factors Group.

Collins, P. (1998). Negotiating selves: reflections on 'unstructured' interviewing [Electronic Version]. *Sociological Research Online, 3*. Retrieved April 7, 2008 from http://www.socresonline.org.uk/3/3/2.html.

Cook, T. D., & Campbell, D. (1979). *Quasi-experimentation: design & analysis issues for field settings*. New York: Rand McNally.

Cooper, M. D. (2000). Towards a model for safety culture. *Safety Science, 36*(2), 111-136.

Cooper, M. D., & Phillips, R. A. (2004). Exploratory analysis of the safety climate and safety behavior relationship. *Journal of Safety Research, 35*(5), 497-512.

Cooperrider, D. L., Whitney, D. L., & Stavros, J. M. (2007). *The appreciative inquiry handbook* (2nd ed.). Brunswick, OH: Crown Custom Publishing Inc.

Cox, S., Jones, B., & Rycraft, H. (2004). Behavioural approaches to safety management within UK reactor plants. *Safety Science, 42*(9), 825-839.

Creswell, J. W. (2007). *Qualitative inquiry and research design. Choosing among five traditions* (2nd ed.). Thousand Oaks, CA: Sage Publications Inc.

Davies, F., Spencer, R., & Dooley, K. (2001). *Summary guide to safety climate tools* (Offshore Technology Report No. 1999/063). London: Health and Safety Executive.

Davies, J., Ross, A., Wallace, B., & Wright, L. (2003). *Safety management: a qualitative systems approach*. London: Taylor & Francis.

De Groot, A. (1961). *Methodology: foundations for research and thinking in the behavioural sciences (in Dutch)*. Den Haag: Mouton.

DeDobbeleer, N., & Béland, F. (1991). A safety climate measure for construction sites. *Journal of Safety Research, 22*, 97-103.

Dick, B. (2003). Action research resources. Retrieved April 24, 2008, from http://www.scu.edu.au/schools/gcm/ar/arhome.html.

Dick, B. (2005). Grounded theory: a thumbnail sketch. Retrieved March 18, 2008, from http://www.scu.edu.au/schools/gcm/ar/arp/grounded.html.

Dobson, P. J. (2002). *Critical realism and information systems research: why bother with philosophy?* Retrieved September 20, 2008, from http://informationr.net/ir/7-2/paper124.html.

Donald, I. J., & Canter, D. V. (1994). Employee attitudes and safety in the chemical industry. *Journal of Loss Prevention in the Process Industry, 7*(3), 203-208.

Ek, A., Akselsson, R., Arvidsson, M., & Johansson, C. R. (2007). Safety culture in Swedish air traffic control. *Safety Science, 45*(7), 791-811.

Ellenbroek, M., & Hende, R. v. d. (2003). *The holes in the cheese. A study of the organisational culture and safety management in a cheese factory. Final course work for Management of Safety, Health and Environment (MoSHE) (in Dutch).* Delft University of Technology, Delft.

Energy Institute (undated). Hearts and Minds programme. Retrieved March 10, 2008, from http://www.energyinst.org.uk/heartsandminds/index.cfm.

Farrington-Darby, T., Pickup, L., & Wilson, J. R. (2005). Safety culture in railway maintenance. *Safety Science, 43*, 39–60.

Flin, R. (2007). Measuring safety culture in healthcare: a case for accurate diagnosis. *Safety Science, 45*(6), 653-667.

Flin, R., Mearns, K., O'Connor, P., & Bryden, R. (2000). Measuring safety climate: identifying the common features. *Safety Science, 34*, 177-192.

Fullarton, C., & Stokes, M. (2007). The utility of a workplace injury instrument in prediction of workplace injury. *Accident Analysis & Prevention, 39*(1), 28-37.

Geertz, C. (1973). *The interpretation of cultures*. New York: Basic Books.

Gill, G. K., & Shergill, G. S. (2004). Perceptions of safety management and safety culture in the aviation industry in New Zealand. *Journal of Air Transport Management, 10*(4), 231-237.

Glaser, B. G. (1998). *Doing grounded theory: issues and discussions*. Mill Valley, Ca.: Sociology Press.

Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: strategies for qualitative research*. Chicago: Aldine.

Glendon, A. I., & Litherland, D. K. (2001). Safety climate factors, group differences and safety behaviour in road construction. *Safety Science, 39*, 157-188.

Grote, G., & Künzler, C. (2000). Diagnosis of safety culture in safety management audits. *Safety Science, 34*(1-3), 131-150.

Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research*. Thousand Oaks, CA: Sage Publications Inc.

Guldenmund, F. W. (2000). The nature of safety culture: a review of theory and research. *Safety Science, 34*(1-3), 215-257.

Guldenmund, F. W. (2007). The use of questionnaires in safety culture research – an evaluation. *Safety Science 45*, 723-743.

Guldenmund, F. W. (2008). Safety culture in a service company. *Journal of Occupational Health and Safety - Australia and New Zealand, 24*(3), 221-235.

Guldenmund, F. W., Arntzen, K., & Vriends, S. (1998). *Measuring the safety perception of the personnel of the steel converter plant Oxy 1 (in Dutch)*. Delft, Netherlands: Safety Science Group, Delft University of Technology.

Guldenmund, F. W., & Baal, C. R. (2004). *Description organisational culture Services HTD and LT Harbour in relation to safety: final report (in Dutch.)*. Delft: Safety Science Group.

Guldenmund, F. W., & Booster, P. C. (2005). The effect of structural measures on safety: a case study (in Dutch). *Tijdschrift voor Toegepaste Arbowetenschap, 18*(2), 38-47.

Guldenmund, F. W., Ellenbroek, M., & van den Hende, R. (2006). Organisational culture research in a true Dutch company (in Dutch). *Tijdschrift voor Toegepaste Arbowetenschap, 19*(2), 24-32.

Haddon, W. (1980). The basic strategies for reducing damage for hazards of all kinds. *Hazard Prevention, 16*(11), 8-12.

Hale, A. R. (2000). Culture's confusions. Editorial for the special issue on safety culture and safety climate. *Safety Science, 34*, 1-14.

Hale, A. R., & Guldenmund, F. W. (2008). *Evaluation of improvement trajectories of the Improvement Occupational Safety (VAV) program (in Dutch)*. Maldon, Essex: Hastam Ltd.

Hale, A. R., Guldenmund, F. W., Van Loenhout, P., & Oh, J. (submitted). Evaluating safety management and culture interventions to improve safety: effective intervention strategies.

Hale, A. R., v.d. Waterbeemd, H. A., Potter, R., Heming, B. H. J., Swuste, P. H. J. J., & Guldenmund, F. W. (2004). Developing an effective diagnosis for safety improvement in steelworks. *Occupational Ergonomics, 4*, 229–240.

Health and Safety Executive. (2000). Behavioural modification to improve safety: literature review [Electronic Version]. Retrieved March 11, 2008 from http://www.hse.gov.uk/research/otopdf/2000/oto00003.pdf.

Heming, B. H. J., & Guldenmund, F. W. (1999). Making much of safety culture: towards another approach (in Dutch). *Gedrag & Organisatie, 12*(6), 474-486.

Hendriks, J. (2001). Hidden rules of the game. Consultation with stagnating culture change (in Dutch). *Management & Organisatie, 4*, 61-79.

Heron, J., & Reason, P. (1997). A participatory inquiry paradigm. *Qualitative Inquiry, 3*(3), 274-294.

Hofmann, D. A., Morgeson, F. P., & Gerras, S. J. (2003). Climate as a moderator of the relationship between leader-member exchange and content specific citizenship: safety climate as an exemplar. *Journal of Applied Psychology, 88*(1), 170-178.

Hofstede, G. R. (1991). *Cultures and organisations: software of the mind*. London: McGraw-Hill.

Hofstede, G. R. (2001). *Culture's consequences* (2nd ed.). London: Sage Publications.

Holstein, J. A., & Gubrium, J. F. (Eds.). (2008). *Handbook of constructionist research*. New York: Guilford Press.

Hoonaard, W. C. v. d. (1997). *Working with sensitizing concepts. Analytical field research*. Thousand Oaks, CA: Sage Publications Inc.

Hopkins, A. (2006). Studying organisational cultures and their effects on safety. *Safety Science, 44*(10), 875-889.

Huang, Y.-H., Ho, M., Smith, G. S., & Chen, P. Y. (2006). Safety climate and self-reported injury: assessing the mediating role of employee safety control. *Accident Analysis & Prevention, 38*(3), 425-433.

Human Engineering Ltd. (2005a). *Development and validation of the HMRI safety culture inspection toolkit* (Research Report No. 365). London: Health and Safety Executive.

Human Engineering Ltd. (2005b). *A review of safety culture and safety climate literature for the development of the safety culture inspection toolkit* (Research Report No. 367). London: Health and Safety Executive.

International Atomic Energy Agency. (2005). *SCART Guidelines. Guidelines for Safety Culture Assessment Review Teams. Unpublished report*. Vienna: IAEA.

International Atomic Energy Agency (undated-a). Operational Safety Research Team - OSART. Retrieved March 10, 2008, from http://www-ns.iaea.org/reviews/op-safety-reviews.htm.

International Atomic Energy Agency (undated-b). Safety Culture Assessment Research Team - SCART. Retrieved March 10, 2008, from http://www-ns.iaea.org/reviews/saf-culture-reviews.htm.

Johnson, S. E. (2007). The predictive validity of safety climate. *Journal of Safety Research, 38*(5), 511-521.

Kaplan, A. (1964). *The conduct of inquiry. Methodology for the behavioral science*. San Francisco: Chandler Publishing Company.

Kirk, R. E. (1995). *Experimental design: procedures for the behavioral sciences* (3rd ed.). Pacific Grove, CA: Brooks/Cole.

Krauss, S. E. (2005). Research paradigms and meaning making: a primer. *The Qualitative Report, 10* (4), 758-770.

LaMontagne, A. D., Barbeau, E., Youngstrom, R. A., Lewiton, M., Stoddard, A. M., McLellan, D., et al. (2004). Assessing and intervening on OSH programmes: effectiveness evaluation of the Wellworks-2 intervention in 15 manufacturing worksites. *Occupational and Environmental Medicine, 61*, 651–660.

Lardner, R. (2004). *Mismatches between safety culture improvement and behaviour-based safety.* Paper presented at the NeTWork 2004 Workshop 'Safety Culture and Behavioural Change at the Workplace', Blankensee, Berlin, 9-11 September.

Lardner, R., Fleming, M., & Joyner, P. (2001). Towards a mature safety culture. *IChemE Symposium Series, 148*, 635-642.

Lee, T., & Harrison, K. (2000). Assessing safety culture in nuclear power stations. *Safety Science, 34*(1-3), 61-97.

Lehtola, M. M., van der Molen, H. F., Lappalainen, J., Hoonakker, P. L. T., Hsiao, H., Haslam, R. A., et al. (2008). The effectiveness of interventions for preventing injuries in the construction industry: a systematic review. *American Journal of Preventive Medicine, 35*(1), 77-85.

Lewin, K. (1946). Action research and minority problems. *Journal of Social Issues, 2*(4), 34-46.

Ludborzs, B. (1995). Surveying and assessing 'safety culture' within the framework of safety audits. In J. J. Mewis, H. J. Pasman & E. E. De Rademaecker (Eds.), *Loss Prevention and Safety Promotion in the Process Industries* (Vol. 1, pp. 83-92).

Luria, G., & Rafaeli, A. (2008). Testing safety commitment in organizations through interpretations of safety artifacts. *Journal of Safety Research, 39*(5), 519-528.

Mark, B. A., Hughes, L. C., Belyea, M., Chang, Y., Hofmann, D., Jones, C. B., et al. (2007). Does safety climate moderate the influence of staffing adequacy and work conditions on nurse injuries? *Journal of Safety Research, 38*(4), 431-446.

Mearns, K., Whitaker, S. M., & Flin, R. (2001). Benchmarking safety climate in hazardous environments: a longitudinal, interorganizational approach. *Risk Analysis, 21*(4), 771-786.

Mearns, K., Whitaker, S. M., & Flin, R. (2003). Safety climate, safety management practice and safety performance in offshore environments. *Safety Science, 41*(8), 641-680.

Meijer, S. D. (1999). *The Gordian knot of organisational and safety culture (in Dutch).* PhD thesis, Technical University Eindhoven.

Merriam-Webster Online Dictionary (undated). Retrieved 12 April, 2007, from http://www.merriam-webster.com.

Miller, D. C., & Salkind, N. J. (Eds.). (2002). *Handbook of research design and social measurement* (6th ed.). Thousand Oaks, CA: Sage Publications Inc.

Mills, J., Bonner, A., & Francis, K. (2006). Adopting a constructivist approach to grounded theory: implications for research design. *International Journal of Nursing Practice, 12*(1), 8-13.

Mohamed, S. (2002). Safety climate in construction site environments. *Journal of Construction Engineering and Management, 128*(5), 375-384.

Myers, M. D. (1997). Qualitative research in information systems. *MIS Quarterly, 21*(2), 241-242.

Parker, D., Lawrie, M., & Hudson, P. T. W. (2006). A framework for understanding the development of organisational safety culture. *Safety Science, 44*(6), 551-562.

Patton, M. Q. (2001). *Qualitative research & evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage Publications Inc.

Pawson, R., & Tilley, N. (1997). *Realistic evaluation*. London: Sage.

Pederson, J. S., & Sorensen, J. S. (1989). *Organisational cultures in theory and practice*. Aldershot, UK: Avebury & Gower.

Pickard, A., & Dixon, P. (2004). The applicability of constructivist user studies: how can constructivist inquiry inform service providers and systems designers? [Electronic Version]. *Information Research*, *9*. Retrieved July 18, 2008 from http://informationr.net/ir/9-3/paper175.html.

Polling, J. (1999). *Management, structure and culture (in Dutch).* PhD thesis, Wageningen University.

Prussia, G. E., Brown, K. A., & Willis, P. G. (2003). Mental models of safety: do managers and employees see eye to eye. *Journal of Safety Research, 34*(2), 143-156.

Rafaeli, A., & Worline, M. (2000). Symbols in organizational culture. In N. Ashkenazy, C. Wilderom & M. Peterson (Eds.), *Handbook of Organizational Culture and Climate* (pp. 71-84). Thousand Oaks, CA: Sage Publications Inc.

Reason, J. T. (1990). *Human error*. Cambridge: Cambridge University Press.

Reason, J. T. (1997). *Managing the risks of organizational accidents*. Aldershot: Ashgate.

Reiman, T., & Oedewald, P. (2004). Measuring maintenance culture and maintenance core task with CULTURE-questionnaire - a case study in the power industry. *Safety Science, 42*(9), 859-889.

Robson, L. S., Clarke, J. A., Cullen, K., Bielecky, A., Severin, C., Bigelow, P. L., et al. (2007). The effectiveness of occupational health and safety management system interventions: a systematic review. *Safety Science, 45*(3), 329-353.

Rogers, C. R. (1961). *On becoming a person. A therapist's view of psychotherapy*. Boston: Houghton Mifflin.

Rundmo, T. (1992). Risk perception and safety on offshore petroleum platforms – Part II: Perceived risk, job stress and accidents. *Safety Science, 15*(1), 53-68.

Rundmo, T. (1996). Associations between risk perception and safety. *Safety Science, 24*(3), 197-209.

Schein, E. H. (1992). *Organizational culture and leadership* (2nd ed.). San Francisco: Jossey-Bass.

Schein, E. H. (1999). *The corporate culture survival guide: sense and nonsense about cultural change*. San Francisco: Jossey-Bass Inc.

Schulte, R. (2006). *Helm position safe. A safety culture study at Van der Sluijs Tankrederij B.V.. Final course work for Management of Safety, Health and Environment (MoSHE) (in Dutch).* Delft University of Technology, Delft.

Seel, R. (2001). Describing culture: from diagnosis to inquiry. [Electronic Version]. Retrieved March 10, 2008 from http://www.new-paradigm.co.uk/describing_culture.htm.

Seel, R. (undated). The organisational culture check list. Retrieved March 10, 2008, from http://www.new-paradigm.co.uk/checklist.htm.

Shannon, H. S., Mayr, J., & Haines, T. (1997). Overview of the relationship between organizational and workplace factors and injury rates. *Safety Science, 26*(3), 201-217.

Silva, S., Lima, M. L., & Baptista, C. (2004). OSCI: an organisational and safety climate inventory. *Safety Science, 42*(3), 205-220.

Spector, P. E. (2006). Method variance in organizational research. Truth or urban legend? *Organizational Research Methods, 9*(2), 221-232.

Spencer-Oatey, H. (2000). *Culturally speaking: managing rapport through talk across cultures*. London: Continuum.

Stave, C., & Törner, M. (2007). Exploring the organisational preconditions for occupational accidents in food industry: a qualitative approach. *Safety Science, 45*(3), 355-371.

Steijger, N. (2005). *Development diagnosis method safety culture. Final course work for Management of Safety, Health and Environment (MoSHE) (in Dutch).* Delft University of Technology, Delft.

Strauss, A., & Corbin, J. (2007). *Basics of qualitative research: techniques and procedures for developing grounded theory* (3rd ed.). Thousand Oaks, CA: Sage Publications Inc.

Swuste, P. H. J. J., Guldenmund, F. W., Hale, A. R., Heimplaetzer, P., Heming, B. H. J., & Oortman Geerlings, P. (1994). *Decentralised safety management system. Development and evaluation of a decentralised safety management system for the improvement of occupational safety results in an integrated steel company - final report (in Dutch).* (No. EGKS-Project nr. 7262/22/244/06). Delft: Safety Science Group & Hoogovens IJmuiden.

Ten Hove, J., & Meems, M. (2006). *Safety culture and the working of the safety management system at major hazard companies. Final course work for Management of Safety, Health and Environment (MoSHE) (in Dutch.*). Technische Universiteit Delft, Delft.

Tijdelijke Commissie Ongevallenonderzoek Defensie. (2004). *Collision YPR with train near Assen on June 17th, 2003 (in Dutch).* Den Haag.

Varonen, U., & Mattila, M. (2000). The safety climate and its relationship to safety practices, safety of the work environment and occupational accidents in eight wood-processing companies. *Accident Analysis & Prevention, 32*(6), 761-769.

Waring, J. J. (2005). Beyond blame: cultural barriers to medical incident reporting. *Social Science & Medicine, 60*, 1927-1935.

Westrum, R. (2004). A typology of organisational cultures. *Quality and Safety in Health Care, 13* (Suppl II), ii22-ii27.

Wiegmann, D. A., Thaden, T. L. v., & Gibbons, A. M. (2007). A review of safety culture theory and its potential application to traffic safety. In *Improving traffic safety culture in the United States. The journey forward* (pp. 113-129). Washington, DC: AAA Foundation for Traffic Safety.

Williams, J. H., & Geller, E. S. (2000). Behaviour-based intervention for occupational safety: critical impact of social comparison feedback. *Journal of Safety Research, 31*(3).

Wogalter, M. S. (Ed.). (2006). *Handbook of warnings*. Mahwah, NJ: Lawrence Erlbaum Associates.

Yin, R. K. (2003). *Case study research: design and methods* (3rd ed.). Thousand Oaks, CA: Sage Publications Inc.

Zohar, D. (2000). A group-level model of safety climate: testing the effect of group climate on microaccidents in manufacturing jobs. *Journal of Applied Psychology, 85*(4), 587-596.

Zohar, D. (2002). The effects of leadership dimensions, safety climate, and assigned priorities on minor injuries in work groups. *Journal of Organizational Behaviour, 23*, 75-92.

Zohar, D., & Luria, G. (2004). Climate as a social-cognitive construction of supervisory safety practices: scripts as proxy of behavior patterns. *Journal of Applied Psychology, 89*(2), 322-333.

Zohar, D., & Luria, G. (2005). A multilevel model of safety climate: cross-level relationships between organization and group-level climates. *Journal of Applied Psychology, 90*(4), 616-628.

Chapter 4

Safety culture in a service company: a case study

Published in the Journal of Occupational Health and Safety – Australia and New Zealand, 24(3), 221-235, 2008

Introduction to Chapter 4

In the previous chapter the most important tools used to study safety culture have been described, along with a series of steps that map out the way how to arrive at a fully equipped safety culture toolbox. What tools to pick is highly dependent on the research problem and the time available for the research, but is also related to important assumptions the research team has about the reality they are studying.

What follows next is the only fully fledged empirical study presented in this book that has been carried out by me. This study was published in the *Journal of Occupational Health and Safety – Australia and New Zealand* in 2008 and it describes an organisational safety culture study executed at a Dutch service company in 2007. This company carried out non-destructive inspections at diverse locations in The Netherlands, ranging from greenhouses to large (petro-)chemical sites. The company had been confronted with various violations, for which they had also been penalised by a governmental inspection agency.

The primary concern of the company's CEO was the extent to which important safety messages from the management team reached and were understood by the field workers. In discussion with the CEO this question was reframed in terms of an underlying organisational safety culture; that is, how can the current organisational safety culture be described and to what extent does it support the dissemination of information to and from the management team? Because of the nature of the fieldwork, employees worked either alone or in small teams, mostly without supervision. The notion of a pervasive organisational safety culture that ensured safe working, in absence of supervision or any other means of control, was quite appealing to the management (see also the Epilogue).

At that time, I had already formulated the three approaches to safety culture research that are worked out in more detail in Chapter 5, i.e. the academic, analytical and pragmatic approaches. It therefore seemed a good idea to apply all three approaches, as these represented a broad range of techniques with which to capture the current organisational culture. Moreover, having data from three different approaches and their accompanying techniques or instruments, an overall comparison would be feasible.

The journal paper describing this study follows next. However, because I was not completely satisfied with the final result, especially because the paper mainly focuses on the quantitative results and a qualitative description of this company's organisational safety culture was not included, the chapter is expanded with an extensive afterword, to compensate for this deficiency.

Abstract

This article discusses the results from a safety culture research project at a service company that carries out nondestructive research at various locations in The Netherlands. The extent to which workers are guided by organisational safety culture when executing their daily work is explored. More conventional management and supervisory activities were found to predict rule-breaking. Being safety conscious while working, on the other hand, required more proactive management and supervisory activities, as well as strict supervision. Analytical, pragmatic and academic approaches were used to gather data. The latter two approaches provided the context within which results from the analytical approach were interpreted. Although the company was diagnosed as 'reactive', it had a respectable safety performance record. Therefore, it would be hard to argue that such a rating is 'inadequate', and that a more advanced, proactive safety culture should be developed

Safety culture in a service company: a case study

1 Introduction

While published research on safety climate and safety culture is found increasingly in the safety scientific literature, articles usually discuss diagnostic methods, their methodological merits, and/or provide descriptions or diagnostics of their research objectives (e.g. Clarke, 2006; Guldenmund, 2007; Mearns, Whitaker, & Flin, 2003; Reiman & Oedewald, 2004; Zohar, 2002a).

Interesting as many of these results might be, they are often not situated within a larger organisational context. Moreover, results are usually not taken one or more steps further in the direction of a final diagnosis, let alone a subsequent intervention trajectory. Using complementary methods, this article attempts to fill this apparent lacuna by providing a diagnosis and, based on research findings, making recommendations for the company studied.

The term 'safety culture' has been connected with several major incidents, including Chernobyl, Piper Alpha and Texas City refinery, as a factor which contributed significantly to these disasters (Baker III et al., 2007; Cullen, 1990; International Nuclear Safety Advisory Group, 1986). The local safety culture allegedly provided a context in which suboptimal conditions could arise and flourish without being corrected or even noticed. It is possible that safety culture (or safety climate) research could be carried out in a company to identify such signs of deterioration, perhaps as a leading indicator of a pending catastrophe (Guldenmund, 2000). Herein lies part of the attractiveness of the concepts of safety culture and safety climate.

The International Safety Advisory Group (1991) defined safety culture as 'that assembly of characteristics and attitudes in organisations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance'. Safety culture here is conceived as something that 'establishes […] attention'. Such attention would be in addition to, or as a substitute for, other means of establishing attention (like instrumentation, procedures and supervision). Herein lies another part of its attractiveness because, in the absence of these other means, safety culture might still demonstrate its influence. In other words, when supervision is lacking, procedures are ambiguous and diagnostic tools are unavailable, the operative safety culture could still encourage safe action. In some companies, this might very well be a daily reality.

The relationship between safety climate scores and other constructs or performance indicators has been explored by several research teams (e.g. Clarke & Robertson, 2007; Reiman & Oedewald, 2004). Whereas a direct link between safety climate and safety performance is often hard to establish, safety climate scores appear to be influenced by the workforce's perceptions of its management and supervisors (e.g. Hofmann & Stetzer, 1998; Sorensen, 2002; Zohar, 2002a; Zohar & Luria, 2005). While management should be the primary advocate of the organisational and safety culture, if it does not hold safety as a value, then why should the workforce bother?

This characteristic of safety culture as a substitute for other risk control actions might be especially attractive to companies that miss the Orwellian possibility of close supervisory control. The present research focuses on a service company in which employees often work alone or in pairs and frequently visit unfamiliar sites that lack a proper safety regime. It was therefore interesting to pose the following research question: To what extent are workers compelled to work safely in the absence of direct supervisory control, and is this supported by their organisational safety culture?

Given the disagreement surrounding the concept, there is also no single technique available with which to comprehensively study safety culture (Guldenmund, 2007; Hale, 2000). However, three broad approaches can be identified: analytical, pragmatic and academic (Guldenmund, 2006).

The analytical approach is aimed at the psychological safety climate, primarily uses questionnaires as its basic technique, and is the dominant approach in the field (Collins & Gadd, 2002; Guldenmund, 2007). The pragmatic approach is principally based on expert opinion and aims to assess the safety culture maturity of a company. This approach uses either Q-sorts or behaviourally anchored rating scales for making appraisals (Energy Institute, undated; Lardner, 2004; Parker, Lawrie, & Hudson, 2006). Different interventions are available which are related to different levels of maturity. The academic approach comprises either anthropological/sociological research or clinical organisational research, using qualitative fieldwork as its basic strategy (Schein, 1992). These complementary approaches each provide a view from the bridge, none of them being perfect or complete (Guldenmund, 2006).

All three approaches have been applied in the present study. A description of the company is given next, followed by the methods applied and the resulting data. These will be discussed in light of the research question posed above, as well as the particular interest of the company.

2 The company

The company being studied is an almost 70-year-old Dutch service business with 484 personnel. The company carries out non-destructive research at chemical and petrochemical companies, nuclear power plants, and shipbuilding companies, as well as in small businesses that produce or bend pipes or weld metal

objects. In the Netherlands, this company is the current market leader. While demand for non-destructive research is larger than the market currently offers, overall competition is weak and work pressure on employees is high.

Although it has been a privately owned company for many years, in the past decade it has been an object for investors who, despite their name, hardly invest in it but try to resell it rapidly to make a significant profit. A larger European organisation currently owns the company, but it is on the market for sale.

In the Netherlands, the company is divided over three regions. In the recent past, there were more regions, which were all controlled by head office. All orders were placed and approved there, but client acquisition and work planning have always been carried out locally. Current policy is to decentralise most control to the three regions, including purchasing and quality, environment, safety and health (QESH). It is management's aim to organise standard project teams in all regions, which will acquire various responsibilities (including QESH). Obviously, the main QESH staff cannot judge all of the local conditions and requirements of all sites where employees work, so this is left to the individual project team's discretion.

Because of the risk analysis and evaluation which the company has to perform every three years according to Dutch law, management was interested in surveying the workforce. The research sought to address two important questions:

1. What are the safety perceptions and evaluations of the workforce and to what extent are these supported by the current communication structure and organisational culture?
2. When is the safety regime at odds with actual working conditions and how is this conflict resolved?

3 Method

3.1 Sample

The sample comprised all 484 employees of the Dutch division of the service company, including office and fieldworkers, as well as maintenance, storage and offshore unit workers. The study involved all levels within the company. As outlined below, several measures were applied corresponding to the three approaches discussed above. All employees were approached with a request to participate in the questionnaire study, and those who indicated that they were interested in further participation were involved in the follow-up study.

3.2 Measures

The questionnaire was in three parts. The first part was a translated version of Zohar and Luria's (2005) questionnaire, adapted to suit local conditions (national and organisational). Their 32-item questionnaire consists of organisa-

tional and group-level sections. The former section surveys safety management activities that should be executed according to OHSAS 18001 (The Occupational Health & Safety Group, 2007). The questions describe a range of activities running from monitoring – enforcing, learning – developing to declaring – informing. Questions also distinguish between declarative or procedural management action, loosely referring to Argyris and Schön's (1996) distinction between espoused theories and theories-in-use. An example of a declarative item is: 'The management in this company regularly holds safety awareness events, eg presentations, ceremonies.' A procedural item is: 'The management in this company provides all the equipment needed to do the job safely.'

The second group-level section of Zohar and Luria's questionnaire deals with a range of contact modes between supervisors and group members, and incorporates a distinction between declarative and procedural efforts. A declarative item from this section is: 'My direct supervisor frequently talks about safety issues throughout the work week.' A procedural item is: 'My direct supervisor frequently checks to see if we are all obeying the safety rules.'

Zohar and Luria's questionnaire is directed at both managers and supervisors, but has no questions about work and colleagues. Therefore, a second part (comprising 18 questions) was added, which was developed by Berends (1995; 1996) and adapted by Guldenmund et al. (1998). This part of the questionnaire addressed issues such as productivity versus safety, rule-breaking and risk-taking, housekeeping, working relations, and satisfaction with information about safety. Hence, the questionnaire dealt with the three most important levels within an organisation: managers, supervisors and operators. Responses to all items were on a five-point rating scale, ranging from completely disagree (1) to completely agree (5). A third, demographic section included questions on the respondent's age, time with the company, education, department, and type of work undertaken.

The second method used a behaviourally anchored rating scale developed for Shell's Hearts and Minds project and aimed to assess the safety culture development of a group, like a department or team, during a workshop (Parker et al., 2006). The scale consists of seven subjects divided into 18 questions or issues. Answers to the questions/issues are ranked to indicate safety culture maturity. The scale distinguishes five levels of maturity: pathological, reactive, calculative, proactive and generative. These levels were introduced by Westrum (1991; 2004) and further elaborated by Parker et al. (2006). Hence, the full questionnaire consisted of an 18 (questions) × 5 (levels) matrix, detailing the five levels of maturity for the 18 different issues (Table 1).

Table 1 Subjects covered in Hearts and Minds questionnaire

Topic		Management	Workforce
A	Are health, safety and environment (HSE) issues communicated to the workforce?	Yes	Yes
B	Commitment level of the workforce	No	Yes
C	What are the rewards of good HSE performance?	Yes	Yes
D	Who causes safety incidents?	Yes	No
E	Balance between profit and HSE	Yes	Yes
F	Contractor management	Yes	No
G	Are workers interested in competency?	No	Yes
H	What is the size/status of the HSE department?	Yes	No
I	Work planning (including permit to work)	No	No
J	Worksite safety management techniques	No	Yes
K	What is the purpose of procedures?	No	No
L	Incident reporting/analysis	Yes	No
M	Hazard and unsafe act reports	No	Yes
N	What happens after an incident?	No	No
O	Who checks HSE on a day-to-day basis?	No	Yes
P	How do HSE meetings feel?	No	Yes
Q	Audits	Yes	No
R	Benchmarking, trends and statistics	Yes	No

Not all questions or issues are considered relevant at each level in the organisation, and the third and fourth columns of Table 1 indicate which questions are pertinent at each level.

It might also be questioned whether this approach is actually concerned with the core of culture or with its manifestation(s), that is, the layer(s) surrounding organisational safety culture. If anything, the latter might be more the case. The method is not yet the result of empirical research, but rather an accumulation of expert judgments that includes both choice of topics covered in the scales as well as the rankings – hence the label 'pragmatic approach'. Nevertheless, even though it is not the rankings per se but rather the mulling over of them that provided data for the workshop, the method was considered useful in the current study. The method also appealed to management and the workforce.

Fieldwork for the academic approach consisted of both observations at worksites and formal and informal interviews with workers, (safety) staff and managers, resulting in a plethora of artefacts and espoused values (see Schein, 1992, for a discussion of these terms). Constant comparison of these findings results in both contrasts and similarities, which might be resolved by formulating underlying assumptions (not unlike conducting a Hegelian dialectic of thesis, antithesis and synthesis). The final result should provide clues as to what the company's workforce is collectively convinced of.

Throughout the research, various unstructured interviews were conducted with respondents who indicated willingness to participate in the follow-up study. Interviews focused on daily safety practices and on major events in the history of the company that might have influenced the workforce's current beliefs. Results from the survey as well as the workshops were discussed as a way of confirming or reviewing these findings.

3.3 *Procedure*

At the start of the project, questionnaires were sent to the home addresses of all 484 employees. The underlying rationale was that questionnaire responses should identify some signals or themes existing in the workforce, which could be used during subsequent workshops and interviews. Besides the questionnaire, the envelope contained a letter from the CEO, a letter from the works council, and a postage-paid return envelope addressed to the university. The questionnaire instructions stressed that the results would remain within the university and that responses could not be traced back to individuals. After about two weeks, a reminder letter was sent (again, to all employees).

The Hearts and Minds behaviourally anchored rating scale procedure is straightforward (Energy Institute, undated). In a workshop, between five and 20 people (who are comparable in level, seniority and type of work) first complete the questions individually. The facilitator then records individual scores on a flipchart, noting areas of agreement and disagreement. Agreement indicates subject's evaluations which apparently converge, whereas disagreement signifies discrepancies between group members. It is not the scoring in itself, but the ensuing workshop discussion that is considered fruitful. Hence, the method can be considered a vehicle to convey discussion towards a common accord on strengths and weaknesses, as well as working towards agreement on steps to improve the current level of safety culture development.

Three focus groups were held, one with part of the management team and two with the workforce. The management team session was conducted with eight participants and lasted for about one and a half hours. During the session, management team members first completed the Hearts and Minds questionnaire individually, and items with the greatest variance were subsequently discussed. The session ended with a short feedback on the questionnaire results.

The two workforce focus groups had three and 10 participants, respectively. The smaller group consisted of two office workers and one fieldworker. However, all had significant experience as fieldworkers. The larger focus group consisted of office workers, most of whom also had extensive fieldwork experience.

These focus groups started with a short brainstorm about safety. Participants were asked to write down words related to safety in the company, with each word or set of words written on a separate note. The researcher collected and organised the notes according to a common theme on one or more flipcharts. During the focus group, the Hearts and Minds questionnaires were also com-

pleted. The session rounded off with the question: 'Your company has just won an award. What was it for?' The purpose of this exercise was to obtain an impression of what the company was really good at and what its members were possibly proud of (Seel, 2001).

As discussed above, throughout the research, interviews were held with various members of the company. Focus groups and interviews were conducted with respondents who had indicated in the questionnaire that they were willing to participate in the follow-up study. At the start of each interview, respondents were informed of the purpose of the study and assured of their anonymity. Interviews covered the interviewee's past (education, time with the company, career, events), present (current work, safety problems, communication with coworkers) and, sometimes, future (ambitions). During these interviews, extensive notes were taken and these were written up afterwards.

4 Results

4.1 Questionnaire

Of the employees, 187 (38.6%) returned completed questionnaires (72 (38.5%) of these were office workers). Thirty-seven respondents (7.6%) indicated willingness to participate in subsequent interviews and focus groups.

The data were analysed using the SAS® program (SAS Institute Inc., 1999) and the statistical software environment R (R Development Core Team, 2005). A principal component analysis with orthogonal (Varimax) rotation was performed. Because the number of respondents meant that the 5:1 cases to variables ratio was not reached (Tabachnick & Fidell, 1989), each part of the questionnaire – i.e. the sections on managers, supervisors and operators, respectively – was analysed separately. Means were calculated using the raw unweighted data corresponding to the found structure. Tables 2, 3 and 4 show the resulting factor structures, percentage of variance explained by each factor, scale reliability coefficients (Cronbach's alpha), means, and standard deviations.

Table 2 Factor structure for questions about management

Factor	M1	M2
Top management in this company …		
– quickly corrects any safety hazard (even if it's costly)	0.78	
– reacts quickly to solve the problem when told about safety hazards	0.78	
– is strict about working safely when work falls behind schedule	0.74	
– listens carefully to workers' ideas about improving safety	0.74	
– provides all of the equipment needed to do the job safely	0.72	
– gives safety personnel the authority they need to do their job	0.67	
– requires each manager to help improve safety in his/her department	0.57	
– insists on thorough and regular safety audits and inspections	0.55	
– provides detailed safety reports to workers (eg injuries, near-miss incidents)		0.79
– considers a person's safety behaviour when moving or promoting people		0.76
– provides workers with a lot of information on safety issues		0.75
– regularly holds safety-awareness events (eg presentations, ceremonies)		0.73
– uses any available information to improve existing safety rules	0.56	0.63
– tries to continually improve safety levels in each department	0.51	0.58
– invests a lot of time and money in safety training for workers		0.56

Factor	Label	Percentage of variance explained	Alpha	Mean	SD
M1	Conventional safety approach management	53%	0.93	3.48	0.73
M2	Proactive safety approach management	8%	0.89	3.30	0.74

Table 3 Factor structure for questions about supervisors

Factor	S1	S2
My direct supervisor …		
– frequently talks about safety issues throughout the work week	0.84	
– frequently tells us about the hazards in our work	0.82	
– gives workers who pay special attention to safety a pat on the back	0.80	
– spends time on our insight to recognise problems before they arise	0.75	
– emphasises safety procedures when we are working under pressure	0.74	
– explains the rules that have been imposed	0.73	
– discusses how to improve safety with us	0.72	
– frequently checks to see if we are all obeying the safety rules	0.71	
– makes sure we follow all of the safety rules (not just the most importantones)	0.69	
– reminds workers who need reminders to work safely	0.68	
– considers safety when setting production speed and schedules	0.66	
– insists that we obey safety rules when fixing equipment or machines	0.61	0.51

Factor	S1	S2
– refuses to ignore safety rules when work falls behind schedule		0.83
– is strict about working safely, even when we are tired or stressed		0.75
– still thinks that safety is important, even after a long day's work	0.57	0.63
– makes sure we receive all of the equipment needed to do the job safely		0.59

Factor	Label	Percentage of variance explained	Alpha	Mean	SD
S1	Support from supervisors	58%	0.95	3.13	0.80
S2	Controlling safety by supervisors	7%	0.85	3.52	0.72

Table 4 Factor structure for workforce questions

Factor	W1	W2
When the people in my department think they can do a job without following the procedures, they deviate from these procedures	0.73	
The people in my department don't always use the required safety measures	0.70	
When the people in my department have to finish their job quickly, they deviate from the safety procedures	0.69	
The people in my department do not always work according to the safety procedures	0.69	
When you tackle somebody from this company about doing a job unsafely, he just does not care	0.66	
We can also do our job safely with improvisation	0.56	
The people in my department sometimes take unacceptable risks	0.56	
The people in my department do not always wear the required personal protective equipment	0.56	
When somebody from this company works unsafely, he is not always tackled by a colleague about it	0.53	
Before my colleagues and I start an unfamiliar job, we first discuss how this can be done in the safest manner		0.79
The people in my department talk a lot about safety with each other		0.67
Before someone from my department starts working, he first checks whether the job can be executed safely		0.62
When somebody from my department sees an unsafe situation, he will do everything possible to improve the situation		0.60
The people in my department warn somebody if they see a possible hazard		0.60
The people I work with are satisfied with the information they get about working safely		0.56
The people in my department know the safety procedures written for their work		0.53
The people in my department report the unsafe situations and unsafe events they see to their supervisors		0.51
When the job cannot be done according to the prescribed procedures, the people in my department report this to their supervisor		0.50

Factor	Label	Percentage of variance explained	Alpha	Mean	SD
W1	Rule-breaking during work	36%	0.86	2.76	0.72
W2	Safety conscious and preventive working	8%	0.83	3.52	0.56

All principal component analyses resulted in two clearly distinguishable factors, in each case corresponding to 'conventional safety' and 'proactive safety'. The conventional factors included questions about working according to rules, wearing safety equipment, and putting safety above production. The proactive scales referred to more active safety behaviour, like stimulating safety, being responsive to others, and reporting safety incidents. Such a distinction roughly parallels Zohar and Luria's (2005) findings, as well as Neal and Griffin's (2000) distinction between safety compliance and participation.

The demographic questions were used to create various contrasting groups. Differences between the groups were tested conservatively using the distribution-free tests of SAS's PROC NPAR1WAY (Wilcoxon–Mann–Whitney U two-sample test and Kruskal-Wallis one-way analysis of variance) (Siegel & Castellan Jr., 1988). These tests showed few significant results, implying fairly consistent opinions overall (Table 5). However, office and fieldworkers were clearly distinguished respectively as the 'blunt' and 'sharp' ends of the company (Flin, O'Connor, & Crichton, 2008; Hollnagel, 2004). Moreover, the greatest number of significant differences were found on the S_1 and S_2 factors, indicating that opinions differed more about immediate supervisors than about management (Table 5).

Table 5 Non-parametric test results for demographic variables on six factors

Factor	M1	M2	S1	S2	W1	W2
Age	ns	ns	ns	ns	ns	ns
Education level	ns	ns	*	*	ns	ns
Department	ns	ns	ns	ns	ns	ns
Roster (nine to five/shift/irregular)	**	*	**	*	ns	ns
Stationary workplace	ns	ns	ns	ns	ns	ns
Office or field job	ns	ns	**	*	ns	ns
Supervisory responsibilities	ns	ns	ns	ns	ns	ns
Use of radioactive sources	ns	ns	*	*	ns	ns
Number of significant results	1	1	4	4	0	0

* < 0.05.
** < 0.01.
ns = not significant.

To test the influence of management and supervision on the fieldworker sample, two regression analyses were performed. Because all three sections of the ques-

tionnaire were analysed separately, the resulting factors were obtained independently and can therefore be used in such an analysis. The two factors used as dependent variables were W_1 (rule breaking) and W_2 (safety consciousness), which were to be predicted by factors M_1 (active management), M_2 (proactive management), S_1 (supervisory support) and S_2 (supervisory control). The models to be tested were:

1. $W_1 = \alpha_0 + \beta_1 M_1 + \beta_2 M_2 + \beta_3 S_1 + \beta_4 S_2 + \varepsilon$
2. $W_2 = \alpha_0 + \beta_1 M_1 + \beta_2 M_2 + \beta_3 S_1 + \beta_4 S_2 + \varepsilon$

Applying several selection procedures resulted in the following models:

1. $W_1 = 5.07 - 0.21 M_1 - 0.47 S_2 + 0.31$ (RMSE)
2. $W_2 = 1.65 + 0.21 M_2 + 0.2 S_1 + 0.18 S_2 + 0.52$ (RMSE)

For model (1): $F_{(2, 99)} = 42.45$, $p < 0.0001$, $R^2 = 0.46$.
For model (2): $F_{(3, 98)} = 57.45$, $p < 0.0001$, $R^2 = 0.64$.

Hence, conventional management (M_1) and supervisory safety activities (S_2) predicted rule-breaking (W_1) best, whereas both proactive management behaviour (M_2) and all supervisory activity (S_1 and S_2) were most influential for workforce safety dedication (W_2).

4.2 *Focus groups*

Table 6 shows themes resulting from organising the notes arising from participants' comments.[1] As it was considerably smaller, focus group 1 produced fewer themes than focus group 2. The focus group notes overlapped on three themes: work and company; company personnel (and others); and procedures and guardianship (helping or correcting colleagues if needed). The other 16 themes (19 minus 3) were exclusive to a single focus group.

Possible awards to the company revolved around the following themes: commitment ('around the clock availability', 'flexibility' and 'commitment to work'); customer satisfaction ('good performance', 'customer satisfaction'); production ('securing large contracts'); and cynicism ('luck', 'national lottery'). Notably, none in this list were concerned with safety.

1 There are no results from the session with the management team because it was limited to the items of the Hearts and Minds matrix. No new themes were explored.

Table 6 Themes and their global content for focus group 1 and focus group 2

Theme	Global content	Focus group 1	Focus group 2
Client	Importance of client (safety over production), work situation at client's workplace	✓	
Workers' commitment	How to keep safety under observation		✓
Company	Attractiveness of work, organisational issues	✓	✓
Equipment	Equipment and its operational readiness		✓
Health	Health issues, regular check-ups		✓
Incidents	Incident reporting		✓
Management	Management support and commitment	✓	
Personnel/bystanders	People involved/present during execution of work	✓	✓
Personal protective equipment	Correct personal protective equipment		✓
Radiation	Protection, barriers (tape, gates)		✓
Risk perception/evaluation	Risk-taking, last-minute checks, responsibility, vigilance		✓
Rules and procedures	Procedures, licences, guardianship	✓	✓
HSE department	Safety plans, people involved		✓
Toolbox talks	Execution of toolbox talks – how many?	✓	
Training	Diplomas, safety information		✓
Workplace visits	Function/role and execution of workplace visits	✓	
Total number of themes		7	12

4.3 *Hearts and Minds*

During the focus group sessions, all participants completed the Hearts and Minds matrix individually. The results were tabulated and a final score was calculated. The scores were: 3.30 (management team); 2.23 (focus group 1); and 2.34 (focus group 2). Table 7 gives combined results for the management and workforce samples.[2]

The results in Table 7 are skewed to the right, which means that the company leans towards a reactive orientation. However, the management team scores clearly produced a shift towards the more proactive end of the scale. It should be stressed that the scale is ordinal, implying no numerical inferences.

2 The rows do not add up to the same number because, when respondents cannot choose between two categories, they are advised to tick both, and not all aspects were pertinent to all groups (Table 1).

Table 7 Combined results of the Hearts and Minds sessions

Topic	Pa	R	C	Pr	G
Communicating HSE issues to the workforce?	–	2/11	4/2	5/1	–
Commitment level of workforce	–	6	7	–	–
What are the rewards of good HSE performance?	0/5	6/4	2/4	1/0	1/0
Who causes incidents?	–	–	–	7	1
Balance between profit and HSE	0/1	0/7	4/4	6/2	–
Contractor management	–	2	5	5	–
Are workers interested in competency?	6	7	3	1	–
What is the size/status of the HSE department?	–	3	3	5	–
Worksite safety management techniques	1	5	8	1	–
Incident reporting/analysis	–	1	6	3	2
Hazard and unsafe act reports	–	5	5	1	1
Who checks HSE on a day-to-day basis?	3	7	4	–	–
How do HSE meetings feel?	1	8	6	1	–
Audits	–	1	7	3	1
Benchmarking, trends and statistics	1	3	4	2	1
Total per level	18	78	78	44	7

Pa = pathological; R = reactive; C = calculative; Pr = proactive; and G = generative.
Where applicable, scores are distinguished between management and workforce.

4.4 Interviews

The interview transcripts were analysed using the qualitative data analysis software program HyperRESEARCH™ (2007). The process first involves the researcher assigning labels to passages or parts of passages. Reports can then be created containing passages assigned to a single label. Homogeneity of content can be inspected and the overall implication/s of passages can be induced and frequencies of labels used can be calculated. Table 8 shows the applied labels and the total number of times that a particular label was applied in all interviews, as well as the maximum number of times that a particular label was used to code a particular passage in a single interview.

Table 8 Labels used in coding interviews (frequencies and maxima)

Label	Frequency	Maximum
Daily business (including remarks about 'culture')	42	12
Safety	22	4
Takeovers	20	4
Incidents	18	6
Work pressure	15	4
Customers/clients	11	5
Working counsel	10	4
Radioactive sources	10	2
Workplace visits	8	2
History	7	3
Management	7	4
Older personnel	6	2
Rules and procedures	6	3
Younger personnel	5	1
Competence and training	5	5
Company	5	4
Hierarchy	4	3
Sanctions/punishment	3	2
Anxiety/ concerns of personnel	2	2
Rewards	2	2
Questionnaire research	2	2

5 Discussion

The company was diagnosed as primarily reactive, implying that it was essentially stirred to action after an event. As one interviewee commented: 'We unconcernedly send them away on a job.' All workers received first-class personal protective equipment and safety training that was superior to that required by customers or by law. However, workers were subsequently left very much to their own devices. Additionally, there was no effective platform to exchange safety issues or concerns, no refresher training, and support from management was lacking. Safety incidents were only investigated when demanded by a customer or by the government. Unsurprisingly, the company had not developed a safety management system, although, of course, it carried out many of the activities defined by such a system (e.g. Guldenmund, Hale, Goossens, Betten, & Duijm, 2006).

Despite this rather unpromising picture, the company did not seem to be bothered much by the diagnosis. Bringing its safety culture to a higher level would require much effort and resources, which, at least in the eyes of the company, would not pay off. History 'proved' the company to be correct because,

according to its records, nothing serious regarding safety (for example, severe injury or death) had happened in its 70 years of existence.

To answer the question posed at the start of this article, we should first consider the questionnaire results. Respondents indicated that they kept comparatively well to the rules (W_1 = 2.76; lower scores indicate less rule-breaking), and were also comparatively high on safety consciousness and preventive orientation (W_2 = 3.52). Although the fit of both regression models was not excellent (R^2 of 0.46 and 0.64), they revealed an interesting prediction. While rule-breaking (or rule-following) was best predicted by more conventional management (M_1) and supervisory activities (S_2), a more safety conscious and preventive attitude amongst fieldworkers was best predicted by a proactive management (M_2), along with supportive *and* strict supervision (S_1 and S_2).

During the interviews, 'the culture' of the company regularly arose as a topic. Interviewees, especially veterans, strongly felt the presence of the organisational culture, which was very much production- and client-centred (Table 8). The topic of workplace visits by managers regularly came up during the interviews as well as in the focus groups, especially the virtual absence of such visits (Tables 6 and 8). These visits were the only means available to the company to control work practices. A few interviewees also mentioned the absence of sanctions; hence, an attitude of doing things your own way was not discouraged.

In conclusion, organisational safety culture definitely seemed to influence the safe work practices of fieldworkers, but was probably not as effective as it could have been. This is suggested by the fact that management did not conduct workplace visits. Evidence from the regression analyses suggested that more supportive management and supervisory activities could result in further improvements.

5.1 *Comparing data sources*

It is instructive to review correspondences and differences between the sources of data in this study. The questionnaire provided a first indication of a possible lack of support by managers and supervisors, while workforce respondents evaluated themselves as both quite responsible and conformist. The Hearts and Minds session outcomes suggested that the company leaned towards the reactive end of the maturity scale. At first sight, this outcome is difficult to reconcile with the questionnaire results – the latter leaning more to the other end of a five-point ordinal scale. However, the questionnaire apparently taps different issues than the maturity scale does. While the maturity scale emphases implementing and operating a safety management system, the questionnaire addresses a range of safety-related perceptions.

The content of the interviews and focus groups differs to a great extent from the standardised formats of both the questionnaire and the Hearts and Minds matrix (Tables 6 and 8). Many 'sharp-end' issues emerged during the discussions, which seem to become more obscured in the answers to standard ques-

tionnaire items. More importantly, the discussions with respondents provided a context within which questionnaire responses could be understood. The company clearly put considerable effort into recruiting and training competent workers who could work responsibly, basically without the structured backing of a safety management system, which is what some of the questionnaire results appeared to convey (scores on factor S_2).

Nevertheless, such an arrangement provided considerable opportunity for local ambiguity to arise, regarding what is and is not acceptable. As a service company, the organisation was very client-centred, with most personnel and supervisors being reluctant to turn down work. Hence, organisational learning in terms of improving safety management processes was impaired because little information was circulated. This meant that incidents could occur many times before measures were taken and appropriate procedures adopted (compare scores on factor M_2).

On the other hand, the company's safety record was seemingly not a matter of concern. Although reactive, it is hard to argue that the company's safety performance was weak and suffering from the lack of a formal safety management system. Rather, it is impressive because of its responsible workforce (compare scores on factors W_1 and W_2), although it might still be argued that the current safety record was mostly a matter of luck (Reason, 1997, 1998).

5.2 Recommendations to the company

Recommendations to the company were aimed at formulating and propagating a clear safety policy by management that required all employees, including managers and supervisors, to demonstrate the specified behaviour. The important role of first-line supervisors is stressed in various publications (e.g. Findley, Smith, Gorski, & O'neil, 2007; Guldenmund, 2007; Zohar, 2002b). This policy should be clear to workers and customers alike, so that each knows what to expect from the other.

In addition, mutual trust should be built up so that workers are confident when going to a new and unknown job that their supervisor (planner, project leader) has discussed safety with the client and that appropriate arrangements have been made. Management can then be confident that contracts will be fulfilled safely. Safety initiatives should be recognised and acted on. When mutual trust is established, information should flow more freely upwards and downwards, and opportunities for learning should be optimised (Argyris & Schön, 1996). Therefore, possibilities to improve this exchange should be explored and employed.

The company was also advised to develop a safety management system, especially to facilitate systematic monitoring and improvement. With the current state of affairs (that is, a highly responsible and independent workforce with a preference for informal communication), initial opposition to such formalisation is to be expected. However, if the benefits start to outweigh the hassle of

reporting, more formal routes of information would be used more effectively and trust would be re-established. This should then provide opportunities for management to demonstrate concern for workers' wellbeing.

Given the response rate and the number of employees participating in the focus groups and interviews, this study has some obvious limitations. It is unclear to what extent the current sample might be biased. The regression analyses might be subject to common method variance, although the importance of this bias is sometimes misconceived or overstated (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003; Spector, 2006). Another issue is the position of the immediate supervisor, which was not clearly defined. This meant that respondents might have had quite different positions in mind – like planner, team leader or project manager – when answering questions about supervisory practices. Given the current results and findings from other research teams, the company might want to review these positions and provide them with clear job descriptions and appropriate authority.

Importantly, the company did not dismiss the results of the study. On the contrary, it indicated that it recognised the picture presented and declared that it would work on the recommendations in the near future.

6 Conclusion

This study presented the results of a safety culture research project at a service company using three different approaches for description and diagnosis. The qualitative (focus group, interview) data provided the context within which the quantitative data (questionnaire, Hearts and Minds) could be interpreted.

The extent to which these data can serve a diagnostic purpose is another question. Although the company could be labelled 'reactive', its safety performance did not raise any concerns. The related conviction that 'Safety is important, we do a lot every time we have an incident' (Energy Institute, undated) did not appear to prevent workers from working safely. Hence, the extent to which this conviction is 'inadequate' as opposed to the proactive or generative side of the Hearts and Minds scale can be disputed.

Acknowledgments

The author wishes to thank the company for its openness and cooperation. Special thanks go to Jos Besters, Ernest Luijkx and Richard van Sonsbeek for sharing their time and knowledge with the author. This paper has benefited significantly from two anonymous reviews; the additional comments and suggestions from Ian Glendon and Andrew Hale are also gratefully acknowledged.

References

Argyris, C., & Schön, D. (1996). *Organizational learning II: theory, method and practice*. Reading, Mass.: Addison Wesley.

Baker III, J. A., Bowman, F. L., Erwin, G., Gorton, S., Hendershot, D., Leveson, N., et al. (2007). *The report of the BP U.S. refineries independent safety review panel*. Washington, DC: CSB.

Berends, J. J. (1995). *Developing and using a widely applicable measurement tool for safety culture.* Unpublished interim report. Eindhoven: Eindhoven University of Technology.

Berends, J. J. (1996). *On the measurement of safety culture.* Unpublished graduation report. Eindhoven: Eindhoven University of Technology.

Clarke, S. (2006). Contrasting perceptual, attitudinal and dispositional approaches to accident involvement in the workplace. *Safety Science, 44*(6), 537-550.

Clarke, S., & Robertson, I. (2007). An examination of the role of personality in work accidents using meta-analysis. *Applied Psychology, 57*(1), 94-108.

Collins, A. M., & Gadd, S. (2002). *Safety culture: a review of the literature*. Sheffield: Health and Safety Laboratory, Human Factors Group.

Cullen, W. D., Lord. (1990). *The public inquiry into the Piper Alpha disaster*. London: H.M.S.O.

Energy Institute (undated). Hearts and Minds programme. Retrieved March 10, 2008, from http://www.energyinst.org.uk/heartsandminds/index.cfm.

Findley, M., Smith, S., Gorski, J., & O'neil, M. (2007). Safety climate differences among job positions in a nuclear decommissioning and demolition industry: employees' self-reported safety attitudes and perceptions. *Safety Science, 45*, 875–889.

Flin, R., O'Connor, P., & Crichton, M. (2008). *Safety at the sharp end. A guide to non-technical skills*. London: Ashgate Publishing Ltd.

Griffin, M. A., & Neal, A. (2000). Perceptions of safety at work: a framework for linking safety climate to safety performance, knowledge, and motivation. *Journal of Occupational Health Psychology, 5*, 347-358.

Guldenmund, F. W. (2000). The nature of safety culture: a review of theory and research. *Safety Science, 34*(1-3), 215-257.

Guldenmund, F. W. (2006). *Much ado about safety culture.* Paper presented at the 3rd International Conference Working on Safety (WOS), Zeewolde, 12 - 15 September.

Guldenmund, F. W. (2007). The use of questionnaires in safety culture research - an evaluation. *Safety Science 45*, 723-743.

Guldenmund, F. W., Arntzen, K., & Vriends, S. (1998). *Meting veiligheidsbeleving personeel Oxystaalfabriek 1. (Measuring the safety perception of the personnel of the steel converter plant Oxy 1)*. Delft, Netherlands: Safety Science Group, Delft University of Technology.

Guldenmund, F. W., Hale, A. R., Goossens, L. H. J., Betten, J. M., & Duijm, N. J. (2006). The development of an audit technique to assess the quality of safety barrier management. *Journal of Hazardous Materials, 130*(3), 234-241.

Hale, A. R. (2000). Culture's confusions. Editorial for the Special Issue on safety culture and safety climate. *Safety Science, 34*, 1-14.

Hofmann, D. A., & Stetzer, A. (1998). The role of safety climate and communication in accident interpretation: implications for learning from negative events. *Academy of Management Journal, 41*(6), 644-657.

Hollnagel, E. (2004). *Barrier analysis and accident prevention*. Aldershot, UK: Ashgate Publishing Ltd.

HyperRESEARCH. (2007). (Version 2.8) [download]: ResearchWare.

International Nuclear Safety Advisory Group. (1986). *Summary Report on the Post-Accident Review Meeting on the Chernobyl Accident* (No. 75-INSAG-1, Safety Series). Vienna: IAEA.

International Safety Advisory Group. (1991). *Safety culture* (No. 75-INSAG-4, Safety Series). Vienna: International Atomic Energy Agency.

Lardner, R. (2004). *Mismatches between safety culture improvement and behaviour-based safety.* Paper presented at the NeTWork 2004 Workshop 'Safety Culture and Behavioural Change at the Workplace', Blankensee, Berlin, 9-11 September.

Mearns, K., Whitaker, S. M., & Flin, R. (2003). Safety climate, safety management practice and safety performance in offshore environments. *Safety Science, 41*(8), 641-680.

Parker, D., Lawrie, M., & Hudson, P. T. W. (2006). A framework for understanding the development of organisational safety culture. *Safety Science, 44*(6), 551-562.

Podsakoff, P. M., MacKenzie, S. B., Lee, J., & Podsakoff, N. P. (2003). Common method variance in behavioral research: a critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88*, 879-903.

R Development Core Team. (2005). *R: a language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing.

Reason, J. T. (1997). *Managing the risks of organizational accidents*. Aldershot: Ashgate.

Reason, J. T. (1998). Achieving a safe culture: theory and practice. *Work and Stress, 12*(3), 293-306.

Reiman, T., & Oedewald, P. (2004). Measuring maintenance culture and maintenance core task with CULTURE-questionnaire - a case study in the power industry. *Safety Science, 42*(9), 859-889.

SAS Institute Inc. (1999). Statistical analysis system (SAS®) (Version 8.2). Cary, NC: SAS Institute Inc.

Schein, E. H. (1992). *Organizational culture and leadership* (2nd ed.). San Francisco: Jossey-Bass.

Seel, R. (2001). Describing culture: from diagnosis to inquiry. [Electronic Version]. Retrieved March 10, 2008 from http://www.new-paradigm.co.uk/describing_culture.htm.

Siegel, S., & Castellan Jr., N. J. (1988). *Nonparametric statistics for the behavioral sciences* (2nd ed.). New York: McGraw-Hill.

Sorensen, J. N. (2002). Safety culture: a survey of the state-of-the-art. *Reliability Engineering and System Safety, 76*, 189-204.

Spector, P. E. (2006). Method variance in organizational research. Truth or urban legend? *Organizational Research Methods, 9*(2), 221-232.

Tabachnick, B. G., & Fidell, L. S. (1989). *Using multivariate statistics* (2nd ed.). New York: HarperCollins.

The Occupational Health & Safety Group. (2007). *OHSAS 18001*. Cheshire, UK: The Occupational Health & Safety Group.

Westrum, R. (1991). Cultures with requisite imagination. In J. Wise, Stager, P. & J. Hopkin (Eds.), *Verification and validation in complex man-machine systems*. New York: Springer.

Westrum, R. (2004). A typology of organisational cultures. *Quality and Safety in Health Care, 13* (Suppl II), ii22-ii27.

Zohar, D. (2002a). The effects of leadership dimensions, safety climate, and assigned priorities on minor injuries in work groups. *Journal of Organizational Behaviour, 23*, 75-92.

Zohar, D. (2002b). The effects of leadership dimensions, safety climate, and assigned priorities on minor injuries in work groups. *Journal of Organizational Behavior, 23*(1), 75-92.

Zohar, D., & Luria, G. (2005). A multilevel model of safety climate: cross-level relationships between organization and group-level climates. *Journal of Applied Psychology, 90*(4), 616-628.

Afterword

Introduction

The previous chapter is based on research carried out at a service company in the Netherlands in 2007 using multiple techniques not necessarily aimed at producing similar or comparable results. The overall objective was to generate as much data as possible, so as to provide sufficient information with which to decipher some of this company's basic assumptions which had an impact on safety. At the time, I felt this task to be too challenging and I therefore resorted to simply answering the research questions posed in the research proposal.[1] I found myself uncomfortable with explicitly stating that this set of basic assumptions guide the behaviour of (all) the members of the organisation.

Although I had roughly familiarised myself with the company for several months through interviews and discussions, observations, workplace visits, the analysis of various documents and the results of a survey, I still thought that I had not really submerged myself in the company and truly experienced it. Suggestions for basic assumptions started to take shape in my mind, but these were not yet thoroughly challenged, for instance, by observing various situations where these assumptions should, in fact, be operating. Moreover, at various times throughout the study I had discussed my observations and thoughts about their basic assumptions with several members of the organisation in an effort to contest these. Nevertheless, I felt uneasy making such quite definite statements, which have a tendency to linger there for a while, sometimes even when proven (way) off target afterwards. Because this still feels like an unsatisfactory conclusion, the purpose of this afterword will be to make yet another, well annotated, effort.

Considering the collected data anew and attempting to find common themes, overlaps and inconsistencies amongst these also brings issues such as substance, reliability and validity to the fore. What should be considered really representative of this company and how reliably has this been assessed? To what extent do

1 These questions were: (1) What are the safety perceptions and evaluations of the workforce and to what extent are these supported by the current communication structure and organisational culture? (2) When is the safety regime at odds with actual working conditions and how is this conflict resolved?

these data provide a window onto the covert and unnamed and how should this be captured in words?

Firstly, I will summarise the data and offer some additional, qualitative data, that were not published in the original paper. Then, I will formulate some basic assumptions for this service company, using the six dimensions of Schein (1992). A conclusion and discussion rounds off the afterword.

The data

The techniques used to gather the data have been described extensively above, so I will not bother with these now and the same goes for the reporting of most of the data. Bullet list-wise, the data consist of:

1. Safety climate data of 187 respondents (= 38.6% response rate)
2. Hearts & Minds data of 3 separate groups (N = 8, N = 10 and N = 3)
3. Focus group data of 3 (2) separate groups (N = 10 and N = 3)
4. Interview data of 11 individuals
5. Observation data of various work sites

Summary of safety climate data

1. Principal component analyses of the safety climate questions resulted in six components, two pertaining to management (M_1 and M_2), two to supervision (S_1 and S_2) and two to the workforce (W_1 and W_2); the latter containing questions about either the respondent or his/ her colleagues. The two components of each of these groups were all related to either more conventional or more proactive safety activities.
2. Answers to questions making up the workforce components (W1 and W2) could be predicted reasonably well from answers to questions from management and supervision components.
3. Not many significant differences were found between groups defined by various demographic variables. Significant results primarily highlighted the difference between office and field workers, i.e. the blunt and sharp end of hazardous organisations, and focussed on supervisor activity rather than management effort.
4. Based on the lack of significant differences I concluded that the response population was rather homogeneous, i.e. agreed on most issues addressed by the questionnaire. The latter conclusion might have been a little premature, in that agreement between groups is yet not established by non-significant between-group tests, but rather based on within-group variance (e.g. Bliese, 2006; Castro, 2002). Additional analyses using agreement coefficients $r_{wg(j)}$ and $r^*_{wg(j)}$ (Bliese, 2006; James, Demaree, & Wolf, 1984; Lindell, Brandt, & Whitney, 1999) and department as grouping variable, indeed show that agreement varies, between groups as well as on the six compo-

nents, but with none of these groups consequently displaying low agreement on all components.

Summary of Hearts and Minds data

Let me first start with a few general remarks. Scoring of Hearts & Minds (H&M) items is less concerned with a (moral) judgement or an evaluation but rather with a description of how things concerning safety currently are in the company. Nevertheless, during the sessions evaluative responses were sometimes provided, both in a positive and a negative sense, like rewarding one's own group behaviour or criticising another group. Moreover, when justifying a particular answer, respondents sometimes did not appear to have understood the H&M question clearly, which will, undoubtedly, have influenced their final answer and which should be taken into account when judging the results. These can be summarised as follows:

1. The overall H&M data reflect a company that appears to be 'reactive' from a worker's point of view, and 'calculative' from a management's point of view.
2. Four items from the H&M matrix lean somewhat towards the 'generative' side of the scale, i.e. 'Incident reporting/ analysis', 'Hazard and unsafe act reports', 'Audits and 'Benchmarking, trends and statistics'. All four items are very much related to the 'monitoring' activity of the company.
3. Four H&M items tend towards the 'pathological' side of the scale, i.e. 'What are the rewards of good HSE performance?', 'Balance between profit and HSE', 'Are workers interested in competency?' and 'Who checks HSE on a day-to-day basis?'. These items more concern the appreciation and daily reality of safety.

Summary of focus group data

In the chapter the topics raised and discussed in the focus groups are only mentioned but not elaborated further; the primary point to be made was that the various techniques used did not tap the same issues and sentiments. Moreover, comparing structured techniques (questionnaire, H&M matrix) with less structured ones (focus group, interview) also did reveal that these did not appear to produce much similar or overlapping data. Indeed, the less structured techniques seemed to provide a context for the more-or-less decontextualised survey results.

As has been described in the chapter, two focus groups sessions started with a mind-mapping exercise, initiated by the word 'safety'. Words or short sentences that immediately sprang to mind were first written down by the participants on sticky notes and then stuck together onto a white board. Step-by-step, these notes were assembled into thematic clusters. In one focus group these clusters revolved around the themes 'Client', 'Company' and 'Rules' which were

clearly interdependent according to the participants. In the other focus group, the themes were 'Safety organisation' (e.g. H&S department, safety plans, how to sell/ preach safety), 'Risk perception' (e.g. responsibility, awareness, work preparation, judgement), 'People' (e.g. myself, bystanders, home, pleasure), 'Radiation and radioactive sources' (e.g. enclosure, transportation, prevention of exposure), 'Preconditions' (e.g. personal protection equipment [PPE], procedures, diplomas, equipment) and 'Accidents' (esp. prevention of these). Elaborations of some of these subjects now follow.

Because workers operate radioactive sources for inspection purposes, training requirements and therefore safety awareness are high. However, because inspections are also often conducted under (very) difficult circumstances (e.g. construction sites that are always highly dynamic and change by day, pipe work difficult to get close by to, deep and slippery ground pits) and time pressure, safety is regularly challenged. Because the radioactive sources are the Achilles heel not only of the company but of the whole branch, working safely with these sources is continuously stressed. The safety of most other inspection modes more-or-less pales in comparison and therefore might remain underexposed.

During the focus groups it became clear that conditions of safety the company requires from the client are often not detailed or even spelled out. This might already be the cause of some safety problems in the Netherlands, but it certainly was abroad. It was expected that formal education, especially the written safety course, and experience would meet most of these challenges but nobody actually knew. As places of work are highly dynamic and unpredictable, workers are expected to deal with these uncertainties themselves and not according to general guidelines or agreements made beforehand between the company and the client. The fact that much of the information about safety problems (and how they were resolved) remains local and hardly ever transcends the level of workers, ensures that safety is not a prominent issue in the company, apart from radiation safety, that is.

The company generally did not check whether safety rules were observed. The topic of (unannounced) workplace visits by the S&H department came up regularly during both focus groups but this appeared to be a hot potato. During such visits workers felt they were being criticised, not encouraged. Local managers were also not happy with these visits because they only provided long action lists for them and, hence, extra work.

Summary of Interview data

Again, in the chapter only the topics raised in the interview are listed, but hardly elaborated. In most interviews the following subjects were more-or-less addressed:

- (daily) communication;
- organisation of safety;
- ambitions regarding safety;

– important events in the recent past.

Many interviewees state that there is abundant communication within the company, but for the most part this is rather informal, 'in the corridor', so to speak. The grapevine is functioning flawlessly. What is also alluded to here, is that, at times, the talking outweighs the doing, which might result in indecisiveness.

The company makes an overall informal impression, a worker's climate, and authoritarian or supercilious bosses are not much appreciated. In the past, most managers were recruited within the company but, recently, external interim-managers have been assigned to shake up the organisation and cut away its outgrowths to make it more lean and up-to-date. Of course, this has led to unrest and even anxiety in some of its ranks.

The informal climate notwithstanding, the classical distinction (and misunderstanding) between managers, engineers and workers is nevertheless present in this organisation (e.g. Schein, 1996a; Schein, 1996b). While managers are mostly concerned with money and meeting deadlines, engineers keep wondering about how those (stupid) workers can always mess up their wonderful technical inventions, whereas the workers feel misunderstood by both their demanding managers and myopic engineers who deliver unfit apparatus that only slows down work and so they have to make the most of it daily while struggling in the field confronting harsh reality. This rather caricatural sketch of 'three cultures of management' (ibid.) will undoubtedly fit many industrial organisations.

In the past, strong relationships were welded between the workers during lengthy projects while they stayed together in hotels for weeks, far away from home. These days people immediately return home after a day's work and on Fridays the usual gatherings at the office have been scrapped. The younger generation has priorities elsewhere.

Safety training is provided in the field through apprenticeships as well as through a written course that is mandatory for newcomers and which is concluded by an exam. In the professional courses provided by the company itself, safety is treated as 'operational safety' (how to use the equipment properly) not as 'occupational safety' (how to work safely); the latter is assumed to be covered by the written course, experience and common sense.

Safety ambitions are very much determined by what the client demands. When working for a large (petro)chemical company, the ambitions are according to this regime, but when the client is less demanding, the company is equally so. Younger workers tend to be less flexible regarding safety than veterans, but the company is nevertheless willing to send an older employee, when a younger one has refused to do a job.

The company went through a series of takeovers during the past eight years which have caused unrest throughout the organisation and have made a significant impact on the employees. However, because there were several takeovers,

interest in these subsequently subsided and resulted in indifference and even cynicism amongst some employees.

Summary of observation data

Various locations of work were visited. Inspections were performed both inside and outside. Inside would mean a drafty, unheated shed and outside often a remote and unkempt area of an industrial site, where the workers could carry out their work undisturbed. Employees work on their own but often two or three were present at the client. They worked silently, purposefully. All workers wore the company's typical blue outfit.

Basic assumptions deciphered

According to Schein, basic assumptions of groups or organisations develop along six 'dimensions', i.e. the nature of: (1) reality and truth; (2) time; (3) space; (4) human nature; (5) human activity; (6) human relationships (Schein, 1992, p. 94 ff.). Below, these dimensions will be used to decipher the basic assumptions of the service company.

The nature of reality and truth

I. 'The customer is always right'. This slogan has been poured over the workforce for many years, so workers are expected to be always flexible and not contrary. Because SHE (safety, health and environment) is, generally, emphasised much more nowadays, the younger generation of workers is also more demanding regarding safety, but this is typically solved by putting the 'right man in the right place'. The implication of this basic assumption is far-reaching and has serious consequences for occupational safety, but this might be less for operational safety due to strict regulation. The difference in H&M scores between management and workers can also be resolved through this assumption. When scoring their matrices, many members of management had the large (petro)chemical companies in mind for which they carried out inspections according to this (strict) safety regime. This also meant reporting incidents and carrying out analyses. Workers scored their H&M matrices with other, smaller companies in mind that had less strict safety regimes and incidents or accidents happening there were not tabulated or investigated.
II. 'Nothing but the best'. With this basic assumption I would like to convey two different aspects of this company's culture. Firstly, workers receive excellent equipment, PPEs and each worker has to take the safety training certificate for supervisors, not the more customary worker's certificate. Secondly, the company wants to provide first class inspections and develops its own inno-

vative equipment to this end. The equipment, especially, is a source of great pride, in particular for the developing engineers.

The nature of time

No particular assumptions about time have been identified. However, time is an important aspect of the work within this company. For instance, during large maintenance stops, there is always much time pressure, because the company performs the last checks before the plant can be started up again. However, this pressure was really the client's not the company's (and therefore they imposed it on them).

The nature of space

Also, no particular assumptions about space have been identified. Working conditions were regularly harsh but the workers did not seem to mind, as long as these did not continue for too long at a stretch. The offices of the company (main office and annexes) were informal and not luxurious, thus reflecting the blue collar mentality identified below.

The nature of human nature

III. 'We are independent and we like it this way'. I think this is one of the most attractive elements of working for this company and it came up during many occasions. Workers often can arrange their own working day, as long as the job is done. They work alone, unless radioactive sources are involved, which requires teams of at least two. Moreover, workers stationed permanently at a client, usually are there at their own request.
IV. 'We are blue-collar workers'. Although the various layers within the organisation are clearly distinguished, there is nevertheless a tendency to level out differences. This is a typically Dutch characteristic, which is often paraphrased as 'act normally, you're crazy enough as it is'.[2] Basically, this requires from people to be modest about themselves, their rank and their accomplishments.

The nature of human activity

V. 'We are individualists and work autonomously'. Employees do not operate as team players and work together only when this is required, e.g. when working with radioactive sources or handling a large and/ or heavy object.
VI. 'We accept things as they are'. In his book, Schein distinguishes three orientations that define different ways in which groups act in relation to their

2 The Dutch saying goes 'Doe maar gewoon, dan doe je al gek genoeg'.

environment, i.e. 'Doing orientation', 'Being orientation' and 'Being-in-becoming orientation' (1992, p. 127 ff.). The present company is best characterised by the second category 'Being orientation' in that it takes situations very much as they come and tries to adapt as much to these as possible. This assumption is closely connected to the first one discussed above, i.e. 'The customer is always right'.

The nature of human relationships

VII. "Do your thing but don't touch mine". Employees very much keep to their own turf and kind. Indeed, there is significant mistrust between the various layers, which hinders the flow of communication and also distorts it. The arrival of external managers has possibly even reinforced this state of affairs.[3] Regional branches of the company are equally independent but show the same distinction between layers and a hesitance amongst employees to move between layers and a preference to stay with their own.

Conclusion and discussion

The assumption that the 'customer is always right' is quite central to this company and has important consequences for the way safety is dealt with. The high independency of the employees, which is a direct result of the type of work the company is involved in, is yet another important characteristic that drives some of the other basic assumptions and might also explain some of the survey findings. The current set of seven assumptions that have been deciphered above is neither complete nor fully tested. They have not been developed in close connection with the company, but independently behind a desk, using Schein's six 'dimensions' as a general guideline. Therefore, they should be considered rather preliminary, ready for confrontation with actual practice.[4]

Trying to decipher these basic assumptions anew, I again found quite difficult. Synthesising various converging or diverging points of view requires a level

3 It might be that the mistrust shown by many employees is primarily the result of several takeovers the company went through in the recent past. Various external managers arrived to prepare the sale of the company only to disappear afterwards. This preparation phase always meant laying off people and other structural changes. In that case, the mistrust mentioned here might be slightly overstated.

4 Deciphering basic assumptions presents the researcher with an interesting iterative reasoning process. Basic assumptions are based on observables, i.e. artefacts and espoused values, but these should not be taken for granted but have to be processed further (i.e. deciphered) into basic assumptions. However, observables again will have to be used to check the basic assumptions against. Obviously, these observables should be processed first to make such a comparison possible. The point I want to make here is that there is sufficient room for circular reasoning, and the researcher should be well aware of that. This also provides another argument why the researcher should work either in a team or, better still, in close cooperation with the client company.

of abstraction that tends to be so general that it borders on the trivial. Moreover, although advocated in Chapter 3, the study conducted at this company was not really participative, i.e. carried out together *with* the company, but conducted alone. Although I shared my observations regularly with people from the company, I noticed there was an overall tendency to agree with what I observed. After all, I was hired as an outside 'expert' to diagnose the current situation.

Some of the basic assumptions uncovered above do seem to reflect regional or even national tendencies. I came to a similar conclusion in another paper, but the particular company studied in that paper did not face much challenge throughout its existence and therefore was not urged to adapt much beyond its regional or national values (Guldenmund, Ellenbroek & van den Hende, 2006). Incidentally, Schein himself makes a comparable remark about his descriptions of 'Multi' and 'Action', who, according to him, also clearly reflect national cultural values (Schein, 1990, p. 115).

The questionnaire data do reveal a distinction between office and field workers and also bring to the surface a lack of support, especially from direct supervisors. However, for deciphering the basic assumptions, these data seem to be less useful though they do support some of them, esp. assumptions III, V and VII above. The dimensions underlying the questions in the survey were confirmed by the analyses, but these are not the issues that people in the company seem to be concerned about as their subjects hardly appeared in the focus groups or in the interviews. Questionnaires typically frame issues according to a particular theoretical outlook, although this view might not be applicable in all situations (cf. Schein, 1992, pp. 184-186).

The H&M data also did not have a high impact on the formulation of these basic assumptions. Interestingly, when discussing their reactive and calculative scores with the workers and with management respectively, they did not demonstrate an inclination to improve beyond these levels, although such a drive is actually assumed by the technique.[5] Again, the assumptions of the designers incorporated into this technique clearly are not shared by the present company. This particular finding, i.e. not willing to improve beyond a certain level, could, however, be used to try to uncover another basic assumption.

What is presented here is a partly integrative and partly differentiating view (e.g. Richter & Koch, 2004); that is, some basic assumptions could be considered 'universal' for the whole company, whereas others might exist more strongly within a particular group. For instance, the strong individualism is closely associated with the field workers, and, possibly, also the 'Being orientation'. Again, these basic assumptions are hypotheses that have to be tested more extensively before they can be finalised.

5 The assumption is that the respondent wants to improve continuously, ultimately arriving at the 'generative' stage (which is, as a matter of fact, a stage in which the respondent improves continuously).

Finally, a word on the various techniques applied is in order. All techniques could very well be placed on a 'useful' (relevance) versus 'truthful' (veracity) continuum (cf. Drenth, 1996). Various techniques bring along their own theoretical framework and by accepting this framework the outcomes of the technique are more-or-less truthful or 'right'; of course, only if the technique has been applied as prescribed. However, right does not necessarily mean useful or relevant.

Two techniques, the questionnaire and the H&M matrices, provide (quasi-) numerical results according to a predetermined format. As has been discussed above, their immediate outcomes have not been particularly helpful for the purpose of deciphering basic assumptions. The questionnaire is especially useful when the research aim is to statistically model various influences of management and supervision on workers' safety performance. The hypothesised 'basic assumptions' involved in these processes are already buried in the questionnaire. Furthermore, the H&M matrix is aimed at defining a so-called 'stick and carrot', the stick being the current 'undesirable' state of affairs, the carrot being the bright future. Companies that feel discouraged by their current safety performance might be motivated by going through a process defined by Hearts and Minds. Again, the basic assumptions that are required for a bright future, i.e. a proactive or generative stage, are already present in the questions and format of the H&M matrix.

The focus groups and interviews do not have any preconceived notions built into them regarding organisational safety culture. However, because of the absence of such frameworks, these techniques do tend to elicit considerably more irrelevant data, or noise. Because it is hard to say beforehand what is relevant in a particular organisation (cf. Schein, 1992) one always has to accept the noise, because it is only after a while that it can be established that some data should be considered 'noise'. Hence, the relevance and usefulness of such data is established during the research, not before. The truthfulness is yet another matter. This is about whether the data generated by the techniques are able to reveal the actual, 'true' basic assumptions of this company. Ideally, such truthfulness is established in close cooperation with the company, i.e. inter-subjectively. Then truthfulness and usefulness go hand in hand. Currently, the basic assumptions have been established independently, and await their actual usefulness in practice, which means that their truthfulness is pending too.

Concluding, different techniques produce different data relevant for different purposes; the previous chapter (Chapter 3) arrives at a similar conclusion and recommendation. It is difficult to reject or even criticise one data technique framework from the perspective of another. All frameworks should prove their usefulness and truthfulness in practice. Similar reasoning can be found with Carnap on the use of classificatory, comparative and quantitative concepts (cited in Michell, 2003, p. 15). Also, neither a qualitative (Carnap's first two concepts) nor a quantitative (the last concept) approach is beatific. Given this state of affairs it will be possible to envision and map out various approaches towards safety culture, which will be done in the final chapter 'Current approaches to

safety culture: six images'. However, firstly, the use of the concept 'culture' in the safety culture concept will be considered critically once more. This will be done in the next chapter.

References

Bliese, P. D. (2006). *Multilevel modeling in R (2.2). A brief introduction to R, the multilevel package and the nlme package*. Washington, DC: Walter Reed Army Institute of Research.

Castro, S. L. (2002). Data analytic methods for the analysis of multilevel questions: A comparison of intraclass correlation coefficients, rwg(j), hierarchical linear modeling, within- and between-analysis, and random group resampling. *The Leadership Quarterly, 13*(1), 69-93.

Drenth, P. J. D. (1996). Psychology as a science: truthful or useful? *European Psychologist, 1*(1), 3-13.

Guldenmund, F. W., Ellenbroek, M., & van den Hende, R. (2006). Organisational culture research in a true Dutch company (in Dutch). *Tijdschrift voor Toegepaste Arbowetenschap, 19*(2), 24-32.

James, L. R., Demaree, R. G., & Wolf, G. (1984). Estimating within-group interrater reliability with and without response bias. *Journal of Applied Psychology, 69*, 85-98.

Lindell, M. K., Brandt, C. J., & Whitney, D. J. (1999). A revised index of interrater agreement for multi-item ratings of a single target. *Applied Psychological Measurement, 23*, 127-135.

Michell, J. (2003). The quantitative imperative: positivism, naive realism and the place of qualitative methods in psychology. *Theory Psychology, 13*(1), 5-31.

Richter, A., & Koch, C. (2004). Integration, differentiation and ambiguity in safety cultures. *Safety Science, 42*, 703-722.

Schein, E. H. (1990). Organisational culture. *American Psychologist, 45*(2), 109-119.

Schein, E. H. (1992). *Organizational culture and leadership* (2nd ed.). San Francisco: Jossey-Bass.

Schein, E. H. (1996a). Culture: the missing word in organization studies. *Administrative Science Quarterly, 41*, 229-240.

Schein, E. H. (1996b). Three cultures of management: the key to organisational learning. *Sloan Management Review, Fall 1996*, 9-20.

Chapter 5

Safety culture and safety management: further perspectives

Paper has been submitted as '(Mis)understanding safety culture and its relationship to safety management'

Introduction to Chapter 5

The next chapter was originally written out of a growing unease with various applications of the concept of organisational safety culture. The chapter went through several stages, which are perhaps best typified by the titles these drafts bore. The initial title for the chapter was 'Much ado about safety culture', which was later replaced by 'Watering down the culture concept; from culture to safety culture'. Both titles were meant to reflect my overall discomfort with the concept of safety culture. This discomfort was based on a particular (normative) use of the concept of safety culture to refer to patterns of, often unwanted, behaviour. This use can be heard expressed (too) frequently. Moreover, while (quantitative) safety climate studies seemed to flourish in the scientific journals, there was only a trickle of qualitative studies in this literature. The time seemed ripe to make a few important observations:

1. Safety culture is derived from the concepts of culture and organisational culture and, hence, researchers are well-advised to consult the literatures associated with these fields, to match or contrast their particular notion of safety culture with views from e.g. sociology or anthropology.
2. There is no single 'right' way to explore safety culture, but various approaches focus on different aspects of the organisation and it therefore makes sense to distinguish and elaborate these approaches. However, after distinguishing these different approaches, the question arises whether it is possible to join them together again into an omnibus approach.
3. The relationship of safety culture with safety management and safety management systems (SMSs) is still only infrequently considered (explicitly) in the literature although both are obviously related; therefore an attempt to do so is particularly welcome. Arguably, it is the SMS that shapes, and partly embodies the 'things' in 'the way we do things around here'. Because the safety of these 'things' is defined and monitored by a local SMS, at least in terms of responsibilities and processes, a discussion of the SMS should appear at some point in a discussion of any organisational safety culture.

Because I wanted to discuss these important points in a separate chapter, it was necessary to reiterate some (safety) culture theory anew, although this meant some overlap with previous chapters, especially the chapter describing the safety culture research process (Chapter 3). However, Chapter 3 primarily focuses on the safety culture research *process* and delivers the techniques with which to

carry out the research. In this chapter, the research team is strongly advised to think clearly about their research problem, their strategy, their distance to the client company and the veracity or the usefulness of the final results (see also the Afterword of Chapter 4). Ultimately, a rather eclectic type of research is advocated, in close collaboration with the client company.

In Chapter 5 three research strategies or approaches to safety culture are distinguished. These approaches are discussed in the larger context of culture and organisational culture research. By combining culture with safety a strong component of description of behaviour is added to the original concept of culture, which initially was (and basically should be) about the meaning and interpretation of behaviour. Moreover, culture and safety have different time frames for change than behaviour does.

Following these theoretical deliberations and descriptions of research approaches, organisational safety culture is placed in context related to organisational structure and processes. Safety management systems are especially concerned with the latter two but because of the assumed interactions between these three organisational aspects, in the end safety management influences and determines safety culture (and vise versa).

Chapter 5 precedes a further classification of approaches discussed in the final chapter of this book where six 'images of safety culture' are introduced. The current version of Chapter 5 has been submitted for publication to the journal *Risk Analysis*.

Abstract

Although the concept of safety culture was coined in relation to major accidents like Chernobyl and Piper Alpha, it has been embraced by the safety community at large as a cause for unsafe practice. In this paper three approaches to safety culture are discussed in terms of their underlying concepts of culture and organisational culture. Culture is an intangible, fuzzy concept encompassing acquired assumptions that is shared amongst the members of a group and that provides meaning to their perceptions and actions and those of others. The basic assumptions that form the essence of a culture are shared, yet tacit convictions, which manifests themselves subtly in the visible world. As applied by safety researchers the culture concept is deprived of much of its depth and subtlety, and is morphed into a grab bag of behavioural and other visible characteristics, without reference to the meaning these characteristics might actually have, and often infused with normative overtones. By combining the three approaches, we can resurrect the notion of safety culture and strengthen its analytical potential in understanding the development and implementation of safety management systems (SMSs).

Safety culture and safety management: further perspectives

1 Organisational safety culture

1.1 Introduction

Ever since The International Nuclear Safety Advisory Group (INSAG) (1986) coined the term 'safety culture' to denote the far from optimal conditions and decision processes in place at the Chernobyl nuclear power plant, it has gradually settled itself in the standard explanatory safety vocabulary. Safety culture has become a term used by people all around the globe to explain everything relating to safety failures that cannot be explained in another way. That the concept is fuzzy does not seem to matter much; however, this fuzziness is both its strength and its weakness. Indeed, (groups of) people sometimes seem to perform in dark, mysterious ways and when groping for an explanation a fuzzy concept such as safety culture is highly attractive (Kets de Vries, 1999). A similar, initial attractiveness is inherent in the concept of organisational culture (Salzer-Morling, 2003).

Organisational safety culture has been defined differently. Its various interpretations are presented in Table 1, along with an indication of the part of safety culture to which the definition seems to refer. As will be explained in more detail below, culture is generally conceived of as having a largely implicit, tacit core of shared values, beliefs, convictions, basic assumptions etc., and manifests itself in artefacts like formal and informal dress, buildings, rituals and behaviour, and verbal expressions like statements and explanations. In the table a distinction is made between definitions that focus solely on the core (C), its manifestations (M) or the whole (W), i.e. the core and its various manifestations.

Table 1 Various definitions of organisational safety culture

Author(s)	Definition of organisational safety culture	Part*
Deal & Kennedy, (1982) but used by numerous other authors also in the field of safety	The way we do things around here	M
Cox & Cox (1991)	Safety cultures reflect the attitudes, beliefs, perceptions, and values that employees share in relation to safety	C
INSAG (1991)	Safety culture is that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance	C
Pidgeon (1991)	The set of beliefs, norms, attitudes, roles, and social and technical practices that are concerned with minimising the exposure of employees, managers, customers and members of the public to conditions considered dangerous or injurious	W
ACSNI (1993)	The safety culture of an organisation is the product of individual and group values, attitudes, perceptions, competencies and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organisation's health and safety management. Organisations with a positive safety culture are characterised by communications founded on mutual trust, by shared perceptions of the importance of safety and by confidence in the efficacy of preventive measures	W
Ostrom, Wilhelmsen & Kaplan (1993)	The concept that the organisation's beliefs and attitudes, manifested in actions, policies, and procedures, affects its safety performance	W
Geller, E.S. (1994)	In a total safety culture (TSC), everyone feels responsible for safety and pursues it on a daily basis	M
Berends (1996)	The collective mental programming towards safety of a group of organisation members	C
Guldenmund (2000)	Those aspects of the organisational culture which will impact on attitudes and behaviour related to increasing or decreasing risk	C
Hale (2000)	The attitudes, beliefs and perceptions shared by natural groups as defining norms and values, which determine how they act and react in relation to risks and risk control systems	C
Richter & Koch (2004)	The shared and learned meanings, experiences and interpretations of work and safety – expressed partially symbolically – which guide peoples' actions towards risks, accidents and prevention	C
Westrum (2004)	The organisation's pattern of response to the problems and opportunities it encounters	M

* The part of culture the definition primarily focuses on; C = core, M = manifestations, W = whole

In more behaviourally oriented approaches, the core of culture is considered to be a black box and is therefore disregarded, e.g. Geller in Table 1, but not necessarily denied (Hopkins, 2006a). Furthermore, definitions may provide guidance for a subsequent research strategy, which is arrived at by going through a series of steps or choices; i.e., the choice of (1) research paradigm; (2) research meth-

odology; (3) research method; (4) research technique; and (5) research instrument (Pickard & Dixon, 2004). In this vein, three main approaches towards the study of safety culture – which I label 'academic', 'analytical', and 'pragmatic' – can be found in the literature.

1.2 *Academic (anthropological) approach*

The primary research *methodology* of this approach is field research or ethnography, which is qualitative in nature. Its purpose is to describe and understand a culture rather than evaluate it and, hence, it is non-normative or value free (Guba & Lincoln, 1994). Applied to organisations, culture is considered as something an organisation *is*, rather than *has*. Moreover, what an organisation currently *is*, is largely the result of what happened in its *past*, its history; either as a realisation of its founder's convictions or due to particular significant events (Denison, 1996; Schein, 1992). This approach has been labelled 'academic' because it is seldom used outside the scientific realm (Hofstede, 1991, p. 180).

The research *method* can be a narrative study, a phenomenological study, a study using grounded theory, an ethnographic or a (historical) case study, or various combinations thereof (Creswell, 2007). It typically begins with a problem definition or an issue turned into a problem to obtain a clear focus for the investigation, for instance, a discrepancy between safety priority in an organisation and performance as mentioned above. Data collection *techniques* include interviews, observations, document studies, literature research and whatever else an organisation brings forth that may hold clues for its underlying assumptions. What is important, however, is that information is collected with sufficient context, to allow for accurate interpretation of the resulting data.

Research findings are almost never quantified because it is meaning and interpretation and not some numerical abstractions and calculations that drive research following this approach. Moreover, if (some) quantification occurs, numbers are never taken as data abstracted from an objective world, which would be in conflict with the research paradigm. The research outcome is a 'thick description', or even a theory of the culture of an organisation (Geertz, 1973; Glaser & Strauss, 1967). The description or theory may be accompanied by summary statements, core categories or basic assumptions. If the theory turns out to be incomplete or 'wrong', it is adjusted to accommodate the contrasting empirical findings.

Importantly, because the data have to be interpreted in order to arrive at a description of the shared underlying assumptions – e.g. assumptions of the organisation, department, team or unit – the relationship with these and safety also has to be deciphered. That is, this relationship is not given but has to be deciphered, just like other basic assumptions.

There are not many journal articles that report on qualitative safety culture studies. Moreover, applied methods are usually limited to either studies building on grounded theory or case studies (e.g. Berends, 1995; Farrington-Darby,

Pickup, & Wilson, 2005; Guldenmund, 2008; Meijer, 1999; Stave & Törner, 2007; A. Walker & Hutton, 2006). Brooks' (2005, 2008) enjoyable papers might, in fact, be the only ethnographic studies around. Book-length studies exclusively focussing on organisational safety culture are equally rare, but numerous safety studies have a clear bearing on the subject; for instance, Hopkins' (2000, 2008) accounts of the Esso gas plant explosion at Longford and the BP Texas City refinery disaster, Mascini's (1999) case studies of a cokes factory and a chemical plant or Vaughan's (1996) careful study of the Challenger disaster. Various sociological and anthropological studies show a similar bearing, e.g. those by Bourrier (1998), Gouldner (1954), Douglas and Wildavsky (1982), Hopkins (2005), Turner and Pidgeon (1997) and Westrum (1999, 2004), to name a few.

1.3 Analytical (psychological) approach

In the analytical approach safety culture is typically studied using (self-administered) questionnaires, which is the primary research instrument of social and organisational psychologists. This approach can be considered 'analytical' in that safety culture is taken to be an attribute of an organisation, i.e. something an organisation (currently) *has*, rather than *is* and it is therefore much more concerned with the organisation's *present* (Hofstede, 1991).

Questionnaire studies generally follow this scenario. First, potential concepts or facets of interest are identified that together make up a construct; this could be the result of a *qualitative* study. Based on these a questionnaire is composed using questions that cover the relevant concepts. This is at first an assumption, which is tested in a subsequent study where the questionnaires are put to an appropriate target population. Data analyses should reveal whether the assumed concepts are present in the response data. These concepts are often conceived as dimensions spanning a multidimensional space; (sub-) cultures then become positions in that space.

The analytical approach employs predominantly realist and (semi-)quantitative *methodology*.[1] Its preferred research *technique* is a standardised questionnaire that is typically self-administered. It can be administered either group-wise, for instance at the start of a company training session, or sent to workers', or other subjects' home addresses. However, it can also have an interpretive aspect to it. For instance, although the questionnaire should have a solid theoretical underpinning, as reflected in the chosen concepts, a subsequent analysis should not assume that these concepts will be present in the data too. On the contrary, an interpretation of the results could reveal new concepts that were not envisioned initially. Ultimately, the final goal is to develop a robust set

1 There is a way of putting the questionnaire to qualitative use. The analysis then is not aimed at spanning a multidimensional space and projecting cases in it. The responses are used to generate themes, which are used in subsequent (qualitative) research, for example see Guldenmund (2008).

of general concepts (factors, dimensions, scales) on which organisations can be assessed and, if required, compared. These latter characteristics make the analytical approach, in contrast to the previous academic approach, well-suited for comparative research. Such comparisons are, in principle, value-free,[2] that is, the mean scores do not have an evaluative sign, although the underlying individual responses might be based on such evaluations, preferences or perceptions (Hofstede, 2001, p. 15 ff.).

Several important aspects to this approach are sometimes overlooked. One, numbers obtained from rating scales are at the ordinal level of measurement, that is, the numbers represent a ranking but their mutual, psychological distances are not necessarily similar. When such numbers are treated as though they are at a higher measurement level (i.e. interval, ratio), the researcher should at least check whether this assumption is sufficiently justified. Two, although safety climate is not equal to culture, it is still an emergent property of a *group* and therefore the within-group agreement, its statistical coherence, should be tested (Zohar & Luria, 2005). There are several indices available for this purpose, see Bliese (2006) for an overview and applications. Three, groups have to be defined at different, but meaningful organisational levels, which have identifiable possibilities and means for interaction, e.g. the overall organisation, the department or unit level, or the team level (Guldenmund, 2007; Zohar, 2008).

Hence, viewed from the analytical perspective, culture is a multidimensional construct and different cultures can be positioned at various positions in that space. These dimensions are either given beforehand or established through subsequent analysis. An organisation's position in the culture space is determined using questionnaire responses, often by using the mean as a descriptor of a dimension. There is abundant literature about how to apply this analytic approach in research; for instance, aimed at the development of a questionnaire (e.g. Berends, 1995; DeDobbeleer & Béland, 1991; Díaz-Cabrera, Hernández-Fernaud, & Isla-Díaz, 2007; Guldenmund, 2007; Human Engineering Ltd., 2005), case studies (e.g. Guldenmund, 2008; Havold, 2005; Reiman & Oedewald, 2004), comparative studies (e.g. Nielsen, Rasmussen, Glasscock, & Spangenberg, 2008; Reiman, Oedewald, & Rollenhagen, 2005; Zohar & Luria, 2005), or modelling various climate-safety outcome relationships (e.g. Cheyne, Cox, Oliver, & Tomæs, 1998; Johnson, 2007; Neal & Griffin, 2006).

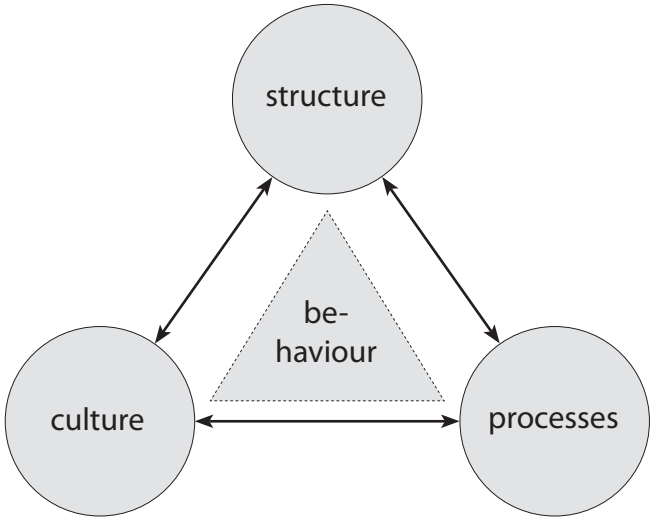
Summarising, the academic and analytical approaches together cover the full range of scientific research into organisational safety culture. The academic approach focuses more on the cultural core and on understanding its meaning by looking at its past, whereas the analytical approach is directed more at a description of present cultural manifestations, like various types of behaviour and how these are perceived by existing groups.

2 In practice the dimensions are often used implicitly or explicitly with a 'good' and 'bad' end.

1.4 *Pragmatic (experience-based) approach*

The third and last approach to safety culture research described here evolves around three important features of an organisation which are thought to interact to generate a desired level of safety performance. These aspects are structure, culture and processes and they are dynamically interrelated (Hofstede, 2001; Van Hoewijk, 1988). Taken together they also provide the context in which behaviour, and hence also safety related behaviour, takes place.[3]

Figure 1 The organisational triangle



Organisational *structure* can be defined as 'the division of authority, responsibility, and duties amongst members of an organization' (Whittington & Pany, 2004). Structure is primarily the formal framework of an organisation, i.e. how the work is done and by whom.[4] From the point of view of management an efficient structure facilitates both effective coordination and communication (Mintzberg, 1979, 1980, 1983).

Culture is then often understood to be the basic assumptions, the underlying tacit convictions of an organisation. For instance, as the general manager of a

3 Hofstede (2001, p. 408 ff.) makes a distinction between strategy, structure, control and culture. It is not difficult to translate his 'controls' into the 'processes' of the present model. Moreover, I see his 'strategy' as the outcome of processes at the highest (strategic) level of the organisation, therefore this element in his model could be considered redundant.

4 Some people also include physical structures like buildings and technology under the heading of structure.

company once declared, 'We need a lot of supervisors because our people need to be watched constantly'. Such a conviction will be found reflected in the structure of an organisation and therefore also on the work floor.

Processes are the patterns of activity taking place throughout an organisation, often divided into three levels; the primary processes, which deal with the main output(s) of an organisation; the secondary processes which support the primary ones, e.g. management, quality control; and the tertiary processes, e.g. formulations of policies and strategies, designed to drive and support both the primary and secondary processes. These three processes are often associated with operational, tactical and strategic levels of organisational action.

Task execution at all levels might be according to what has been laid down in the structure, but this does not have to be the case. For instance, some supervisors do not watch regularly, or do not correct workers, although they see them make mistakes or violate rules. The reason for this might be structural, the wrong man in the right place, or cultural, e.g. the convictions of a group of people do not match the structure of the organisation. One important implication to be gathered from Fig. 1 is that an organisation's culture should not be isolated from its structure or its processes; a holistic approach is needed to capture it.

The third approach to safety culture is labelled 'pragmatic' here because its content is not so much grounded in empirical research on cultures but rather in experience and expert judgement. In practice, the pragmatic approach concentrates on both the structure and processes of an organisation, which, because of their dynamic interplay, will subsequently influence the culture (Fig. 1). Applied approaches concentrating on processes often focus on desired behaviour and the correction of deviations from it, e.g. DuPont's STOP™ (undated) or ProAct Safety's Lean Behavior-Based Safety℠ (undated). It is thought that a change in behaviour will result in subsequent cultural adjustments. According to cognitive dissonance theory, attitudes and thoughts about particular behaviours will change in the long run when the two are incongruent and desired behaviour is rewarded (Eagly & Chaiken, 1993, p. 469 ff.).

Studies in the pragmatic tradition prescribe in detail what an organisation should do to advance to a 'more developed' level of safety (culture), i.e. what processes should be implemented supported by an accompanying structure. Geller's (1994) Total Safety Culture is a prime example of this approach, and the IAEA requirements and characteristics for nuclear power plants are of a similar nature (International Atomic Energy Agency, 1998, 2002; International Safety Advisory Group (INSAG-4), 1991). Descriptive approaches towards culture such as the ones already discussed, i.e. the academic and analytical approaches, are of less relevance here, because it is not the organisation's history or its current status but deviations from a predefined norm which are assessed and considered.[5] In other words, this approach is primarily directed at change and the

5 However, knowledge of the current status might result in dissatisfaction with it, which can be helpful in providing the organisation with a sense of urgency to change. Moreover,

future of the organisation, i.e. a desirable future state. Conversely, from the point of view of the interpretative, academic approach inferences that are made about an underlying culture solely based on descriptions of behaviour means committing a mortal sin. According to this approach it is impossible to infer such meanings based on observed behaviour. Geertz (1973, p. 6 ff.), quoting the philosopher Ryle, illustrates this nicely by comparing a wink, with a twitch, with a parody of a wink: all three look much the same, but have quite different meanings indeed.

Lately, the notions of stages or levels of organisational maturity with regard to safety management have become fashionable (e.g. Energy Institute, undated; Lardner, 2004; Parker, Lawrie, & Hudson, 2006; Westrum, 1993). Each level describes common local attitudes and behaviours in relation to safety, especially in relation to incident and accident prevention, reporting, accident investigation and solutions. Once more, a diagnosis of the current organisational status in relation to these attitudes and behaviours might be prepared. However, the main objective is to ascend the safety development hierarchy. This might be accomplished by following the behavioural approach above, i.e. an emphasis on processes, or with more or less structural adaptations. It is again assumed that culture will follow in the wake of these interventions. This approach assumes, rather implicitly, that safety culture is something an organisation *has* (or has not); that is, mature 'generative' or 'continuously improving' organisations have 'it', whereas immature 'pathological' or 'emerging' organisations do not (Lardner, 2004; Westrum, 1993). Regarding paradigm, this approach finds itself therefore at the realist side of the paradigm spectrum.

The actual level of development of an organisation is assessed through behaviourally anchored rating scales, with either explicit or covert ordinal scales. These assessments are always done in groups for two important reasons. Firstly, it is a shared opinion one is after, not the mean score of a group of employees. Secondly, it is not so much the rating but the ensuing discussion that follows because of this rating process that is considered the most important outcome. Nevertheless, scores are calculated and reported back to the organisation.

2 What is this thing called culture?

Having explored the concept of organisational safety culture and, especially, three different approaches with which to capture it, we shall next take into consideration the concepts of culture and organisational culture. Safety culture is, of course, just an elaboration of these two concepts, which themselves are grounded in long established research traditions. The concept of culture is the research field of sociologists and anthropologists who try to understand and describe it, rather than to measure it. An understanding of a culture's past often enables

such knowledge may also provide information on what structure and processes are fitting given the current status.

them to interpret and explain the present. There is no need here to change a culture, but rather to customise certain measures or processes to local cultural conditions. For some, particularly for managers and practitioners, organisational culture represents a powerful tool, for others it is a concept akin to (national) culture, and everything that comes along with it. Below, short summaries will be provided of both concepts, starting with the general concept of culture, which will be discussed from a sociological and anthropological perspective, and then moving on to the combination of culture and organisation.

2.1 Humans and culture

The scientific study of culture covers a wide range of perspectives, meaning that scholars often differ on what culture actually 'is' (Keesing, 1981). Unlike animals, humans develop a culture. Whereas an animal's behaviour and its drivers in one part of the world are likely to be judged similarly for the same animal in another part of the world, the ideational systems and convictions of humans in different parts of the world are often quite dissimilar. According to Geertz (1973, p. 49) there is no culture without humans but, also, 'more significantly, without culture no men'.

An early notion placed cultures on a single continuum ranging from savage (low) to civilised (high), with high cultures obviously enjoyed by the colonialists and low cultural levels assigned to the conquered natives (Avruch, 1998). This view could be labelled 'colonialist', being both ethnocentric and evaluative and putting much emphasis on refinement and (evolutionary) development as seen by those doing the labelling. This notion of social evolution was later dismissed by many in favour of a descriptive stance, emphasising the uniqueness and variety of cultures, with none of them superior to or more developed than the others (ibid.).

An important function of culture is related to the reduction of uncertainty, which, consequently, leads to more continuity, because less time is spent on various mutual adjustments within a group (Van Hoewijk, 1988). The fact that people know what to expect in a variety of situations – e.g. with regard to particular rituals, like celebrations, meetings, appointments and so on, the expression of emotions, dress codes, behaviours, etc. – makes life more predictable and hence more fluent. Culture has also been linked to adaptation and habituation (Schein, 1992). Adaptation is important for learning, for continuity and therefore for survival. Forces from outside the organism that demand its adaptation will initiate change;[6] in this view, cultures are considered highly functional and well-adapted to their environment. However, while adaptation and learning are both necessary aspects of culture, they neither define its essence nor its working mechanisms.

6 Please note that Schein (1992, p. 298 ff.) follows a similar reasoning about culture change.

As early as 1952 Kroeber and Kluckhohn compiled a list of 164 definitions of culture and it does not appear useful to embark upon another definitional cruise (Kroeber & Kluckhohn, 1952). Hofstede (2001, p. 9) defines culture as 'the collective programming of the mind, which distinguishes the members of one group or category of people from another' and considers culture to be 'mental software'.[7] He distinguishes three levels of such mental programming (Hofstede, 1991, p. 6, 2001, p. 3):

1. human nature: universal;
2. culture: collective;
3. personality: individual.

Human nature corresponds to the functional programs all humans are born with, i.e. a need to feed, to grow, to reproduce, to avoid pain etc. along with a rich assortment of feelings, but this software can be influenced by both culture and personality. For instance, the way an individual expresses his or her anger will be determined both by this person's personality and culture, and by situational conditions, but the last are kept out of the discussion for the time being. Applying the psychoanalytical idiom to this three-way split, human nature would represent the *Id*, personality would be considered the *Ego* and culture, encompassing various assumptions about ethics and behaviour, would represent the *Superego*. Considered in this way the attention paid to organisational culture from a managerial point of view is certainly not surprising.

Hence, culture is distinguished from human nature and personality in that it is shared by a distinct *group* of people, whereas human nature and personality are not.[8] Culture is often considered to be the 'collective memory' of a group and is therefore thoroughly intertwined with the history of that group. Moreover, the term 'memory' implies that culture is learned, not inherited. Importantly, one person can belong to many groups and can therefore share several cultures with different people. This particular characteristic makes the study of culture especially difficult, because to what particular culture should any observed or otherwise assessed regularities of groups be attributed? This issue will be taken up more extensively in Section 3.2.

Within its bounds a culture provides norms for thoughts and action, perceptions and behaviour. Therefore, within a (national) culture actions and justifications for these actions can be compared to the norms that have developed within that culture (Hofstede, 2001, p. 15). Indeed, such norms become part of the culture and define its core, alongside its values. Consequently, culture provides *one of* the anchors for behaviour. This behavioural aspect is actually not captured in the definition supplied by Hofstede. Anthropologists Spradley and McCurdy

7 Following Geertz (1973, p. 44), who refers to 'plans, recipes, rules, instructions, […] programs.'

8 Human nature is shared by everybody and a personality is held by only one person. Additionally, Hofstede (2001, p. 10) considers culture the 'personality' of a group.

(1975) define culture as 'the acquired knowledge people use to interpret experience and generate behavior'. Combining this definition with Hofstede's results in the following characterisation: *Culture is the acquired and collective knowledge groups or categories of people use to interpret experience and generate behaviour which distinguishes them from other groups or categories of people.*

In this definition the learned and shared aspects of culture and its sense-making and action components are also captured, yet it still misses the particular fuzziness of the concept, which is better captured in Spencer-Oatey's (2000) definition: *Culture is a fuzzy set of attitudes, beliefs, behavioural conventions, and basic assumptions and values that are shared by a group of people, and that influence each member's behaviour and each member's interpretations of the 'meaning' of other people's behaviour.*

Attempting to reveal the essence of a culture raises an important question; i.e. to what extent are cultures comparable and to what extent are they unique (Hofstede, 2001, p. 24 ff.)? This distinction is discussed in various (social) sciences, e.g. sociology, anthropology, cross-cultural psychology, and it pertains to the issue of generality and specificity. An argument of the generalists may be that each group (collective, category, society) has to face similar problems during their lifetime. However, as the specifists would retort, each group will develop solutions based on its unique personal situation. It would be too much of a simplification to narrow this discussion down to a 'basic problems focus' versus 'unique solutions focus' dichotomy although the aspect of survival is quite important in this discussion. Survival of the organisation is also the primary incentive for change in Schein's (1992, p. 51 ff.) conception of *organisational* culture, resulting in external adaptation and internal integration.

An outcome of the generalist approach is that cultures can be described using a limited number of aspects, e.g. dimensions, facets or factors. The unique culture approach does not have this common underlying framework and its descriptions are limited to single cultures. However, either approach can ultimately lead to a third approach, a typology of cultures, as offered, for example, by Douglas and the so-called Cultural Theory framework that has been developed by her followers (Thompson, Ellis, & Wildavsky, 1990). All three approaches are well represented in the organisational culture literature and, as we have already seen, can also be discerned in the literature on safety culture.

2.2 *Layers of culture*

Most scholars consider culture as something consisting of a core surrounded by one or more layers, not unlike the anatomy of an onion (Table 2). Whereas the core is something (deeply) hidden, the culture projects itself gradually through and onto the outer layers. The further a layer is located from the core, the more easily it can be observed but also the more indirect, or interpretive, its relation with the core becomes. One cannot therefore understand a culture by only examining its outer layer(s). Likewise, the more deeply a layer is located, the

more difficult it becomes to actually change it (Meijer, 1999; Sanders & Neuijen, 1987). Hofstede, citing Bem, argues that a particular culture can be more effectively changed by starting with the practices of the outer layers, not the values of the core (Bem, 1970; Hofstede, 2001, p. 12). The latter change only gradually, with different time estimates for different levels of culture. For instance, a substantial change in national culture might take a millennium, whereas a change in an organisational culture around twenty-five years (Hofstede, 2001; Schein, 1992); however, accumulating anecdotal evidence suggests that this might be overstated (Westrum, 2004); for instance, see Abrashoff's (2002) account of his takeover of the USS Benfold.[9]

Table 2 Layers of culture according to various authors

Author(s)	Central core	Layer 1	Layer 2	Layer 3
Deal & Kennedy (1982)	values	heroes	rites and rituals	communication network
Van Hoewijk (1988)	fixed convictions	norms and values	myths, heroes, symbols, stories	codes of conduct, rituals, procedures
Hofstede (2001)	values	rituals*	heroes*	symbols*
Meijer (1999)	fundamentals	practices		
Rousseau (1990)	fundamental assumptions	values	behavioural norms	patterns of behaviour; and artefacts (= 4th layer)
Sanders & Nuijen (1987)	values and principles	rituals	heroes	symbols
Schein (1992)	basic underlying assumptions	espoused values	artefacts	
Spencer-Oatey (2000)	basic assumptions and values	beliefs, attitudes and conventions	systems and institutions	artefacts and products; rituals and behaviour
Trompenaars & Hampden-Turner (1997)	basic assumptions	norms and values	explicit culture (e.g. behaviour, clothes, food, language, housing)	

* Taken together, Hofstede has labeled these layers 'practices'.

All authors have something deep and profound positioned at the core – values, convictions, principles, basic assumptions – but beyond that there are differences, not so much concerning the nature of the layers, but regarding their position in the culture onion. Importantly, of the authors listed in Table 2 Hofstede, Spencer-Oatey and Trompenaars & Hampden-Turner elaborate *national* cul-

9 Importantly, to what extent a substantial cultural change has been realised is very much dependent on how change has been defined. This is, of course, related to the layered model of culture; that is, has the core of a culture actually been modified or is it (just) the manifestations?

ture, whereas the rest mainly focus on *organisational* culture. Regarding organisational culture from the perspective of his theory, Hofstede argues that the core, i.e. the values, is less relevant for the study of organisations, because it primarily reflects the values of the country where the organisation is situated. Hofstede therefore maintains that the notion of national culture does not apply so much to differences between organisations within a country. They only differ in what he calls 'practices', i.e. the outer three layers of his onion: rituals, heroes and symbols (Hofstede, 1991, pp. 182-183).

Schein makes no distinction amongst the more visible aspects of culture, i.e. between rituals, heroes and symbols, all of which he sweeps under the heading of artefacts along with all visible behaviour.[10] However, Schein divides the core into espoused values and basic assumptions, thereby indicating that he does not take the values for granted that members of an organisation express when asked about these. Schein also makes a point of calling his core 'basic assumptions' and not 'values'. To him, basic values are still negotiable whereas basic assumptions are not (Schein, 1992, p. 16). This discussion suggests that the labels given to the layers are typically assigned from an analyst's point of view. For a member of a particular culture these aspects are thoroughly intertwined and their meaning is obvious. It is therefore the researchers who label these activities as such and in many cases their differentiations are not clear-cut.

When conceptualising culture it is possible to distinguish two general views; one view considers culture to be a *sociocultural* (i.e. behavioural) *system*, whereas the other considers it to be an *ideational system*, i.e. a system comprising ideas, concepts, rules and meanings (Keesing, 1981, p. 68). Whether it is sufficient to observe the practices and not understand their underlying rationale seems much more a matter of preference for a particular paradigm than something that can be resolved through scientific inquiry. Researchers observing only practices sometimes might be bothered by their inconsistency, their irrationality or their incongruence and might end up relying on apparent, behavioural psychology (Avruch, 1998, p. 19). While researchers focussing on the core, i.e. values, rules and meanings, have a hard time untangling it. Some refer to the core as 'deep', something fundamental and pre-conscious (Schein, 1990, p. 109). People become emotional when their fundamentals are questioned or under attack, often without being aware why this is so important to them (Avruch, 1998; Hofstede, 1991). Moreover, the 'more deeply internalised and affectively loaded, the more certain images or schemas are able to motivate action' (Avruch, 1998, p. 19).

Culture is not only deep because it is so fundamental and covert, it is also immensely patterned and therefore related to everything we think, perceive and

10 Pedersen and Sorensen (1989, p. 29), taking Schein's research model as a starting point, bring some diversity to his rather amorphous artefacts, distinguishing (1) physical symbols, (2) language, (3) traditions and (4) stories amongst them, all of which they consider important for a cultural analysis.

do (Schein, 1992). When attempting to change one's belief, we have to change many related beliefs, and much that has been built upon these; we have to make fundamental changes to our belief networks.

Trying to express such deeply seated assumptions, these 'webs of significance' as Geertz (1973, p. 5) calls them, will be particularly difficult because they are so taken for granted that, within the boundaries of a culture, they are never challenged and, consequently, never have to be verbalised (Schein, 1992). Due to its fundamental nature, a culture can be blinded by itself to itself. Schein's distinction between basic assumptions and their verbal counterpart, i.e. espoused values, seems therefore quite valid and sensible. Bloch (1998) presents comparable reasoning; he proposes that much (conceptual) knowledge, and, hence, also cultural 'knowledge', is essentially non-linguistic and acquired primarily through experience and not through explanation, i.e. communication. When such knowledge is 'rendered into language', its character is also changed (ibid., p. 7). Hence, what is considered 'deep' can also be considered non-verbal and implicit. Making this deep knowledge explicit also changes its character.

3 Culture and organisations

The term 'culture' as used in the study of 'organisational culture' becomes a much more practical and tangible concept. According to some scholars, organisational culture is just that: practices (Hofstede, 1991), but others, like Schein, insist that organisational culture still has sufficient substance to it and, hence, cannot be reduced to behavioural regularities only but has to be deciphered to arrive at its description (Schein, 1992, 1999). Firstly, the development of organisational culture will be briefly described. Then, the issue of cultures and subcultures will be discussed.

3.1 The development of organisational culture

According to Schein, an organisational culture develops in organisations that have existed for some time and that have experienced significant external or internal difficulties or changes. Alongside the influence of founder(s) of a company or of significant leaders (heroes), the solution for problems or issues that are effectively resolved or overcome may become part of the leading, but tacit, assumptions that an organisation entertains (Schein, 1992). Such internal difficulties may very well be major safety problems, like fatal accidents, explosions or releases of dangerous chemicals, but also reorganisations, retrenchments or winning of a market. External problems of organisations often include macroeconomic woes, new legislation or drastic technological changes, e.g. see Hofstede (2001), Exhibit 1.5. Organisational culture could be considered the by-product of the adaptations that follow from these difficulties. Viewed this way, organisational culture is a product of social ecology and it is quite reasonable

to assume that such effective changes settle into the organisational collective as (basic) assumptions about how things generally work.

3.2 *Cultures and subcultures*

An organisation can be defined as having one unifying culture. Several scholars, like Schein, have held this position for some time and this notion may have been inspired by research done on national or indigenous cultures. Organisational culture research conducted using standardised questionnaires often carries the implication of a common set of dimensions or scales on which such cultures primarily differ and hence also contains the notion of a single culture, although with local nuances. Moreover, the word 'organisational' already seems to imply a large monolithic entity and certainly not something that is disintegrated or fragmented. However, organisations are quite open systems with leaders constantly changing. Further, many organisations are spread over more than one building or location; in this situation members of the organisation often do not have a chance to meet and develop much together as a collective. Additionally, members of organisations bring along their own cultures; for instance, their national culture, their regional culture, their professional/ occupational culture, their religious culture and their (socioeconomic) class culture. It is therefore quite possible that no specific organisational culture develops within an organisation; the existence of an organisational culture is an empirical issue, not a general rule (Antonsen, 2009). Local subcultures within an organisation may also develop; for instance, based on the professional background of members of a group or some challenging event(s) a certain group had to face in the past (see above). When group members have a similar educational background, they do not have to interact within the organisation to share common cultural features. This seems to be the case in Schein's (1996) paper on subcultures and this thinking may also underlie Jones and James' (1979) findings in the US navy.

Nowadays, the notion of an unitary organisational culture has lost popularity in favour of a view promoting differentiation (e.g. Martin, 2002; Richter & Koch, 2004). In this view, an organisational culture is not unitary but consists of multiple subcultures. Some researchers propose a fragmentation view (Martin, 2002), which implies that culture is basically dynamic and much more defined on a day-to-day basis (Roe & Schulman, 2008; Weick & Sutcliffe, 2001), but I do not think this view should be applied to such a stable concept as culture, although it does do justice to the impression of constant commotion some organisations give off.

Moreover, whatever the point of view, i.e. integration, differentiation or fragmentation, within a group or population, culture is '*socially distributed*' (Avruch, 1998, p. 18 ff.). That is, individuals belonging to a particular culture do not share their cultural content perfectly. Additionally, culture is '*psychologically distributed*' within a group, meaning that a cultural content can be deeply ingrained in one individual whereas in another it is a shallow cliché (ibid.).

One could question whether the characteristics of culture that have been discussed earlier apply in equal force to the concept of organisational culture. The concept of culture as applied to organisations has seemed rather attractive and provided explanations for certain phenomena that had gone unexplained previously. Yet in the process it has become but another instrument that managers wanted to use to mould things their way. In the face of this some scholars of organisational culture have simply given up, because they felt there was little value in contributing to yet another management tool (Salzer-Morling, 2003). A similar process can be recognised in the development of the safety culture concept. The first anthropologist has stood up and asked the research community to be more sensitive to assessment of safety cultures and managers to be more modest regarding changing these (Haukelid, 2008).

4 The future of safety culture

As has been discussed above, the step from culture to organisational culture already meant a significant theoretical move in the direction of a more tangible notion of culture. Furthermore, for some the assessment of organisational culture involves comparison, benchmarking and change; that is, the introduction of a normative element, which is something the original concept of culture did not possess. Such a practical turn also implied a different temporal focus, which then changes to the present and future of a company. Similar developments have been described for organisational safety culture, and below, some implications of these developments will be outlined further.

4.1 Safety culture assessment

Regarding the matter of safety culture and its assessment, there are several aspects that require particular attention:

- By its origins, culture is a value-free concept, whereas safety is not. The required purpose of safety culture assessments is not descriptions but evaluations, preferably with recommendations on how the underlying culture can be improved to support safety better, or the processes to manage and achieve safety can be so designed that the existing culture supports them.
- Safety is about behaviour, whereas understanding culture is about the meaning of behaviour. The relationship of culture with behaviour is partly dependent on the strength with which core assumptions are held. Hence, knowledge about the *direction* of assumptions is not sufficient, also their *intensity* is important for behaviour.[11]
- The assessment of safety culture is therefore complicated and not straightforward. In the pragmatic but also the analytical approach, behaviour tends to become the primary focus with some allusions to its meaning and an

11 As far as I know, only Zohar and Luria (2004) do acknowledge this in their research.

underlying culture but in the end, the actual meaning of the observed behaviour seems to be much less important than the behaviour itself.
– Finally, the temporal frames of organisational culture change, arguably spanning many years, and safety issues, often requiring immediate attention, are quite different.

The three broad approaches towards the assessment of safety culture outlined earlier differ in their emphasis on the particular period in time on which the research focuses (past, present and future), their research paradigm as well as accompanying research techniques. The approach that has been labelled 'academic' is most in line with traditional, interpretive research into culture and is aimed at truly understanding a particular organisational (safety) culture by looking into its past. This approach delivers value-free descriptions, or theories of cultures, which are not, at least in their description, formulated in terms of good or bad. The analytical approach focuses on the present and provides a description of culture along a few, general dimensions. Because these dimensions define a (quasi-)numerical space, cultures can be ordered within this space and this ordering can be explored to see if it relates to the safety performance of those cultures. Finally, the pragmatic approach focuses on an organisation's future; although an assessment is made of its current status, the aim is either to grow or develop along a predefined hierarchy, or to maintain the current status quo in case a certain level of development has already been reached. These three approaches can be arranged along a continuum running from value-free to normative. Or, viewed in another way, a continuum running from 'thick descriptions' to rather thin and global evaluations of observable safety behaviour, stripped of any local meaning.

What does all this mean for the concept of safety culture? The academic approach delivers a quite rigorous strategy for understanding a culture but not primarily for judging it. The analytical approach provides a current snapshot of a culture and, because of its (quasi-)numerical assessment, a means for ordering cultures. Moreover, because assessments are made on multiple dimensions, several (quasi-)numerical indicators are available which can be used in statistical routines to explore relationships. The academic and analytical approaches both also employ the empirical cycle, a systematic routine that should ensure a close match between theory and observations. Although generally applied to match up theory with observations, this cycle could equally well be used to monitor a development towards a desired future state. In that case, the theory is substituted by this pre-defined future state, and observations are made regularly to check progress. Finally, the pragmatic approach supplies a normative hierarchy, along which cultures can be ordered. All three approaches could be considered complimentary rather than just alternatives.[12]

12 Although a small step for some, this might seem like a giant leap for others. Nevertheless, I advocate an eclectic approach rather than a dogmatic one to penetrate the core of cul-

The academic approach can provide and validate the rich descriptions of various stages of safety culture. It can be used to assist in determining whether these stages can be clearly distinguished and recognised. The rich descriptions of these stages can be matched with dimensions provided by the analytical approach. When matches have been established, rich descriptions of cultures can be positioned in a multidimensional space. Moreover, developments of these cultures, as monitored by the adjusted empirical cycle, can be matched with changing positions within this multidimensional space. Ultimately, it should be possible to compare this space and developments of cultures within it with the various stages put forward by the pragmatic approach (Westrum, 2004). Expert judgement is then gradually replaced by empirical data. Moreover, the accompanying techniques all become attuned to this particular purpose.

4.2 *Safety culture and safety management*

The relationship between safety culture and safety management is illustrated in Fig. 1; safety management is primarily a process, but will also be present in the power and responsibilities defined in the organisational structure. Relatively few studies focus explicitly on both, i.e. on culture and safety management (Clarke, 2000; Kennedy & Kirwan, 1998) but successful accounts of safety management interventions can be found in the literature. These studies explore the establishment and systematic unfolding of various safety management activities and their impact on either intermediate outcomes (e.g., changes in attitudes, behaviours or risks) or final outcomes (e.g., changes in injury/ lost-time accident rates and associated costs) (e.g. Edkins, 1998; Hale, Guldenmund, van Loenhout, & Oh, 2008; LaMontagne et al., 2004; Robson et al., 2007; D. Walker & Tait, 2004).

These interventions are typically aimed at developing, orchestrating and focussing the overall safety effort of companies, that is, establishing a safety management system (SMS). Although compliance to current regulation might often be a first step, this is certainly not the final goal of most interventions. On the contrary, they are aimed at establishing an effective SMS as opposed to a paper tiger bureaucracy of rules and procedures. It is in the establishment of such a 'working' system that the secret of success lies, which is often attributed to safety culture (Reason, 1997). Moreover, organisations that are able to learn continuously and effectively from deviations in their processes are, supposedly, improving their safety performance in the long run. Also, these organisations are eager to pick up and analyse still 'weak signals' that have not materialised into something serious yet (ibid.). Importantly, significant information should be able to flow uninhibited throughout the organisation, so that anybody who has to be informed about something, actually also is (Homsma, 2007; Pidgeon, 1997; Reason, 1997; Westrum, 2004). What is more, qualities like trust and

ture, seeking the middle of the paradigm spectrum, cf. Davies et al. (2003), Heron and Reason (1997) or Pickard and Dixon (2004).

responsibility are cherished within such organisations and can be discerned in their decision making processes (Hudson, 1999). Likewise, trust and responsibility are also demonstrated with the empowerment provided to the work force to solve safety issues on-line (Hale et al., 2008). Finally, despite the criticism on behaviourally based approaches (Hopkins, 2006b) there is a growing literature on successful applications of such programs (e.g. Cox, Jones, & Rycraft, 2004; Hale et al., 2008; Williams & Geller, 2000).

The SMS of an organisation is the obvious arrangement to control and monitor these processes and to ensure that they are present, well-executed and the subject of continuous scrutiny and improvement, when necessary. Supported by an appropriate structure, this framework as well as its constituent processes will be able to invoke and ensure the safety behaviour that is required and desired, at least to a certain extent.[13] The SMS then embodies the organisational structure and processes, which are empowered or driven by the motor of the safety culture to produce the safety performance (behaviour) of the system.

A related aspect that is gaining serious attention in the safety literature is the role of managers and supervisors in combination with their leadership style (e.g. Barling, Loughlin, & Kelloway, 2002; Clarke & Flitcroft, 2008; Hofmann, Morgeson, & Gerras, 2003; Zohar, 2002; Zohar & Luria, 2004). Indeed, managers and supervisors have significant influence on establishing, promoting and monitoring the processes and qualities mentioned above. Moreover, being responsible for establishing the safety management system, they should be able to understand and manage it, uphold and control it, propagate and improve it.

Many organisations already have an SMS in place but it is unclear whether this system is deployed in the way that is put forward here, that is, as a framework for meaning and a reference for behaviour. The 'engineering' of such a system is described by, for instance, Reason (1997) who draws heavily on studies of (what have become known as) high reliability organisations (HROs), like aircraft carriers, nuclear power plants and air traffic control centres, and the three organisational safety culture typologies of Westrum (1993, 2004). The development, implementation and maintenance of such an extensive system is yet another challenge, but this falls beyond the scope of this paper.

5 Conclusion

In this paper the study of safety culture has been discussed from three different research approaches; the academic approach, the analytical approach and the pragmatic approach. Whereas the first two are descriptive and primarily driven by the empirical cycle of scientific research, the latter is normative and mainly based on expert opinion. It has been argued that these approaches emphasise

13 According to Hofstede (2001, pp. 6-7), the desirable is ideological, the desired pragmatic. For Reason (1997, p. 220) the apex of safety culture is indeed idealistic: 'like a state of grace, a safety culture is something that is striven for but rarely attained'.

different parts of an organisation's lifecycle, with the academic approach looking at a company's *past* to understand its present, the analytical approach taking a generic snapshot of the *present* status of safety within the company and the pragmatic approach assessing its current level of development to prepare for the *future*, using a universal developmental hierarchy.

The three approaches to organisational safety culture mirror comparable developments and controversies in the study of culture and organisational culture. Here, both generalists and specificists have put forward different research strategies to capture what they think is the essence of culture. To come to a solid underpinning of the concept of safety culture, the three approaches should be combined. In this way it becomes feasible to ground various culture types, representing different levels of development, into solid empirical research.

A more explicit focus on the development of safety management systems seems attractive and also warranted. A dedicated focus on organisational processes and/or structure will ultimately also influence the organisational culture. Furthermore, it has been argued that an SMS can, at least in part, provide a framework for people to give meaning and direction to their safety actions, but the SMS should be supported by appropriate leadership of management and supervisors. The notion of safety culture development or maturity can gradually be replaced by SMS development, i.e. to what extent a company has been able to implement their SMS structures and processes effectively.

Keeping the torch of safety aflame will always remain a challenging task. However, a continuous desire for improvement is also part and parcel of the notion of an SMS as advocated here. Because an SMS will never become a *perpetuum mobile* its motion is not a given. The motor that drives the system to its desirable end will always be particular idealistic individuals, not the system alone or the convictions it promulgates (Hale et al., 2008).

Acknowledgements

The author would like to thank Andrew Hale, Ben Ale and especially Paul 't Hart for their comments on earlier drafts of this paper as well as two anonymous reviewers for their constructive remarks.

References

Abrashoff, D. M. (2002). *It's your ship: management techniques from the best damn ship in the Navy*. New York: Warner Books.

Antonsen, S. (2009). Safety culture and the issue of power. *Safety Science, 47*(2), 183-191.

Avruch, K. (1998). *Culture & conflict resolution*. Washington, DC: United States Institute of Peace Press.

Barling, J., Loughlin, C., & Kelloway, E. K. (2002). Development and test of a model linking safety-specific transformational leadership and occupational safety. *Journal of Applied Psychology, 87*(3), 488-496.

Bem, D. J. (1970). *Beliefs, attitudes and human affairs*. Belmont, CA: Brooks/Cole Publishing Company.

Berends, J. J. (1995). *Developing and using a widely applicable measurement tool for safety culture.* Unpublished interim report. Eindhoven: Eindhoven University of Technology.

Bliese, P. D. (2006). *Multilevel modeling in R (2.2). A brief introduction to R, the multilevel package and the nlme package*. Washington, DC: Walter Reed Army Institute of Research.

Bloch, M. E. F. (1998). *How we think they think: anthropological approaches to cognition, memory, and literacy*. Oxford: Westview Press.

Bourrier, M. (1998). Elements for designing a self-correcting organisation: examples from nuclear plants. In A. R. Hale & M. Baram (Eds.), *Safety management: the challenge of change* (pp. 133-146). Oxford: Pergamon.

Brooks, B. (2005). Not drowning, waving!: safety management and occupational culture in an Australian commercial fishing port. *Safety Science, 43*(10), 795-814.

Brooks, B. (2008). The natural selection of organizational and safety culture within a small to medium sized enterprise (SME). *Journal of Safety Research, 39*(1), 73-85.

Cheyne, A., Cox, S., Oliver, A., & Tomæs, J. M. (1998). Modelling safety climate in the prediction of levels of safety activity. *Work & Stress, 12*(3), 255-271.

Clarke, S. (2000). Safety culture: under-specified and overrated? *International Journal of Management Reviews, 2*(1), 65-90.

Clarke, S., & Flitcroft, C. (2008). Effects of transformational leadership on perceived safety climate: a longitudinal study. *Journal of Occupational Health and Safety - Australia and New Zealand, 24*(3), 237-247.

Cox, S., Jones, B., & Rycraft, H. (2004). Behavioural approaches to safety management within UK reactor plants. *Safety Science, 42*(9), 825-839.

Creswell, J. W. (2007). *Qualitative inquiry and research design. Choosing among five traditions* (2nd ed.). Thousand Oaks, CA: Sage Publications Inc.

Davies, J., Ross, A., Wallace, B., & Wright, L. (2003). *Safety management: a qualitative systems approach*. London: Taylor & Francis.

Deal, T. E., & Kennedy, A. A. (1982). *Corporate cultures*. Reading, Mass.: Addison-Wesley.

DeDobbeleer, N., & Béland, F. (1991). A safety climate measure for construction sites. *Journal of Safety Research, 22*, 97-103.

Denison, D. R. (1996). What *is* the difference between organizational culture and organizational climate? A native's point of view on a decade of paradigm wars. *Academy of Management Review, 21*(3), 619-654.

Díaz-Cabrera, D., Hernández-Fernaud, E., & Isla-Díaz, R. (2007). An evaluation of a new instrument to measure organisational safety culture values and practices. *Accident Analysis & Prevention, 39*(6), 1202-1211.

Douglas, M., & Wildavsky, A. B. (1982). *Risk and culture: an essay on the selection of technical and environmental dangers*. Berkeley: University of California Press.

DuPont (undated). DuPont™ Stop™ program. Retrieved July 7, 2009, from http://www2.dupont.com/Safety_Products/en_US/products/programs_training/index.html.

Eagly, A. H., & Chaiken, S. (1993). *The psychology of attitudes*. Fort Worth: Harcourt Brace Jovanovich.

Edkins, G. D. (1998). The INDICATE safety program: evaluation of a method to proactively improve airline safety performance. *Safety Science, 30*(3), 275-295.

Energy Institute (undated). Hearts and Minds programme. Retrieved March 10, 2008, from http://www.energyinst.org.uk/heartsandminds/index.cfm.

Farrington-Darby, T., Pickup, L., & Wilson, J. R. (2005). Safety culture in railway maintenance. *Safety Science, 43*(1), 39-60.

Geertz, C. (1973). *The interpretation of cultures*. New York: Basic Books.

Geller, E. S. (1994). Ten principles for achieving a Total Safety Culture. *Professional Safety, September*, 18-24.

Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: strategies for qualitative research*. Chicago: Aldine.

Gouldner, A. W. (1954). *Patterns of industrial bureaucracy*. New York: Free Press.

Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research*. Thousand Oaks, CA: Sage Publications Inc.

Guldenmund, F. W. (2007). The use of questionnaires in safety culture research - an evaluation. *Safety Science, 45*, 723-743.

Guldenmund, F. W. (2008). Safety culture in a service company. *Journal of Occupational Health and Safety - Australia and New Zealand, 24*(3), 221-235.

Hale, A. R., Guldenmund, F. W., van Loenhout, P., & Oh, J. (2008). *Evaluating safety management and culture interventions to improve safety: quantitative results*. Paper presented at the Bi-annual Conference 'Working on Safety' (WOS), Crete, 30 September - 3 October.

Haukelid, K. (2008). Theories of (safety) culture revisited—an anthropological approach. *Safety Science, 46*(3), 413-426.

Havold, J. I. (2005). Safety-culture in a Norwegian shipping company. *Journal of Safety Research, 36*(5), 441-458.

Heron, J., & Reason, P. (1997). A participatory inquiry paradigm. *Qualitative Inquiry, 3*(3), 274-294.

Hofmann, D. A., Morgeson, F. P., & Gerras, S. J. (2003). Climate as a moderator of the relationship between leader-member exchange and content specific citizenship: safety climate as an exemplar. *Journal of Applied Psychology, 88*(1), 170-178.

Hofstede, G. R. (1991). *Cultures and organisations: software of the mind*. London: McGraw-Hill.

Hofstede, G. R. (2001). *Culture's consequences* (2nd ed.). London: Sage Publications.

Homsma, G. J. (2007). *Making errors worthwhile: determinants of constructive error handling.* Vrije Universiteit, Amsterdam.

Hopkins, A. (2000). *Lessons from Longford: the Esso gas plant explosion*. Sydney: CCH Australia.

Hopkins, A. (2005). *Safety, culture and risk*. Sydney: CCH Australia.

Hopkins, A. (2006a). Studying organisational cultures and their effects on safety. *Safety Science, 44*(10), 875-889.

Hopkins, A. (2006b). What are we to make of safe behaviour programs? Retrieved August 4, 2008, from http://dspace.anu.edu.au/manakin/bitstream/1885/43176/1/hopkins36.pdf.

Hopkins, A. (2008). *Failure to learn: the BP Texas City refinery disaster*. Sydney: CCH Australia.

Hudson, P. T. W. (1999). *Safety culture - the way ahead? Theory and practical principles*. Leiden: Centre for Safety Science Leiden University.

Human Engineering Ltd. (2005). *A review of safety culture and safety climate literature for the development of the safety culture inspection toolkit* (Research Report No. 367). London: Health and Safety Executive.

International Atomic Energy Agency. (1998). *Developing safety culture in nuclear activities. Practical suggestions to assist progress. Safety reports series* (No. 11). Vienna: IAEA.

International Atomic Energy Agency. (2002). *Safety culture in nuclear installations. Guidance for use in the enhancement of safety culture* (No. IAEA-TECDOC-1329). Vienna: IAEA.

International Nuclear Safety Advisory Group. (1986). *Summary Report on the Post-Accident Review Meeting on the Chernobyl Accident* (No. 75-INSAG-1, Safety Series). Vienna: IAEA.

International Safety Advisory Group (INSAG-4). (1991). *Safety culture* (No. 75-INSAG-4, Safety Series). Vienna: International Atomic Energy Agency.

Johnson, S. E. (2007). The predictive validity of safety climate. *Journal of Safety Research, 38*(5), 511-521.

Jones, A. P., & James, L. R. (1979). Psychological climate: dimensions and relationships of individual and aggregated work environment perceptions. *Organizational Behavior and Human Performance, 23*, 201-250.

Keesing, R. M. (1981). *Cultural antropology. A contemporary perspective* (2nd ed.). Fort Worth: Holt, Rinehart and Winston Inc.

Kennedy, R., & Kirwan, B. (1998). Development of a Hazard and Operability-based method for identifying safety management vulnerabilities in high risk systems. *Safety Science, 30*(3), 249-274.

Kets de Vries, M. F. R. (1999). *Struggling with the demon – essays on individual and organizational irrationality (in Dutch)*. Amsterdam: Uitgeverij Nieuwezijds.

Kroeber, A., & Kluckhohn, C. (1952). *Culture: a critical review of concepts and definitions*. New York: Meridian Books.

LaMontagne, A. D., Barbeau, E., Youngstrom, R. A., Lewiton, M., Stoddard, A. M., McLellan, D., et al. (2004). Assessing and intervening on OSH programmes: effectiveness evaluation of the Wellworks-2 intervention in 15 manufacturing worksites. *Occupational and Environmental Medicine, 61*, 651–660.

Lardner, R. (2004). *Mismatches between safety culture improvement and behaviour-based safety.* Paper presented at the NeTWork 2004 Workshop 'Safety Culture and Behavioural Change at the Workplace', Blankensee, Berlin, 9-11 September.

Martin, J. (2002). *Organizational culture: mapping the terrain*. Thousand Oaks, CA: Sage Publications Inc.

Mascini, P. (1999). *Risks at work. Handling health risks on the shop floor (in Dutch).* PhD thesis, Erasmus University, Rotterdam.

Meijer, S. D. (1999). *The Gordian knot of organisational and safety culture (in Dutch).* PhD thesis, Technical University Eindhoven.

Mintzberg, H. (1979). *The structuring of organizations*. Englewood Cliffs: Prentice Hall.

Mintzberg, H. (1980). Structure in fives: a synthesis of the research on organisation design. *Management Science, 26*(3).

Mintzberg, H. (1983). *Structures in five: designing effective organisations*. Englewood Cliffs, NJ, USA: Simon & Schuster.

Neal, A., & Griffin, M. A. (2006). A study of the lagged relationships among safety climate, safety motivation, safety behavior, and accidents at the individual and group levels. *Journal of Applied Psychology, 91*, 946-953.

Nielsen, K. J., Rasmussen, K., Glasscock, D., & Spangenberg, S. (2008). Changes in safety climate and accidents at two identical manufacturing plants. *Safety Science, 46*(3), 440-449.

Parker, D., Lawrie, M., & Hudson, P. T. W. (2006). A framework for understanding the development of organisational safety culture. *Safety Science, 44*(6), 551-562.

Pederson, J. S., & Sorensen, J. S. (1989). *Organisational cultures in theory and practice*. Aldershot, UK: Avebury & Gower.

Pickard, A., & Dixon, P. (2004). The applicability of constructivist user studies: how can constructivist inquiry inform service providers and systems designers? [Electronic Version]. *Information Research*, *9*. Retrieved July 18, 2008, from http://informationr.net/ir/9-3/paper175.html.

Pidgeon, N. F. (1997). The limits to safety? Culture, politics, learning and man-made disasters. *Journal of Contingencies and Crises Management, 5*(1), 1-14.

ProAct™ Safety (undated). Lean behaviour-based safety. Retrieved July 07, 2009, from http://www.proactsafety.com/leanbbs

Reason, J. T. (1997). *Managing the risks of organizational accidents*. Aldershot: Ashgate.

Reiman, T., & Oedewald, P. (2004). Measuring maintenance culture and maintenance core task with CULTURE-questionnaire - a case study in the power industry. *Safety Science, 42*(9), 859-889.

Reiman, T., Oedewald, P., & Rollenhagen, C. (2005). Characteristics of organizational culture at the maintenance units of two Nordic nuclear power plants. *Reliability Engineering & System Safety, 89*(3), 331-345.

Richter, A., & Koch, C. (2004). Integration, differentiation and ambiguity in safety cultures. *Safety Science, 42*, 703-722.

Robson, L. S., Clarke, J. A., Cullen, K., Bielecky, A., Severin, C., Bigelow, P. L., et al. (2007). The effectiveness of occupational health and safety management system interventions: a systematic review. *Safety Science, 45*(3), 329-353.

Roe, E., & Schulman, P. R. (2008). *High reliability management: operating on the edge*. Stanford, CA: Stanford University Press.

Salzer-Morling, M. (2003). Cultivating culture: Mats Alvesson, Organisationskultur och ledning, Liber förlag, Malmö, 2001; Joanne Martin, Organizational Culture: Mapping the Terrain, Sage, London, 2002; Martin Parker, Organizational Culture and Identity, Sage, Thousand Oaks, 2000. *Scandinavian Journal of Management, 19*(3), 385-392.

Sanders, G., & Neuijen, B. (1987). *Organisational culture: diagnosis and influencing (in Dutch)*. Assen: Van Gorcum.

Schein, E. H. (1990). Organisational culture. *American Psychologist, 45*(2), 109-119.

Schein, E. H. (1992). *Organizational culture and leadership* (2nd ed.). San Francisco: Jossey-Bass.

Schein, E. H. (1996). Three cultures of management: the key to organisational learning. *Sloan Management Review, Fall 1996*, 9-20.

Schein, E. H. (1999). *The corporate culture survival guide: sense and nonsense about cultural change*. San Francisco: Jossey-Bass Inc.

Spencer-Oatey, H. (2000). *Culturally speaking: managing rapport through talk across cultures*. London: Continuum.

Spradley, J. P., & McCurdy, D. W. (1975). *Anthropology: the cultural perspective*. New York: John Wiley & Sons Inc.

Stave, C., & Törner, M. (2007). Exploring the organisational preconditions for occupational accidents in food industry: a qualitative approach. *Safety Science, 45*(3), 355-371.

Thompson, M., Ellis, R., & Wildavsky, A. (1990). *Cultural theory*. Boulder, CO: Westview Press.

Turner, B., & Pidgeon, N. (1997). *Man-made disasters* (2nd ed.). Oxford: Wykeham.

Van Hoewijk, R. (1988). The meaning of organisational culture: an overview of the literature (in Dutch). *M&O, Tijdschrift voor Organisatiekunde en Sociaal Beleid, 1*, 4-46.

Vaughan, D. (1996). *The Challenger launch decision. Risky technology, culture, and deviance at NASA*. Chicago The University of Chicago Press.

Walker, A., & Hutton, D. M. (2006). The application of the psychological contract to workplace safety. *Journal of Safety Research, 37*(5), 433-441.

Walker, D., & Tait, R. (2004). Health and safety management in small enterprises: an effective low cost approach. *Safety Science, 42*(1), 69-83.

Weick, K. E., & Sutcliffe, K. M. (2001). *Managing the unexpected. Assuring high performance in an age of complexity*. San Francisco, CA: Jossey-Bass.

Westrum, R. (1993). Cultures with requisite imagination. In J. Wise, P. Stager & J. Hopkin (Eds.), *Verification and validation in complex man-machine systems: human factors issues* (pp. 401-416). New York: Springer.

Westrum, R. (1999). *Sidewinder: creative missile design at China Lake*. Annapolis, MD: Naval Institute Press.

Westrum, R. (2004). A typology of organisational cultures. *Quality and Safety in Health Care, 13* (Suppl II), ii22-ii27.

Whittington, R., & Pany, K. (2004). *Principles of auditing and other assurance services* (14th ed.). Boston, MA: McGraw-Hill.

Williams, J. H., & Geller, E. S. (2000). Behaviour-based intervention for occupational safety: critical impact of social comparison feedback. *Journal of Safety Research, 31*(3), 135-142.

Zohar, D. (2002). The effects of leadership dimensions, safety climate, and assigned priorities on minor injuries in work groups. *Journal of Organizational Behaviour, 23*, 75-92.

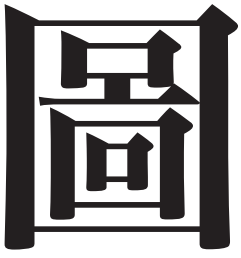
Zohar, D. (2008). Safety climate and beyond: a multi-level multi-climate framework. *Safety Science, 46*(3), 376-387.

Zohar, D., & Luria, G. (2004). Climate as a social-cognitive construction of supervisory safety practices: scripts as proxy of behavior patterns. *Journal of Applied Psychology, 89*(2), 322-333.

Zohar, D., & Luria, G. (2005). A multilevel model of safety climate: cross-level relationships between organization and group-level climates. *Journal of Applied Psychology, 90*(4), 616-628.

Chapter 6

Current approaches to safety culture: six images



Introduction to Chapter 6

The original design of this volume was that it would contain five chapters, each an accepted or published journal paper. However, the chapter on the safety culture research process (Chapter 3), albeit an indispensable part of the book, proved quite difficult to get published in a scientific journal; partly because of its length, but, more importantly, because it was a résumé of current safety culture and climate research techniques compiled to shed light on the rest of the book, not to function as a stand-alone article. This triggered a reconsideration of the structure of the book.

While mulling over an appropriate picture for the cover of the book I remembered the parable of the six blind men and the elephant, recounted in Gareth Morgan's book (Chapter 6). This parable described my thoughts and feelings about the concept of safety culture very well and not long thereafter, I also located the Japanese woodcut that now adorns the cover of this book. Having a nice cover, but also an unpublished journal paper, it seemed a good idea to add another chapter to the current volume, which was also closely linked to the image on the cover and that would synthesise the previous chapters and also answer the two research questions, see Introduction to this volume, in the same breath. Furthermore, by adding an additional chapter the more radical message of Chapter 5, i.e. focus on safety management instead of safety culture, which marked the original ending of the book, could be put into perspective.

As has been described in its introduction, Chapter 5 went through various stages, starting out as a rather sceptical paper on the dilution of the original concept of culture for the sake of safety, but ending as a synthesis of more or less fundamental and applied – i.e. truthful versus useful, see Afterword to Chapter 4 – approaches to safety culture. By combining the three approaches described in Chapter 5 – i.e. the academic, analytical and pragmatic approaches – thick, or rich, descriptions of various safety culture types emerged, accompanied by a set of techniques, to map organisations into a well-defined safety culture space. Moreover, organisational safety culture is linked once more to a systematic management of safety and, hence, changes in culture can be initiated and monitored through the processes defined by this system (see also Chapter 2). Eventually, through a number of rewritings, Chapter 5 lost much of its initial exasperation and ended up being quite constructive.

This brings us to Chapter 6. The original parable mentions *six* blind men, so six images of safety culture seemed appropriate. The approaches of Chapter 5

are not real images. They are much more research strategies, although some image of safety culture lies buried in all of them. Chapter 6 builds on those and expands them. I managed to come up with six different images and I practiced with those in various presentations to see whether I was able to really distinguish them, to explain them convincingly and to make them mutually exclusive to a certain extent. A few adaptations followed, resulting in the final six images, presented and discussed in the next chapter.

Abstract

Researchers as well as consultants have put significant effort into the development and assessment of the concept of safety culture, resulting in multiple approaches to capture and evaluate it. Interestingly, none of this seems to have led to a particularly heated debate on the nature of safety culture; each just went their own separate way.

Approaches to safety culture differ on whether safety culture pertains to either practices, or a system of ideas, or both. Overall, six approaches to safety culture can be discerned, each of which can be represented by an image or metaphor: (1) the scientific approach (a net); (2) the religious perspective (a castle in the air); (3) safety culture as a sensitising concept (indeterminate); (4) safety culture as a developmental hierarchy (a mirror); (5) the instrumental approach (a thing) and; (6) safety culture as an essentially contested concept (a work of art).

Although none of the images is particularly wrong or right, it is envisioned that a process oriented, iterative safety approach that is understood and shared by all members in the organisation will hold out longest.

Current approaches to safety culture: six images

6.1 Introduction

Somewhere at the end of his book 'Images of organisations', Gareth Morgan recounts the famous Indian tale of six blind men touching an elephant, but not knowing what it is and therefore making inferences based on what they hold; e.g. the one that holds a leg claims it is a tree, the one that holds a tusk thinks it is a spear, the one touching its belly declares it is a wall, *et cetera* (Morgan, 1986, p. 340). This story has essentially two morals, one pertaining to the absence of one single truth and the modesty that seems appropriate regarding one's own half-truths, the other pointing towards the mulish confidence people have in the beliefs they behold (Wikipedia contributors, 2009, August 14). A concept as fuzzy as organisational safety culture, and various other forms of culture, lends itself extremely well for a guessing game with such a conceptual elephant.

Looking upon the discourse on safety culture as a guessing game of blind men with an elephant is a metaphor. Metaphors are considered helpful in understanding processes or situations which are difficult to grasp immediately. However, the meaning of metaphors is obviously limited and they should not be confused with the situations or processes they depict. For instance, pushing the guessing game one step forward one could ask for the keeper of the elephant to rule over the game and either declare a winner or reveal the actual, true identity of the elephant. Unfortunately, in the discourse on organisational safety culture, the keeper is one of the blind guessers, so to speak, and will decide accordingly. More important, however, is the fact that establishing the true identity of the elephant is already an act that involves making assumptions, the most significant of these being that an object actually can be known and understood separately from its observer. So, declaring a winner in the guessing game brings along the assumption that the object of the game can be known, and also is known, as an indisputable fact.[1] The moral of the use of metaphors is, therefore, that these can be very helpful but they are also rather limited. They should not be confused

1 An obvious way out of the situation of the different perceptions is to allow, or even force, the blind men to compare their Braille notes and go and feel each other's, well-marked parts of the elephant, so that all eventually share all perspectives or 'sensations'. This approach would compare well with what is considered participative inquiry and it is discussed here and advocated at various other places in this book.

with, or worse, exchanged for the complex issue for which they were brought up in the first place. Being fully aware of this, the story of organisational safety culture can now continue.

Nowadays, many people are interested in safety culture, but they do not always adhere to the same view. These views range from quite abstract (conceptual) to very concrete (instrumental), from straightforward to complex, from useful to truthful (see Chapter 4's afterword for a discussion of these terms). Consequently, theoretical developments that accompany each of these particular views on organisational safety culture differ as well as the ensuing research approach. What follows is a discussion of these perspectives using various images to represent them. These perspectives are not mutually exclusive and some have quite some overlap. Some images are more dominant or popular in the study of organisational safety culture than others. However, clinging on to a single perspective is neither recommended nor considered fruitful. The following perspectives and images will be subsequently discussed: (1) the scientific perspective: safety culture as a nomological network; (2) the religious perspective: safety culture as a castle in the air; (3) the indeterminate perspective: safety culture as a sensitising concept; (4) the developmental approach: safety culture as a mirror; (5) the instrumental approach: safety culture as a thing; and (6) safety culture as an essentially contested concept.

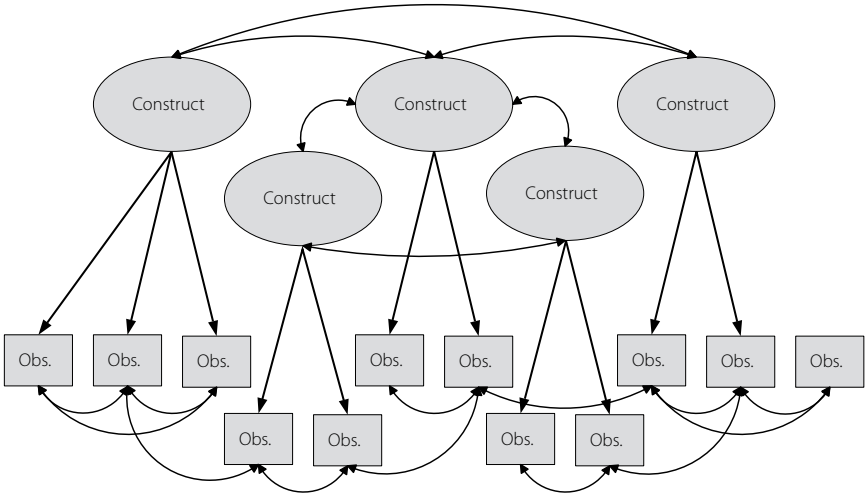
6.2 Safety culture as a net (the scientific perspective)

Safety culture does not exist. It is not 'out there' to be touched and moulded to one's liking. It is a scientific concept or construct that exists only in theories elaborated in books and papers, and presented at conferences. A construct is a product of the mind that is often based on assumed regularities we perceive in the world that we would like to explain and, possibly, predict. This concept of culture follows from (artefactual, behavioural, espoused) regularities, common symbols, language or idiom, dress codes, and on and on, which can be observed with (groups of) people. When observing such consistencies one can assume that something – a common meaning, a common understanding – is underlying these persisting regularities, which brings them forth. Incidentally, this 'bringing forth' is somewhat problematic in a literal sense. Because, how can something that exists only in minds and theories be the cause of something observable? Treating a theoretical construct as something concrete is called reification and this fallacy, although quite understandable, should be avoided both in theory and practice (Avruch, 1998).

Various related constructs and associated observables can be combined into what has been labelled a 'nomological network', which is 'a representation of the concepts (constructs) of interest, their observable manifestations and the interrelationships among and between these' (Trochim, 2006). The concept of a nomological network was put forward originally by Cronbach and Meehl (1955) to illustrate their notion of construct validity. For culture, this network con-

sist of covert basic assumptions, which are often also unconscious and overt espoused values and artefacts. Indeed, Schein presents his organisational culture models as sets of interrelated assumptions (e.g. Schein, 1992, p. 36 ff.), but in these models he does not clearly present the accompanying observables, i.e. espoused values and artefacts, on which they are based. Perhaps not entirely a nomological network in the sense meant by Cronbach and Meehl, culture still fits this image well.

Figure 1 A nomological network as a representation of theoretical concepts, their observable manifestations (Obs.) and the relations amongst and between these



Using the nomological network as a central image with which to capture the scientific approach towards organisational safety culture, the exploration of various elements of the network becomes a next step. As stated above, within the nomological network, the observational or empirical framework supplies the net which supports the theoretical framework. In the case of culture, the theoretical framework consists of basic assumptions and the empirical framework of espoused values and artefacts. Regarding the interpretation of these two frameworks, roughly two viewpoints are available, a constructivist and a (naïve) realist perspective. According to naïve realism, we can make observations about reality that truly say something about it and not (only) of its observer, i.e. 'our ordinary perception of physical objects is direct, unmediated by awareness of subjective entities, and that, in normal perceptual conditions, these objects have the properties they appear to have' (Dretske, 1995). Hence, objective judgments and statements of reality are feasible and these are either correct or miss the

point (Michell, 2003). Thus, according to Michell, naïve realists do not claim that all that is being said about reality is always true, but, nevertheless, 'things can only ever be considered in terms of what we can say about them' (ibid., p. 21). In contrast, constructivism rejects the existence of an objective reality; all that is being said about it is subjective and highly dependent on the particular reporting observer. It is a relativist viewpoint.

From the realist perspective, the observable entities that comprise the empirical framework of organisational safety culture are thus things that exist in the real, experiential world, independent of theories or researchers studying and describing them. This position also implies that such an experiential world indeed exists and can be connected to – i.e. can be studied and known objectively. Science then becomes an activity of discovering truths about reality and striving for near-perfect correspondence between theoretical concepts and the real, objective world. The most important way of obtaining objective knowledge about reality is through the application of the 'scientific method'. The scientific method is a stepwise approach of turning concepts or constructs into apprehensible data, which are subsequently compared with the constructs again.

As already discussed in Chapter 3 of this book (The safety culture research process), before investigating a construct such as organisational safety culture various philosophical issues should be addressed, starting with the choice for a particular paradigm. The research paradigm basically determines how (empirical) phenomena should be understood, what steps are taken in researching these phenomena and what the final results entail. For instance, culture research starting from a positivistic paradigm (that, according to Guba & Lincoln, 1994, also endorses realism) will rely primarily on empiricism and focus on generalisation, theory formation and, ultimately, discovering universal laws. A constructivist, and hence relativist approach, will not aim for such common laws or claim generality, but would rather focus on understanding the phenomenon under study and providing a rich or thick description, reflecting the particular researcher's appreciation of the construct in a particular context at a particular time. The former paradigm might be the first choice when developing or enriching a theory on organisational safety culture, whereas the later might be more appropriate when a particular problem for a client company has to be solved.

Positivist social sciences generally follow the steps of the empirical cycle by De Groot; that is, observation, induction, deduction/ prediction, testing and evaluation (De Groot, 1961). Although observation of regularities can be an initiating event, the cycle can start for any other reason, like theory falsification or confirmation or an abstract notion a researcher suddenly has. Likewise, induction does not have to occur at all times, because a particular theory can already be at hand and, hence, does not have to be induced from various observations.

The next step of deduction/ prediction is quite important for the current discussion of the organisational (safety) culture construct, because here a link is made between the theoretical and empirical framework, making it 'empirically tangible'. This basically means that theoretical constructs are linked to some-

thing 'tangible' in the outside (real) world that is somehow meaningfully linked to the invisible theoretical construct(s). Of course, one is free to do this any other way, but when the gap between the theory and the outside world, between the conceptual and the tangible, becomes too large, one loses significant credibility in the face of science. Moreover, after the theory has been linked to the observable world, one still has to demonstrate the 'robustness' of this link – i.e. its external validity – and hence relate it to, or ground it in other theoretical notions that are already accepted. The deduction/ prediction step also makes clear that, for instance, the issue of causality is very much dependent on what is decided here, i.e. how the construct of culture is made tangible, operationalised.

Operationalisation usually involves two different steps; one step is finding relevant 'tangibles' and the other usually entails attaching numbers to what has been made tangible or observable; this latter activity is called measuring. De Groot's subsequent steps – testing and evaluation – refer to the, again usually numerical and statistical, treatment of what has been measured or assessed and the testing of hypotheses. Based on these results an evaluation is made of the particular operationalisation and measurement, and implications are formulated for these as well as the underlying theoretical construct. Importantly, Michell strongly rejects the rather narrow-minded notion present amongst some researchers that operationalisation can only occur through quantification. He traces this urge back to the work of S.S. Stevens and, ultimately, the influence of the Pythagoreans (Michell, 2003). For Michell the door to qualitative data is still wide open at this stage.

This overview of the empirical cycle is ideal in that all steps are taken including the evaluation of the theoretical developments of the construct. However, the empirical cycle indeed provides some shortcuts, one of which has already been indicated above, i.e. skipping the observation and/or induction steps. These short-cuts are acceptable only when the cycle is, ultimately, completely finished and the construct is both well-grounded in theory as well as has been operationalised validly and can be measured reliably. However, when the empirical cycle starts iterating between deduction/ prediction and testing, and proceeds with (limited) evaluation, it will operate within a vacuum where the underlying theory alienates more and more from the particular operationalisation and measurement. In that case the theoretical construct(s) underlying the measurement become(s) of secondary importance and leads to the rather pragmatic notion that construct *x* 'is' what its test measures.[2]

Summarising, from a realist and positivist viewpoint the theoretical framework of the nomological network is linked to the empirical framework through the empirical cycle. By going through this cycle various times, the empirical framework is adapted to the theoretical one and vice versa. Thus, a close correspondence between theory and reality is established through well-chosen techniques that capture reality in a valid way. In organisational safety culture research

2 Please note that in the natural sciences this is a quite common situation.

the quantitative application of this approach is called safety climate research and it is considered to provide a more transient view of safety culture, a Polaroid (Flin, Mearns, O'Connor, & Bryden, 2000). An (organisational) safety climate is measured through questionnaires, often applying a Likert scale. Recent developments in this field tend to operationalise safety climate as the workforce's perception of the expression and enforcement of safety policies and procedures by management and supervisors and the way they promote and reward adherence (Zohar, 2008; Zohar & Luria, 2005). Indeed, policies and procedures are considered to be an important instrument for the dissemination of basic assumptions (e.g. Schein, 1992) and the true enforcement of these and compliance to them sets them apart from espoused values (see Section 6.5., however, for an alternative perspective on the adherence to rules and procedures). Moreover, before safety climate data can be analysed further, sufficient agreement within the units that have been assessed must be established, because climate is a group phenomenon – actually, an emergent property of that group – not simply the aggregation of unrelated individuals. Further analyses involve testing relationships with various safety outcome variables, like safe behaviour, incidents or accidents/ injuries (Mearns, Whitaker, & Flin, 2003; Neal & Griffin, 2004; Neal & Griffin, 2006; Zohar, 2002).

Importantly, when only the workforce's perception of (the expression and enforcement of) safety policies and procedures and their relationship with safety outcomes is considered, what then is a safety climate study actually establishing? It seems as if safety climate in that case rather establishes the fact that the procedures that have been formulated and are enforced are also effective (or ineffective, when safety performance is poor). This raises the question of the usefulness of the safety climate concept, for when it only establishes that safety procedures are effective, one could inspect various safety performance indicators directly and decide that this is the case. Furthermore, the usefulness and therefore also the validity of a climate questionnaire will increase significantly if its outcome provides an indication of why the safety policies and procedures are not working. However, as is the case in much questionnaire research, the results are often inconclusive and ambiguous (see also Afterword of Chapter 2).

A constructivist approach towards the study of organisational safety culture considers both the theoretical and empirical framework that are both part of the nomological network, the product of an individual researcher or research team. Moreover, according to constructivism, what is being said about reality (e.g. the data within the empirical framework) never completely reveals how things really are (Michell, 2003). This is where constructivists and (naïve) realists diverge. However, in that case constructivists cannot also reveal what their theories really are, because what they say about these theories does not capture their true content. Things become really complicated then. To be able to conduct any form of science a researcher should be able to make statements that truly capture reality, for instance statements about his/ her own theories or judgements of other's, otherwise all exchange of information becomes quite use-

less. Hence, a strict constructivist approach towards organisational safety culture, or towards the study of any social scientific construct for that matter, is an enterprise doomed to ultimately founder (cf. P. Reason & Bradbury, 2001). Guba and Lincoln describe their (constructivist) approach as 'relativist' and they consider reality 'apprehendable in the form of multiple, intangible mental constructions, socially and experientially based, local and specific in nature […] and dependent for their form and content on the individual persons or groups holding the construction' (Guba & Lincoln, 1994, pp. 110-111). Hence, their nomological network is mainly based on consensus.

Scientific research on organisational safety culture has primarily used the realist perspective, using either qualitative (e.g. Brooks, 2008; Stave & Törner, 2007; Walker, 2008) or quantitative approaches (e.g. Clarke & Robertson, 2007; Findley, Smith, Gorski, & O'neil, 2007; Neal & Griffin, 2006; Nielsen, Rasmussen, Glasscock, & Spangenberg, 2008; Zohar & Luria, 2005). Also Schein's assessment of organisational culture, although not explicitly put forward in this way, is compatible with realism to the extent that he does not consider his findings the product of a particular researcher. However, Schein is quite restrained about generalising his findings outside a particular company and is negative about applying standardised techniques, such as a questionnaire (Schein, 1992). Therefore, it can be presumed that, although Schein works from a realist paradigm, his findings are limited to a particular company for he does not seem to be inclined to generalise these to, for example, company types or industries, although such generalisations are not explicitly excluded either.

The latter point highlights a potential shortcoming of both quantitative and qualitative approaches adhering to positivism. Because of their one-sided focus on general laws and mechanisms, positivist approaches reduce data to that which fits or tests a universal theory and discard useless specifics as 'error'. However, when such theories become too general, a local application can become difficult because the generic hardly matches the specific anymore (Pickard & Dixon, 2004). Moreover, an overly rich description of a local phenomenon (at a particular place and time) can become so detailed that it becomes difficult to discover meaning beyond the particular description. When safety is at stake, both conditions – meaningless universals and overdetailed specifics – are undesirable.

Concluding, when investigating the construct of organisational safety culture, it is important how the construct is understood and approached by the researcher or, more ideally, the research team. This is the very message of Chapter 3 of this book on the safety culture research process. Indeed, the approach advocated here is the middle road between realism and relativism, i.e. participative inquiry (Heron & Reason, 1997). Within this paradigm, the researcher and the researched jointly embark on the investigation, jointly defining the problem, the approach, the empirical framework and then carry out the research together. This way, the possibility of ending with something useless is limited to failures in the composition and competence of the research team, rather than the team's basic assumptions.

6.3 Safety culture as a castle in the air (the religious perspective)

In his book on 'organisational accidents', Reason describes safety culture as: 'Like a state of grace, a safety culture is striven for but rarely attained. As in religion, the process is more important than the product. The virtue – and the reward – lies in the struggle rather than the outcome' (J. T. Reason, 1997, p. 220). Although this quote might seem rather spiritual, mystical even, in the end Reason has a very practical and down to earth vision of safety culture. According to him, a safety culture, which he, by the way, equates with an 'informed culture' (ibid., p. 196), has several distinct features (p. 195-196):

- there is a continuous drive towards maximum safety;
- people are constantly in a state of vigilance;
- people are frequently and effectively informed, i.e. there is an informed culture;
- there is a reporting culture;
- there is a responsible, a just culture;
- there is a flexible culture that shifts between various hierarchical structures when required; and
- there is a learning culture.

Without going into the specifics of what these different features might actually entail, it is important to note that Reason defines a safety culture exclusively in terms of various organisational activities and characteristics, these being either related to organisational structure or process (or behaviours); nevertheless, he also stresses that an organisation not so much *has* a culture, but rather *is* a culture. Hence, an organisation possessing the abovementioned features does not necessarily qualify for the 'safety culture' label; it is only the possession in addition of the 'organisational chemistry' (ibid., p. 220) that propels these characteristics to their desirable end.

With the religious perspective the general and also very strong belief is denoted that by performing particular safety related activities consciously, conscientiously and unquestioningly, i.e. without questioning their essence, a stage is ultimately reached where safety is controlled in the best possible way. In this view, there is no tolerance for cynicism or relativity, or even much room for heterogeneity between beliefs, and dedication and idealism abound.

Idealism is to be found in the philosophies of, for instance, Plato, Immanuel Kant or Max Weber.[3] In Plato's case, detailed knowledge of the ideal world was contingent on one's particular place in the chariot that rides through this perfect, ideal world before one's actual birth. Philosophers, apparently, have occupied window seats, so their knowledge of this ideal world is more extensive than

3 Weber's 'Idealtyp' is not meant to represent the perfect specimen – i.e. perfect objects, statistical averages or moral ideals – but rather embodies certain elements common to most cases of a given phenomenon.

the more common soul's. Whether future safety scientists or experts have occupied window seats while riding through the safety Walhalla before they were born is still a matter of debate, as accidents continue to happen, even where safety experts have the opportunity to do things very much their own way. It even raises the question of whether this safety Walhalla might actually exist.

Anyway, the way this image or viewpoint transpires in practice is that organisations initially assign significant resources to safety while the ultimate result of these efforts is actually unknown in its specifics, although they believe it really must be fantastic; in other words, the path, the process, becomes the goal. The notion here is also very strong that assuming the goal has in fact been reached leads to a form of complacency that is actually counterproductive, and that might even turn out to be destructive. So, keeping the goal sufficiently vague and far ahead actually helps to keep the complacency out.

An approach that is entirely process without end is the well-known Deming circle, originally developed by W. Edwards Deming as a model for uninterrupted quality control (e.g. Deming, 1993), but that has found application in many other fields as a model for problem solving. By going through the subsequent steps of *plan* (i.e. plan a change or some progress), *do* (carry out the plan), *study/ check* (check, or better still, study the actual results of the plan) and *act* accordingly (adjust the plan, which will start a new cycle), continuous improvement is achieved, assuming that, in the check/ study phase, always a mismatch between the plan and its outcome is established.

Sometimes, however, a more clear image is offered of this ideal world that is worth striving for. In the section discussing the developmental perspective, this image is more extensively described (Section 6.5.). Another ideal image can be found in the work by Argyris and Schön (1978; 1996). They contrast rather unconstructive behaviour that prevents organisations from actually learning, i.e. Model 1 behaviour, with a behaviour they call 'Model 2'. According to Argyris and Schön true learning is only accomplished when one is willing to revise one's 'theories in use'[4] and the various assumptions or 'governing values' that come with these. However attractive this may seem though, the opposite is much more prominent in the manner that organisations deal with setbacks. Here they show a reluctance to scrutinise their theories-in-use closely but prefer to define situations in a way that no substantial changes have to be made, only in the manner they deal with such events, i.e. their 'action strategies', in the future. Argyris and Schön call this 'single loop learning' as opposed to the 'double loop learning' of Model 2 behaviour. Hence, Argyris and Schön more clearly define some heavenly features, which, although rare, should steer organisations away from disaster. Nevertheless, it is certainly not known what situation will arise when all organisations, or all people involved, finally work according to Model 2, as is usually the case with beliefs and ideals that have been realised.

4 Argyris and Schon's 'theories-in-use' compare well to Schein's 'patterns of basic assumptions'.

Although not often stated this way, the religious perspective basically flourishes in the world of safety. For instance, many organisations strive for 'zero accidents' as the ideal world good. The view that safety professionals are 'missionaries' and function as the 'conscience' of the organisation can be overheard regularly (cf. Hale, 1995; 1999). Indeed, a safety manager once confessed to me that he often felt like 'a minister' when talking to his 'parish'. No wonder employees sometimes roll their eyes when safety professionals start repeating their safety commandments of do's and don'ts. Predictably, various safety management systems incorporate concepts similar to the Deming circle in their processes, for instance, OHSAS 18001:1999, ISRS[7] PSM (Det Norske Veritas, undated) and ARAMIS (Guldenmund, Hale, Goossens, Betten, & Duijm, 2006). Again, it is the (iterative) process that really counts, not the marbles.[5]

Summarising, the religious perspective on safety culture primarily focuses on the process and not on the ultimate goal. This goal is preferably left hazy, because organisations might start pursuing it in any other way instead of following the standard, iterative process. Assessments are typically aimed at this process, i.e. whether it can actually be discerned in activities developed in the organisation and whether all bases are sufficiently touched. Finally, although it is generally not known how the world will look when the safety gospel has been put fully into practice, it is believed to be ideally safe.

6.4 Safety culture as a sensitising concept

In 1954 the American sociologist Herbert Blumer published a paper titled 'What is wrong with social theory?' (Blumer, 1954). According to Blumer, social science has estranged itself from empiricism and has gradually become completely submerged in sterile theorising. One way out of this unproductive impasse is, according to Blumer, to define social scientific concepts operationally and to develop, and subsequently refine, techniques with which to capture these concepts. In due course, the concept will coincide with its operationalisation and specific empirical instances defined by its procedures and might become a 'definitive concept' (ibid., p. 6). However, Blumer is not fully satisfied with this solution because social science, it seems to him, is not so much a science of definitive concepts but rather of 'sensitising concepts'. Such concepts instead provide 'the user [with] a general sense of reference and guidance in approaching empirical instances. Whereas definitive concepts provide prescriptions of what to see, sensitizing concepts merely suggest directions along which to look' (ibid. p. 7). And it is a 'general sense of reference' social scientists need, because the concepts they study do not have a single empirical referent, but, on the contrary, are typically unique and are also influenced by the context in which they appear. Importantly, sensitising concepts should not give rise to sloppy theoris-

5 In accordance with the Dutch saying 'het gaat om het spel, niet om de knikkers', i.e. it's not the winning (marbles) that counts, but taking part.

ing and provide a license for bad science. 'Sensitizing concepts can be tested, improved and refined. Their validity can be assayed through careful study of empirical instances which they are presumed to cover' (ibid., p. 8). However, the aim is not to arrive at definitive or final concepts, as these are excluded from social studies on fundamental grounds.

In his monograph, Van den Hoonaard argues that Glaser and Strauss's grounded theory (GT) can be considered a 'direct descendent' of Blumer's sensitising concept (Van den Hoonaard, 1997, p. 5). Indeed, in GT theoretical ideas gradually emerge from the data as the research develops and not through any preconceived notions or standardised techniques. Also, due to their intermediate status, i.e. halfway between theory and empiricism, sensitising concepts are neither sterile, nor overly specific. Van den Hoonaard provides a general approach for constructing sensitising concepts (ibid., p. 35 ff.) and offers various nice examples of these; for example, Kluckhohn's 'design for living' as a concept for culture, (ibid., p. 46), or Charmaz's 'identifying moments' for instants of sudden (self)insight and redefinition (ibid., p. 62).

Sensitising concepts do not really stand on their own but rather serve to create an analytic framework (ibid., p. 29). Again, the link between sensitising concepts and GT is apparent, but also a link between such concepts and Schein's 'patterns of basic assumptions' (e.g. Schein, 1992, 1999). Although not very often identified as such, 'safety culture' as originally defined by the International Safety Advisory Group basically is a sensitising concept. Its definition of safety culture as 'that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance' (International Safety Advisory Group (INSAG-4), 1991) clearly sensitises the researcher to a complex area of research, which encompasses individuals and organisations, characteristics and attitudes. Considered this way, safety culture is neither a definitive concept nor something meant to be regarded as such. On the contrary, the concept of safety culture should give rise to the development of a conceptual network, built from other sensitising concepts, that, together with an empirically rooted narrative, captures its essence. This approach contrasts with the application of a nomological network discussed previously, in that sensitising concepts are not operationalised as observable variables (i.e. the empirical network) but rather derived and refined from empirical data.

In his study of a small furniture-manufacturing business Brooks (2008) employs Schein's six cultural dimensions (Schein, 1992, p. 95 ff.) as sensitising concepts to come to a description of this company's basic assumptions. The same set of dimensions has been used to decipher the service company's assumptions in the afterword to Chapter 4 of this book. In these studies a set of predefined sensitising concepts has served as Blumer's 'directions along which to look' (see citation above). As has been stated at various places in this book, unfortunately not many qualitative safety culture studies have been published so far, and even less employing sensitising concepts, so, at the moment, it is no

use to start working on a more general framework that will bring these findings together. Nevertheless, the wish is expressed here once more that the amount of qualitative studies into safety culture will gradually increase so that, in due time, a general framework can be built from these, much in line with the original sensitising concept of safety culture coined by INSAG.

6.5 Safety culture as a mirror (the developmental perspective)

The next image, and also one of the most prominent and popular images in safety culture research, or more precisely, safety culture consultancy, is the image of the mirror. By the image of the mirror, the act of measuring up and scrutinising oneself is evoked. In the context of safety, this act should be (but often is not) carried out critically and not admiringly. Organisations regularly want to know where they stand, whether there is still room for improvement and what has to be done to succeed. These latter demands also suggest the existence of an order, or better still, a ranked order comprising various layers, i.e. a hierarchy.

Hierarchies are everywhere to be found in the world and are too numerous even to start summarising or classifying them. Within psychology several important hierarchies have been developed, researched and documented. For instance, Piaget's hierarchy of human sensory motor development describes the four stages children go through to reach a level of understanding of the surrounding world that enables them to cope with it cognitively (Atkinson, Atkinson, & Hilgard, 1983). According to Piaget, each stage has its own distinctive, but also imperfect, reasoning processes that come along with it and that first have to be generalised and also falsified sufficiently to be able to finally reject them in favour of new, but nevertheless also faulty cognitive processes. This climbing of the ladder of cognitive sense-making continues until the last, fourth stage is reached, the stage of abstract, formal operations, which is accomplished around the age 12 but continues onwards. Importantly, in Piaget's hierarchy each higher stage presupposes the mastering of cognitive operations from the previous stage, otherwise no falsification will take place and hence no progression (Flanagan, 1984).

Building on Piaget's hierarchy, Kohlberg developed a similar one for moral reasoning that also has the underlying assumption that stages cannot be skipped (Kohlberg, 1981). Moreover, contrary to the rather certain progress on Piaget's developmental hierarchy, individuals can remain stuck at a particular level on Kohlberg's. Overall, he distinguishes three main levels (pre-conventional, conventional and post-conventional), each level being subdivided into two sub-levels (Atkinson et al., 1983). It is important to note that although each of these levels manifests itself in a particular way, it is the underlying individual reasoning that determines the behaviour shown. Again, progression from one level to the next is initiated by a growing dissatisfaction with one's current level of moral reasoning. Interestingly, Kohlberg had difficulty finding individuals who consistently operated at his sixth and hence last level (Flanagan, 1984). Moreover,

he also encountered examples of moral regression; that is, individuals shifting downwards on his moral hierarchy (Kohlberg, 1976).[6]

As a final example, Maslow's famous hierarchy of human needs is mentioned. Maslow developed a five-stage hierarchy of such needs, where each stage has to be satisfied before needs at a higher stage (e.g. esteem, self-actualisation) can be pursued. Maslow considered needs at lower stages (physiological needs, safety) fundamental, as they pertain to physiological conditions, like food and breathing, and safety, like security of employment, resources or protection (Atkinson et al., 1983). However, the lower level needs can keep human development trapped at a certain level, because any further development sometimes requires giving up certain needs of security or belonging. This is a fundamental dilemma for people and, arguably, it also inspires Argyris and Schön's Model 1 behaviour discussed above.

Various hierarchies have been developed to reflect organisational development. An early example is Crosby's Quality Management Maturity Grid (1979), an assessment instrument that can be deployed in the overall improvement of a company's quality control system. By making quality not only a production issue but even more an organisational issue, Crosby preceded his colleagues working in safety at least by a few years. Crosby's grid consists of five levels – i.e. uncertainty, awakening, enlightenment, wisdom, certainty – and six 'measurement categories', each of which has to be assessed on the five level scale (ibid., p. 32-33) to assess the current stage a company has arrived at.[7]

The development of a comparable hierarchy for safety culture was bound to come. The first to produce a hierarchy comparable to Crosby's is Westrum. Regarding the way management dealt with safety in an organisation, especially safety information, he distinguished three levels: pathological, bureaucratic and generative (Westrum, 1993, 2004) along with descriptions of accompanying overall organisational tendencies.

Westrum's hierarchy, or perhaps Crosby's, as such references are often not supplied, has inspired a few other research teams to produce their own. Two well-know examples of these are the Safety Culture Maturity Matrix (SCMM) (Lardner, Fleming, & Joyner, 2001; Straughen & Williams, undated), which is employed by the Keil centre in Scotland, whereas the other is known as Hearts and Minds (H&M), which is currently distributed by the Energy Institute in the United Kingdom (undated) but which has been developed by Parker et al. (2006) in close connection with Shell International Exploration and Production

6 Kohlberg (1976) has tried to resolve this by further postulating intermediate stages (e.g. stage 4^{+}), in which the subsequent (fifth) stage has not yet been completely assimilated and the individual sometimes switches between the previous (fourth) and the emerging stage.

7 These categories are: Management understanding and attitude, Quality organisation status, Problem handling, Cost of quality as percentage of sales, Quality improvement actions and Summation of company quality posture.

B.V.[8] Both techniques are ideally carried out with groups or teams, and the aim is to arrive at a certain degree of consensus on the particular stage the company currently resides at. To achieve this, participants give answers to various issues presented to them that are related to safety. Answers to issues are framed as descriptions, which pertain to a certain level; such rating scales are known as behaviourally anchored rating scales (BARS). The BARS in the SCMM are significantly shorter than the BARS in the H&M matrix. Moreover, in the H&M matrix the various stages or levels are clearly visible, whereas the descriptions in the SCMM are provided on separate cards, and come accompanied by symbols rather than numbers or labels, so the stage a particular description belongs to is not immediately apparent (see Chapter 4 for an overview of the subjects that are addressed in H&M).

The various descriptions of the levels in all these hierarchies have been inspired by expert judgement, experience and, regarding the highest levels, best practices; a propos the latter especially those in what have been become known as high reliability organisations (HROs) (e.g. Roe & Schulman, 2008; Weick & Sutcliffe, 2001). Although often highly hierarchic and bureaucratic, these organisations can switch very quickly from standard operational procedures (SOPs) to a more decentralised mode when the situation demands this (J. T. Reason, 1997, p. 213 ff.). Incidentally, this emphasis on flexibility, especially with regard to SOPs, as a defining feature of an excellent safety culture is quite at odds with the way safety climate is currently operationalised (see discussion of the scientific perspective above). This operationalisation rather focuses on the existence and *enforcement* of SOPs.

The most obvious drawback of the SCMM and H&M techniques is the required, verbal response. A similar objection is made about the (verbal) responses provided to Kohlberg's moral dilemmas (Flanagan, 1984). Indeed, a given verbal intention certainly does not ensure a certain action and this is also why Schein prefers the term 'espoused values'. This particular drawback is not simply resolved by administering the technique in groups because these can be seized by various group dynamics that lead to certain biases, e.g. acquiescence or social desirability. Additionally, consensus might not be reached, breaking groups into two or more. Moreover, and this is especially true for the Hearts and Minds technique, respondents can get lost in the descriptions that are provided for each level and might miss the actual underlying message of each description but instead focus on just a few anchor words in these.

At the moment no publications in the scientific literature are available describing either repeated measurements or any other experiences with either of these techniques. Hence, it is currently not possible to determine whether companies progress stage-by-stage through the hierarchy, that is, in a Piagetian

8 The H&M matrix has been employed in a study of the safety culture of a service company, described in Chapter 4 and its afterword. The Keil centre's SCMM is not available for private use.

way, and what interventions are effective to initiate or sustain a progression. If assessments of companies become available along with detailed descriptions of the current state of affairs regarding safety, it would be possible to validate these instruments to a certain extent, by comparing their assessments with other safety related information (again, see Chapter 4 for an example) and with information about interventions having been carried out to proceed through the hierarchy. This basically coincides with the recommendation given in Chapter 5 to combine research approaches.

Concluding, the developmental perspective is an attractive image because of its hierarchical composition and the precise descriptions that accompany each of the levels. Contrary to the religious perspective described above, this approach has a clear picture of what the final stage entails. Given the separate steps leading to it this approach provides the 'stick' as well as the 'carrot' to encourage companies up the safety ladder. However, the approach is not well-grounded in empirical research and has not yet been able to make its mark in the scientific literature.

6.6 Safety culture as a thing (the instrumental perspective)

Although a concept such as culture does not actually exist as a thing in reality, it is sometimes tempting to talk about it as if it is. Considering abstract concepts as if they are concrete objects is called reification. Reification is actually provoked by following the scientific method, especially when a concept is operationalised, i.e. made empirically tangible (see above) and the particular operationalisation in a way replaces the concept. As a consequence, IQ 'is' what the test measures or safety culture 'is' what the questionnaire describes. Furthermore, by introducing various stages of safety culture (see previous section) and defining various artefacts and behaviours for each of these levels, safety culture becomes even more concrete. Although culture is a term primarily concerned with meaning, i.e. the meaning particular artefacts or behaviours have for a specific group, by replacing meaning with visibilities, culture can definitely become a thing.

The suggestions for interventions that are proposed following an assessment like Hearts and Minds (H&M), or the Safety Culture Maturity Model (SCMM) (again, see previous section), mostly focus on behavioural change. For instance, on the flip side of the actual H&M matrix a section is provided called 'personal behaviour', subdivided into management, supervisors and workforce (Energy Institute, undated). Using this section, respondents can decide what they need to change in their personal behaviour to contribute to an upward change. Also,

various behavioural interventions are proposed following an SCMM assessment that are specific for the level that has been established (Straughen & Williams, undated, p. 22 ff.). Although, possibly, a particular change in mentality is aimed for, the stress is primarily on behaviour and artefacts, not meaning.[9]

In the aftermath of the Chernobyl disaster, the International Atomic Energy Agency (IAEA) disseminated a series of publications regarding the assessment and installation of (a) safety culture in nuclear installations (e.g. International Atomic Energy Agency, 1998, 2002a, 2002b; International Nuclear Safety Advisory Group, 2002), along with lists of prompting questions that can be employed in questionnaires or during an audit to obtain a picture of the current state of affairs. The 1998 and 2002 reports also discuss three consecutive 'stages' of safety culture, i.e. (1) Safety based solely on rules and regulations; (2) Safety performance becomes an organisational goal and; (3) Safety performance can always be improved, along with (a slightly adapted version of) the Kolb Learning Cycle to progress systematically from one stage to the next (International Atomic Energy Agency, 1998, p. 5 ff., 2002a, p. 17 ff.).[10] However, through the application of various quantification and ranking procedures, the more practical side of culture tends to get stressed compared to the underlying intangible core, which, supposedly, drives these various manifestations.

By exchanging the covert concept culture for its overt manifestations it is quite plausible to also focus on those manifestations when attempting to change culture. Moreover, according to dissonance theory, our attitudes might actually adapt accordingly following a behaviour change, especially when the behaviour is induced with a minimum amount of pressure (Atkinson et al., 1983, p. 549). However, the attitudes that might be changed under such circumstances are individual attitudes, not so much group attitudes. Indeed, as De Boer and Van Drunen convincingly argue, the various processes influencing individual behaviour work according to different time frames and individual rational processes have much shorter frames (minutes to hours) than social processes (days to months) or the proximal processes of culture (years to decades) (De Boer & Van Drunen, 2003, p. 3 ff.). Hence, however appropriate behavioural interventions might actually be, it is perhaps more appropriate not to talk about culture change in this context but rather about 'performance change' or process change (Millman, 2007).

Summarising, the instrumental approach to culture follows from the way culture is operationalised or is assumed to manifest itself in the surrounding world. Interventions tend to focus on these tangibles rather than on underlying

9 However, on page 25 of 'Changing Minds' (Straughen & Williams, undated) it is stressed that managers are judged by the workforce on the perceived importance they attach to safety using their visible behaviour rather than what they say about safety. Hence, it could be said that it is the *meaning* attached to the behaviour of managers that the workforce uses to judge what is really important to their managers.

10 The IAEA's version of the Kolb Learning Cycle has the following steps: experience, reflect, review and implement.

assumptions. Consequently, these interventions are mistaken as cultural interventions and any ensuing behavioural change as cultural change. However, cultural change has a much different time frame and when it changes it is due to prolonged perseverance, not the twist of a monkey-wrench.

With the instrumental perspective, nearly all images of safety culture that can be distinguished have been discussed. In Table 1 all images that have been discussed so far, are summarised by their key features.

Table 1 Overview of images of safety culture

Safety culture as	Image	Approach	Technique	Distinguishing feature
A construct	A net	Operationalisation of theoretical concepts by joining them with representative empirical tangibles	Various techniques available	Analytical, explanatory, generalising
A belief	A castle in the air	Necessarily theoretical, bolstered by expert judgement and good practice	Deming cycle or other iterative improvement cycle	Idealistic, drive/ motivator
A sensitising concept	A porcupine	Positivist or relativist, using iterative refinement	Formulating sensitising concepts and building theoretical frameworks with these	Holistic, tentative
A thing	A machine	Pragmatic, focussing on tangibles like behaviour and frequencies of behaviour	Behaviourally based safety programmes, training, coaching	Instrumental, superficial, control
A development	A mirror	Carrot and stick: confrontational and liberating	Behaviourally based safety programmes, training, coaching	Pragmatic, control
An essentially contested concept	A piece of art	None	None	Confusion

6.7 Safety culture as an essentially contested concept

After sketching the various images above, the time has come to provide a final sketch which encompasses them all. Going through these different approaches attentively, it is evident that none of them is completely off the mark, or sheer nonsense. On the contrary, together they provide a rather comprehensive image of what safety culture might stand for or symbolises. Nevertheless, there are also various differences of opinion, which makes a full resolution near impossible.

In the last century, the British philosopher Gallie introduced the term 'essentially contested concept' to denote those concepts which remain submerged in an endless unresolved dispute. Later Garver (1978) described the essentially contested concept as 'a name to a problematic situation that many people recognize: that in certain kinds of talk there is a variety of meanings employed for key terms in an argument, and there is a feeling that dogmatism ("My answer is right and all others are wrong"), scepticism ("All answers are equally true (or false); everyone has a right to his own truth"), and eclecticism ("Each meaning gives a partial view so the more meanings the better") are none of them the appropriate attitude towards that variety of meanings.'

The notion of essentially contested concept is itself not contested. For instance, it has been assigned to various concepts that are surrounded by heated discussions. However, this is not what Gallie actually meant by the term. Essentially contested refers to the very core of the concept, which contains some internal tension between related ideas, that provide it with a potential for creating and sustaining such disputes. Gallie proposed several conditions for the very existence of an essentially contested concept that have been extended by others throughout the years. Wikipedia provides a current list of sixteen conditions, which will be employed here to examine the essential 'contestedness' of the concept of safety culture (Wikipedia contributors, 2009, October 20).

Table 2 Overall conditions of an essential contested concept reviewed for safety culture

	Requirement	Satisfied?	Remarks
1	Essentially contested concepts are evaluative, and they deliver value judgements.	✓	Culture is basically not evaluative, but the prefix safety is. However, as described extensively above, in some approaches safety culture is used in an evaluative way.
2	Essentially contested concepts denote comprehensively evaluated entities that have an internally complex character.	✓	The entities referred to in this condition are the various manifestations of culture, that can be roughly classified as artefacts and espoused values. Many of these indeed might have an internally complex character.
3	The evaluation must be attributed to the internally complex entity as a whole.	✓	If evaluations take place in safety culture research, they pertain to whether elements of a particular organisational culture are conducive to or support safety or not.
4	The different constituent elements of that internally complex entity are initially variously describable.	✓	True; if artefacts and espoused values are considered to be the constituent elements of culture, these can be experienced and, hence, described in various ways. Moreover, their relation with an underlying culture is yet another point of interpretation.

	Requirement	Satisfied?	Remarks
5	The different users of the concept will often allocate substantially different orders of relative importance, substantially different "weights", and/or substantially different interpretations to each of those constituent elements.	✓	Again, very true. Some users will stress e.g. the behavioural part of culture (artefacts) whereas others will try to decipher the particular meaning of this behaviour.
6	Psychological and sociological causes influence the extent to which any particular consideration is: a. salient for a given individual, b. regarded as a stronger reason by that individual than by another, and c. regarded as a reason by one individual and not by another.	✓	Whether the 'causes' are actually either sociological or psychological is perhaps slightly difficult to say, but they are definitely not empirical but rather theoretical or pragmatic.
7	The disputed concepts are open-ended and vague, and are subject to considerable modification in the light of changing circumstances.	✓	Yes, culture is a 'fuzzy' concept (see, for instance, Chapter 5) . Safety is a concept often agreed on through consensus, but other ways are possible too.
8	This further modification can neither be predicted nor prescribed in advance.	✓	Yes, opinions about culture as well as about safety are open to unpredictable future modification.
9	Whilst, by Gallie's express stipulation, there is no best instantiation of an essentially contested concept – or, at least, none knowable to be the best – it is also obvious that some instantiations will be considerably better than others; and, furthermore, even if one particular instantiation seems best at the moment, there is always the possibility that a new, better instantiation will emerge in the future.	✓	This is, of course, mostly true for the developmental approach.
10	Each party knows and recognizes that its own peculiar usage/ interpretation of the concept is disputed by others who, in their turn, hold different and quite incompatible views.	±	Perhaps not true. There is no strong safety culture debate, although some users are aware of the pragmatic, non-scientific approach and, so far, understand the refutability (contestability) of their approach.
11	Each party must at least to a certain extent understand the criteria upon which the other participants' repudiated views are based.	–	Not true. Again, the field of safety culture is not characterised by hot disputes or a profound deepening in other, opposite viewpoints.
12	Disputes centred on essentially contested concepts: a. are 'perfectly genuine', b. not resolvable by argument, and c. nevertheless sustained by perfectly respectable arguments and evidence.	✓	Yes, I do think all three conditions are satisfied here; that is, most divergence in this field is not based on confusion on anyone's part about the concept of culture itself rather on how this culture manifests itself and what therefore are important clues for change or improvement (if desired).

	Requirement	Satisfied?	Remarks
13	Each party's use of their own specific usage/ interpretation is driven by a need to uphold their own particular correct, proper and superior usage/ interpretation against that of all other incorrect, improper and irrational users.	±	See remarks about the absence of true conflict or dispute above. Any controversy surrounding safety culture is not that strong.
14	Because the use of an essentially contested concept is always the application of one use against all other uses, any usage is intentionally aggressive and defensive.	±	I find this condition strongly put and I do not recognise it as such in the field of safety culture research. Nevertheless, the lack of hybrid research is also striking, which might be considered a case in point.
15	Because it is essentially contested, rather than 'radically confused', the continued use of the essentially contested concept is justified by the fact that, despite all of their ongoing disputation, all of the competitors acknowledge that the contested concept is derived from a single common exemplar.	±	I am not sure about this condition either. For instance, although I agree with e.g. Denison (1996) that culture and climate are about the same 'exemplar', I am nevertheless unsure whether this view is entirely shared by others.
16	The continued use of the essentially contested concept also helps to sustain and develop our understanding of the concept's original exemplar/s.	✓	Undeniably true, and this is why I therefore stress the importance of especially hybrid case studies.

As can be seen in Table 2, the concept of safety culture satisfies at least eleven of the sixteen conditions. However, the heated dispute that surrounds some essentially contested concepts, like 'art', 'fairness' or 'discrimination', is virtually absent in the discourse on safety culture.[11] Furthermore, it was not Gallie's intention to provide an insipid argument for a dispute that can be better resolved otherwise than just an unexciting "let's try to agree to disagree". Nevertheless, it can be reasonably assumed that particular applications of the concept of safety culture will be contestable in the eyes of some, while others will be more than happy to use them in this particular contestable way.

I leave you with the following future scenario. Safety climate research has alienated itself more and more from the study of safety culture, through its single focus on (the perception of) policies and rules, various psychological facets and several outcome variables, assembled in elegant statistical models. Perhaps it will be relabelled safety attitude research again. Looking into the mirror of safety culture maturity has become ineffective, because accidents and incidents all have reached a solid baseline and appropriate interventions seem to have run out. Managers have become tired of looking into this mirror and want something else, a new thing. Behaviour based safety has remained an option but it

11 According to the entry on Wikipedia, Gallie considered culture an essentially contested concept, along with art, morality, logic, the novel, nature, rationality, democracy, science and philosophy (Wikipedia contributors, 2009, October 20).

has long become accepted that behaviour and culture are two separate realms, not necessary related to each other. The academic quest for safety culture has indeed put its full effort into qualitative research and safety journals are bristling with eclectic case studies. But nobody seems to be able to make much sense out of them. That leaves the castle, still hanging in the air, but properly obscured. Many organisations now run the famous (Deming) cycle devotedly, in which they retain an infinite trust. Running this cycle is provoking a continuous stream of information, which is openly shared throughout the organisation. They have safety management systems in place that are understood and supported by all employees. These systems are the subject of constant revision, but have enough flexibility engineered into them to allow for the quick and unexpected. Sometimes employees look up, into the sky, but there seems to be nothing there. They turn back to earth once more, to the clear but yet unending path. Because the path remains the goal.

References

Argyris, C., & Schön, D. (1978). *Organizational learning: a theory of action perspective*. Reading, Mass: Addison Wesley.

Argyris, C., & Schön, D. (1996). *Organizational learning II: theory, method and practice*. Reading, Mass.: Addison Wesley.

Atkinson, R. L., Atkinson, R. C., & Hilgard, E. R. (1983). *Introduction to psychology* (8th ed.). San Diego: Harcourt Brace Jovanovich, Publishers.

Blumer, H. (1954). What is wrong with social theory? *American Sociological Review, 18*, 3-10.

Brooks, B. (2008). The natural selection of organizational and safety culture within a small to medium sized enterprise (SME). *Journal of Safety Research, 39*(1), 73-85.

Clarke, S., & Robertson, I. (2007). An examination of the role of personality in work accidents using meta-analysis. *Applied Psychology, 57*(1), 94-108.

Cronbach, L. J., & Meehl, P. E. (1955). Construct validity in psychological tests. *Psychological Bulletin, 52*(4), 281-302.

Crosby, P. B. (1979). *Quality is free*. New York: McGraw-Hill.

De Boer, J., & Van Drunen, M. (2003). *Occupational safety from a behavioural perspective* (No. E-03/12). Amsterdam: Institute for Environmental Studies (IVM), Vrije Universiteit.

De Groot, A. (1961). *Methodology: foundations for research and thinking in the behavioural sciences (in Dutch)*. Den Haag: Mouton.

Deming, W. E. (1993). *The new economics for industry, government, education* (2nd ed.). Cambridge, MA: The MIT Press.

Det Norske Veritas (undated). isrs[7] PSM [Electronic Version]. Retrieved April 30, 2009 from http://www.dnv.com/binaries/isrs7%20PSM%20Brochure%20rev%207_tcm4-273420.pdf.

Dretske, F. (1995). Naïve realism. In T. Honderich (Ed.), *The Oxford companion to philosophy* (pp. 602). Oxford: Oxford University Press.

Energy Institute (undated). Hearts and Minds programme. Retrieved March 10, 2008, from http://www.energyinst.org.uk/heartsandminds/index.cfm.

Findley, M., Smith, S., Gorski, J., & O'neil, M. (2007). Safety climate differences among job positions in a nuclear decommissioning and demolition industry: employees' self-reported safety attitudes and perceptions. *Safety Science, 45*, 875–889.

Flanagan, O. J., Jr. (1984). *The science of the mind*. Cambridge, Mass.: The MIT Press.

Flin, R., Mearns, K., O'Connor, P., & Bryden, R. (2000). Measuring safety climate: identifying the common features. *Safety Science, 34*, 177-192.

Garver, E. (1978). Rhetoric and essentially contested arguments. *Philosophy and Rhetoric, 11*(3), 156-172.

Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research*. Thousand Oaks, CA: Sage Publications Inc.

Guldenmund, F. W., Hale, A. R., Goossens, L. H. J., Betten, J. M., & Duijm, N. J. (2006). The development of an audit technique to assess the quality of safety barrier management. *Journal of Hazardous Materials, 130*(3), 234-241.

Hale, A. R. (1995). Occupational health and safety professionals and management: identity, marriage, servitude or supervision? *Safety Science, 20*(2-3), 233-245.

Hale, A. R. (1999). *Why occupational health and safety experts? (Keynote address).* Paper presented at the International Symposium of the International Social Security Association: Training of occupational health and safety experts; issues at stake and future prospects. 30 June-2 July, Mainz.

Heron, J., & Reason, P. (1997). A participatory inquiry paradigm. *Qualitative Inquiry, 3*(3), 274-294.

International Atomic Energy Agency. (1998). *Developing safety culture in nuclear activities. Practical suggestions to assist progress. Safety reports series* (No. 11). Vienna: IAEA.

International Atomic Energy Agency. (2002a). *Safety culture in nuclear installations. Guidance for use in the enhancement of safety culture* (No. IAEA-TECDOC-1329). Vienna: IAEA.

International Atomic Energy Agency. (2002b). *Self-assessment of safety culture in nuclear installations. Highlights and good practices* (No. IAEA-TECDOC-1321). Vienna: IAEA.

International Nuclear Safety Advisory Group. (2002). *Key practical issues in strengthening safety culture* (No. INSAG-15). Vienna: International Atomic Energy Agency.

International Safety Advisory Group (INSAG-4). (1991). *Safety culture* (No. 75-INSAG-4, Safety Series). Vienna: International Atomic Energy Agency.

Kohlberg, L. (1976). Moral stages and moralization: the cognitive-developmental approach. In T. Lickona (Ed.), *Moral development and behavior: theory, research and social issues*. Holt, NY: Rinehart and Winston.

Kohlberg, L. (1981). *Essays on moral development, Vol. 1: The philosophy of moral development*. San Francisco: Harper & Row.

Lardner, R., Fleming, M., & Joyner, P. (2001). Towards a mature safety culture. *IChemE Symposium Series, 148*, 635-642.

Mearns, K., Whitaker, S. M., & Flin, R. (2003). Safety climate, safety management practice and safety performance in offshore environments. *Safety Science, 41*(8), 641-680.

Michell, J. (2003). The quantitative imperative: positivism, naive realism and the place of qualitative methods in psychology. *Theory Psychology, 13*(1), 5-31.

Millman, G. J. (2007). Corporate culture. More myth than reality? *Financial Executive* (July/August).

Morgan, G. (1986). *Images of organisation*. Newbury Park, CA: Sage Publications Inc.

Neal, A., & Griffin, M. A. (2004). Safety climate and safety at work. In J. Barling & M. R. Frone (Eds.), *The psychology of workplace safety* (pp. 15-34). Washington, DC: American Psychological Association.

Neal, A., & Griffin, M. A. (2006). A study of the lagged relationships among safety climate, safety motivation, safety behavior, and accidents at the individual and group levels. *Journal of Applied Psychology, 91*, 946-953.

Nielsen, K. J., Rasmussen, K., Glasscock, D., & Spangenberg, S. (2008). Changes in safety climate and accidents at two identical manufacturing plants. *Safety Science, 46*(3), 440-449.

Parker, D., Lawrie, M., & Hudson, P. T. W. (2006). A framework for understanding the development of organisational safety culture. *Safety Science, 44*(6), 551-562.

Pickard, A., & Dixon, P. (2004). The applicability of constructivist user studies: how can constructivist inquiry inform service providers and systems designers? [Electronic Version]. *Information Research*, *9*. Retrieved July 18, 2008 from http://informationr.net/ir/9-3/paper175.html.

Reason, J. T. (1997). *Managing the risks of organizational accidents*. Aldershot: Ashgate.

Reason, P., & Bradbury, H. (2001). Inquiry & participation in search of a world worthy of human aspiration. In P. Reason & H. Bradbury (Eds.), *Handbook of action research: participative inquiry and practice* (pp. 1-14). London: Sage Publications.

Roe, E., & Schulman, P. R. (2008). *High reliability management: operating on the edge*. Stanford, CA: Stanford University Press.

Schein, E. H. (1992). *Organizational culture and leadership* (2nd ed.). San Francisco: Jossey-Bass.

Schein, E. H. (1999). *The corporate culture survival guide: sense and nonsense about cultural change*. San Francisco: Jossey-Bass Inc.

Stave, C., & Törner, M. (2007). Exploring the organisational preconditions for occupational accidents in food industry: a qualitative approach. *Safety Science, 45*(3), 355-371.

Straughen, M., & Williams, S. (undated). *Changing minds. A practical guide for behavioural change in the oil and gas industry.*

Trochim, W. M. (2006). The research methods knowledge base (2nd ed.). Retrieved April 24, 2009, from http://www.socialresearchmethods.net/kb.

Van den Hoonaard, W. C. (1997). *Working with sensitizing concepts. Analytical field research*. Thousand Oaks, CA: Sage Publications Inc.

Walker, A. (2008). A qualitative investigation of the safety culture of two organisations. *The Journal of Occupational Health and Safety - Australia and New Zealand, 24*(3), 201-212.

Weick, K. E., & Sutcliffe, K. M. (2001). *Managing the unexpected. Assuring high performance in an age of complexity*. San Francisco, CA: Jossey-Bass.

Westrum, R. (1993). Cultures with requisite imagination. In J. Wise, P. Stager & J. Hopkin (Eds.), *Verification and validation in complex man-machine systems: human factors issues* (pp. 401-416). New York: Springer.

Westrum, R. (2004). A typology of organisational cultures. *Quality and Safety in Health Care, 13* (Suppl II), ii22-ii27.

Wikipedia contributors (2009, August 14). Blind men and an elephant. In Wikipedia, The Free Encyclopedia. Retrieved October 15, 2008, from http://en.wikipedia.org/w/index.php?title=Blind_men_and_an_elephant&oldid=307907366.

Wikipedia contributors (2009, October 20). Essentially contested concept. In Wikipedia, The Free Encyclopedia. Retrieved May 5, 2009, from http://en.wikipedia.org/w/index.php?title=Essentially_contested_concept&oldid=321021136.

Zohar, D. (2002). The effects of leadership dimensions, safety climate, and assigned priorities on minor injuries in work groups. *Journal of Organizational Behaviour, 23*, 75-92.

Zohar, D. (2008). Safety climate and beyond: a multi-level multi-climate framework. *Safety Science, 46*(3), 376-387.

Zohar, D., & Luria, G. (2005). A multilevel model of safety climate: cross-level relationships between organization and group-level climates. *Journal of Applied Psychology, 90*(4), 616-628.

Epilogue

The two research questions posed at the start of this book pertained to the *understanding* of (organisational) safety culture and the *assessment* of it. I have given an overall answer in the preceding 6 chapters, but the answer to these two questions is certainly not straightforward.

I understand that Geert Hofstede began his lectures on (national) culture by writing down on the blackboard in large letters 'Culture does not exist'. There *is* no culture, because culture is a construct, not an entity. Just as the assumed *content* of culture has to be interpreted, the concept itself also has to be delineated, deciphered. But capturing culture in a definition is virtually impossible, for there is no definition that even approaches all instances of the concept of culture. One of the takes on safety culture provided in Chapter 6 is that safety culture is an essentially contested concept, implying that there is something about its core meaning that is contestable, compelling those who are employing the concept to adapt it to their own needs and expectations.

So, how should organisational safety culture be finally *understood*? Most scholars, especially from the 1980s onwards, put forward a model of culture consisting of a rather stable core, surrounded by two or more layers, representing the various manifestations of this core (see Chapters 1 and 5). However, according to e.g. Hofstede (1991; 2001, see also Chapter 5) this model does not apply in equal force to all levels of aggregation of culture. Actually, Hofstede maintains that only national cultures have 'something' that can be called a core; all lower levels of aggregation have to make do with the layers around this core. Hofstede combines his three layers – symbols, heroes and rituals – into one notion: 'practices'. So, according to Hofstede, when looking at organisational (safety) culture, one basically looks at (safety) practices, possibly, but also perhaps not, related to any underlying cultural core.

Schein (1992), being an organisational as opposed to a national culture researcher, still finds value in maintaining an organisational culture core, and he is primarily triggered by any incongruence between what he thinks is the culture core and its various manifestations. Basically, this means that he is interested in the difference between what (groups of) people state, claim or 'espouse' and the shared assumptions according to which the same groups of people actually seem to operate. This is a striking phenomenon that has been the object of study for many years (e.g. Deutscher, 1973, for multiple examples). Identifying and subsequently resolving the incongruence between a person's (outer) actual

experience and (inner) self-concept is also the rationale behind Carl Roger's client-centred therapy (1961). The existence of a comparable tension between cognition and behaviour within an individual is the basis for the creation of 'cognitive dissonance', which is usually resolved by bringing cognition, i.e. an attitude, sufficiently into line with action so that the two match comfortably again (e.g. Cooper, 2007; Eagly & Chaiken, 1993). Consequently, the creation of cognitive dissonance provides a powerful tool to shape (group) attitudes, by inviting people to behave repeatedly in certain ways, and then pointing out that their accompanying thoughts or attitudes may not be in line with their previous actions.

Summarising, the layered model of culture as applied to organisations basically distinguishes thoughts from actions and, hence, Hofstede's claim that organisational cultures do not have a substantial core might be overstated. However, the pliability of this core is yet another issue. It might be that some thoughts or attitudes are changed as easily as described above. Moreover, changing such attitudes at the individual level is probably (much) more easy than at the group level (e.g. De Boer & Van Drunen, 2003). However, when such thoughts are actually firmly rooted in a national culture, and here we are back at Hofstede again, a change of (shared) thoughts might turn out to be much more difficult. Indeed, such thoughts are no longer considered attitudes, but rather the shared beliefs and assumptions that shape these.

One way of approaching the second question of this book, i.e. on the *assessment* of organisational safety culture, is to consider the way a particular user wants to utilise the concept; that is, how will any (acquired) knowledge about an organisational safety culture be employed? If culture is thought to be something one ultimately has to adapt to, organisational safety culture will be assessed in a way which is relatively value-free, and planned measures or processes or changes will be adapted to fit the local culture. If culture is something that finally has to be changed, culture will be approached normatively, and the norm determines the (amount of) cultural change that has to be achieved. Although the two approaches might seem at odds at first, this does not have to be the case. When organisational safety culture is equated with either one or both of Schein's layers, i.e. artefacts and/or espoused values, a cultural change only implies a change in behaviour or the way organisational members talk about safety and not the shared assumptions underlying such behavioural patterns.[1] In such an approach, these assumptions, and therefore also what happens to them, are simply left out of the discussion. However, a change program often will have to be customised to local circumstances and then we are actually back at the first

1 Please note that I am not claiming that organisational culture = organisational *safety* culture; hence, Schein's model remains intact. However, by claiming that organisational *safety* culture is limited to the outer layers, I basically do the same as Hofstede does with national culture and its relation to organisational culture, i.e. assuming that the latter is more superficial than the former.

point of view, i.e. the adaptation of planned measures or processes to local conditions.[2]

Finally, a last word on the understanding and assessment of organisational safety culture. Why actually bother? There is, of course, the romantic scientific ideal of simply understanding for understanding's sake: *Ars gratia artis*. However, there is also a more practical notion, which is perhaps even more pertinent for safety. According to Peters and Waterman, all people in an organisation only have to be committed to no more than three or four core values to enable them to decide and act in a similar and preferred manner (1982, p. 322): 'the discipline based on a small number of shared values […] in fact induces practical autonomy and experimentation throughout the organization and beyond'. And this is exactly what Weick and Sutcliffe mean by 'managing the unexpected' mindfully (2001, p. 124): 'A culture with three or four key values that have been converted into norms for appropriate behaviour, norms that are shared widely and implemented with intensity, will be coordinated, resilient, opportunistic'. Interestingly, this notion is closely related to the research question posed in Chapter 4: 'To what extent are workers compelled to work safely in the absence of direct supervisory control, and is this supported by their organisational safety culture?'.

A set of only three or four key values to establish a mindful culture seems very attractive indeed, but almost too good to be true. Research conducted along the lines described in Chapters 3 and 5 should eventually be able to either confirm or falsify this claim.

References

Cooper, J. (2007). *Cognitive dissonance: 50 years of a classic theory*. London: Sage Publications Ltd.

De Boer, J., & Van Drunen, M. (2003). *Occupational safety from a behavioural perspective* (No. E-03/12). Amsterdam: Institute for Environmental Studies (IVM), Vrije Universiteit.

Deutscher, I. (1973). *What we say/what we do; sentiments & acts*. Glenview, Ill.: Scott, Foresman and Co.

Eagly, A. H., & Chaiken, S. (1993). *The psychology of attitudes*. Fort Worth: Harcourt Brace Jovanovich.

Hofstede, G. R. (1991). *Cultures and organisations: software of the mind*. London: McGraw-Hill.

Hofstede, G. R. (2001). *Culture's consequences* (2nd ed.). London: Sage Publications.

Peters, T. J., & Waterman, R. H., Jr. (1982). *In search of excellence. Lessons from America's best-run companies*. New York: Harper & Row.

2 Viewed this way, the only difference between the two viewpoints is that changing basic assumptions is extremely difficult versus changing basic assumptions is not really one's concern.

Rogers, C. R. (1961). *On becoming a person. A therapist's view of psychotherapy*. Boston: Houghton Mifflin.

Schein, E. H. (1992). *Organizational culture and leadership* (2nd ed.). San Francisco: Jossey-Bass.

Weick, K. E., & Sutcliffe, K. M. (2001). *Managing the unexpected. Assuring high performance in an age of complexity*. San Francisco, CA: Jossey-Bass.

Samenvatting

Introductie

In dit boek wordt beschreven hoe organisatorische veiligheidscultuur kan (en misschien zelfs moet) worden begrepen en onderzocht. Deze beschrijving vindt plaats aan de hand van twee onderzoeksvragen:

1. Hoe kan, of wellicht moet, veiligheidscultuur begrepen worden?
2. Hoe kan dit begrip van veiligheidscultuur [conceptueel] gevangen en onderzocht worden?

Voor de beantwoording van deze vragen worden twee modellen als uitgangspunt gebruikt: de empirische cyclus van de Groot en het cultuurmodel van Schein. De empirische cyclus van de Groot beschrijft (de) vijf stappen van (traditioneel) empirisch wetenschappelijk onderzoek: observatie, inductie, deductie, toetsing en evaluatie.

Als tweede leidraad dient het cultuurmodel van Schein. Hij modelleert cultuur als een kern van basisassumpties omgeven door twee lagen bestaande uit beleden waarden en artefacten. Deze twee buitenste lagen zijn empirisch waarneembaar maar de kern van basisassumpties niet. Deze laatste dient daarom te worden afgeleid, of ontcijferd, uit waarneembare artefacten en beleden waarden.

Beide modellen kunnen worden verenigd in een onderzoeksmodel waarmee een theorie over een bepaalde organisatiecultuur kan worden geformuleerd. Dit is een iteratief proces dat stopt wanneer (1) een punt van verzadiging wordt bereikt en het toevoegen van meer gegevens geen zin meer heeft; (2) de gevonden basisassumpties aantoonbaar worden gedeeld in een groep mensen; en (3) de onderzoeksvraag afdoende kan worden beantwoord met de huidige set basisassumpties. Dit proces dient te worden uitgevoerd door een buitenstaander, of in ieder geval geleid worden door een buitenstaander, omdat de dragers van een cultuur zelf vaak weinig inzicht hebben in hun basisassumpties.

Met het uitvoeren van cultuuronderzoek rijst onmiddellijk de vraag hoe universeel de gevonden basisassumpties zijn: staat het resultaat los van een bepaalde onderzoeksgroep, of zijn zij juist het product van deze onderzoeksgroep, of gaat het om een combinatie van beide? Cultuuronderzoek brengt aldus onherroepelijk het dispuut tussen positivisme en constructivisme naar voren.

Een belangrijke aanname die ten grondslag ligt aan het boek is dat een cultuurstudie waardevrij behoort te. Een bepaalde cultuur is het resultaat van vallen en opstaan en van (geleidelijke) aanpassing aan veranderende omstandigheden en draagt aldus in belangrijke mate bij aan de overleving en het voortbestaan van de groep. In combinatie met veiligheid is dit enigszins problematisch, want veiligheid is juist geen waardevrij begrip; een cultuur kan bijvoorbeeld onveiligheid herbergen of stimuleren. Sommige onderzoekers hebben dit knelpunt opgelost door veiligheidscultuur te beschouwen als een eigenschap die een organisatie bezit of juist niet, of als een ontwikkelingsrangorde met daarin verschillende stadia van veiligheidscultuur.

Het is vooral het waardeoordeel dat de combinatie van cultuur met veiligheid enigszins onfortuinlijk maakt. Iets waardevrijs combineren met iets normatiefs is daarom uitdagend. Redenerend vanuit de cultuurkant moeten veiligheidsmaatregelen aangepast worden aan een vigerende cultuur, maar rederenend vanuit de veiligheidskant dienen lokale omstandigheden, i.e. de cultuur, te worden aangepast. Met behulp van dissonantietheorie kan wellicht een synthese worden bereikt.

De modellen van De Groot en Schein zijn echter niet voldoende om een cultuur te begrijpen, daarvoor zullen aanvullende assumpties moeten worden gemaakt. Het boek gaat daarenboven niet in op het veranderen van cultuur; cultuuronderzoek is hier aldus een doel op zich. Het onderzoek naar bovenstaande onderzoeksvragen wordt derhalve uitgevoerd binnen de volgende kaders: (1) het cultuurmodel van Schein en de empirische cyclus van De Groot; (2) cultuur als waardevrij concept dat middels onderzoek ontcijferd dient te worden; (3) de essentie van cultuur ligt grotendeels verborgen voor de dragers ervan; en (4) het onderzoek naar cultuur is een nuttige bezigheid. Idealiter wordt een cultuuronderzoek in nauwe samenwerking met de klantorganisatie uitgevoerd omdat dit bijdraagt aan de acceptatie van het resultaat.

Het cultuurmodel van Schein staat hier verder niet ter discussie. Zijn integratiestandpunt (één universele cultuur) wordt in sommige gevallen echter verdrongen door een differentiatiestandpunt (verschillende, naast elkaar opererende subculturen) maar zeker niet door een fragmentatiestandpunt (de nadruk ligt hier op de dynamiek in de organisatie en de zingeving door de leden).

De zes artikelen waaruit dit boek bestaat kunnen langs de vijf stappen van de empirische cyclus van De Groot worden gelegd, waarbij de meer theoretische stappen, gezien de onderzoekvragen, de meeste aandacht krijgen. De 'observatie- en inductiestappen' worden gerepresenteerd door Hoofdstuk 1. Hoofdstukken 2 en 3 omvatten tezamen de 'deductiestap'. 'Toetsing' vindt plaats middels Hoofdstuk 4 en de 'evaluatie' van het concept van veiligheidscultuur vindt ten slotte plaats aan de hand van Hoofdstukken 5 en 6.

Hoofdstuk 1

Hoofdstuk 1 betreft een in 2000 gepubliceerde literatuurstudie naar de begrippen veiligheidscultuur en veiligheidsklimaat. Geconstateerd wordt dat er in de afgelopen 20 jaar weliswaar veel onderzoek naar veiligheidscultuur en -klimaat is uitgevoerd, maar dat de theoretische ontwikkeling van beide concepten hierbij is achtergebleven.

Het concept van veiligheidscultuur vindt zijn oorsprong in de concepten van organisatiecultuur en -klimaat. Theorievorming rond organisatiecultuur is aanvankelijk begonnen onder de noemer organisatieklimaat, maar de betekenis van dit laatste begrip werd later beperkt tot het psychologische klimaat in een organisatie en is geleidelijk verdrongen door het begrip organisatiecultuur. Dit laatste begrip verwijst nu naar de sterke overtuigingen, assumpties en dogma's in een organisatie, die zich o.a. manifesteren in het meer oppervlakkige organisatieklimaat.

Organisatiecultuur heeft een aantal kenmerken waarover brede consensus bestaat: (1) het is een construct; (2) het is stabiel; (3) het is meerdimensionaal; (4) het wordt gedeeld door (groepen) mensen; (5) het bestaat uit verschillende aspecten; (6) het betreft voornamelijk praktijken. Aangaande dit laatste aspect is men echter wat minder unaniem. Ten slotte wordt cultuur doorgaans gemodelleerd als een kern met daaromheen verschillende lagen en wordt (7) cultuur als functioneel beschouwd.

Organisatiecultuur en -klimaat zijn complexe concepten. Bijvoorbeeld, dient cultuur beschouwd te worden als een kenmerk van een organisatie of is het een kenmerk van de individuen daarin? Anders gezegd: *is* een organisatie een cultuur of *heeft* zij een cultuur? Daaraan gerelateerd is de vraag of een cultuur een aspectsysteem is of een subsysteem. En welke (causale) rol speelt cultuur of klimaat in een organisatie? Het is belangrijk om de lagen in bovengenoemd model goed gescheiden te houden opdat oorzaak en gevolg niet door elkaar raken. Echter, voordat er sprake kan zijn van 'een cultuur' of 'een klimaat' moet een groep een zekere mate van homogeniteit vertonen en dit dient te worden getoetst middels statistieken. Genoemde discussiepunten gaan eveneens in gelijke mate op voor de concepten veiligheidscultuur en -klimaat.

Veiligheidscultuur en -klimaat worden door verschillende onderzoekers verschillend gedefinieerd; deze definities zijn bovendien doorgaans vrij impliciet. Het onderzoek naar beide constructen is meestal praktisch gericht maar dient daarnaast eveneens een theoretisch doel. De meest gebruikte onderzoekstechniek is de schriftelijke vragenlijst, die hetzij door het onderzoeksteam zelf is ontwikkeld, of gebaseerd is op het werk van Zohar.

Sociaalwetenschappelijke constructen zijn meestal meerdimensionaal. Indien gebruik gemaakt is van een vragenlijst dan worden de antwoorden hierop doorgaans geanalyseerd met PCA-gerelateerde technieken, die één of meer (orthogonale) dimensies opleveren. Bij het gebruik hiervan kunnen echter meerdere methodische kanttekeningen worden geplaatst. Zo loopt het aantal dimensies

afkomstig uit veiligheidsklimaatonderzoek uiteen van 2 tot 19, maar gezien de kanttekeningen zowel als de subjectiviteit bij het benoemen van dimensies, kan dit aantal waarschijnlijk aanzienlijk worden teruggebracht. Ook dient er meer aandacht te komen voor het aggregeren van data naar verschillende niveaus. Op dit moment is hier nog te weinig aandacht voor in de literatuur.

Een model van veiligheidscultuur kan bij het interpreteren van vragenlijstresultaten behulpzaam zijn. Verschillende modellen zijn inmiddels geopperd, maar geen van deze modellen beschrijft zowel de oorzaak, inhoud als het gevolg van veiligheidscultuur; de nadruk ligt vooral op de inhoud en het gevolg ervan. Het eerder genoemde model van Schein kan hier gebruikt worden om cultuur en klimaat ten opzichte van elkaar te positioneren.

Naast vragenlijstonderzoek zijn er een aantal andere technieken ontwikkeld waarmee veiligheidscultuur kan worden onderzocht of veranderd: de vijf actieplannen van de Total Safety Culture van Geller; het normatieve raamwerk van de INSAG; de veiligheidscultuuraudit van Ludborsz en de Safety Culture HAZOP van Kennedy. Pidgeon positioneert veiligheidscultuur in een meer uitgebreid krachtenveld waarin ook, bijvoorbeeld, de gehele industrietak en de politiek een rol spelen.

Hoewel theoretische vooruitgang is geboekt, is het jammer dat er geen integraal raamwerk voor onderzoek is ontwikkeld. Uit de voorgaande bespreking kan verder het volgende worden opgemaakt:

1. veiligheidscultuur en -klimaat zijn nog immer slecht gedefinieerd en onvoldoende uitgewerkt;
2. de relatie tussen veiligheidscultuur en -klimaat is onduidelijk;
3. er is verwarring over de oorzaak, de inhoud en het gevolg van een veiligheidscultuur;
4. er is geen bevredigend model van beide concepten; en
5. het aspect van aggregatie heeft onvoldoende aandacht gekregen.

Op basis van een attitudemodel van Eagly & Chaiken en de drie componenten van het model van Schein kan een model geponeerd worden dat veiligheidscultuur en veiligheidsklimaat verenigd. Veiligheidsklimaat is hierin gelijk aan veiligheidsattituden en deze vallen dan samen met de beleden waarden uit Schein's model. Verschillende attitudeobjecten kunnen nu benoemd worden. Deze kunnen worden ondergebracht in vier brede klassen: hardware (o.a. materiaal, omgeving), software (o.a. procedures, training), mensen (o.a. leidinggevenden, collega's) en gedrag (o.a. veiligheidsgedrag, communicatie). Veiligheidscultuur bestaat uit de gedeelde basisassumpties in de organisatie, die niet specifiek voor veiligheid geformuleerd behoeven te zijn. Zowel het model van Eagly & Chaiken als de zes dimensies van Schein kunnen als leidraad dienen voor het bepalen van de inhoud van deze assumpties.

Op grond van het voorafgaande kan veiligheidscultuur gedefinieerd worden als: die aspecten van de organisatiecultuur die een impact hebben op de attituden en het gedrag met betrekking tot het verhogen of verlagen van risico.

Ten slotte, het nut van het doen van veiligheidscultuur- en -klimaatonderzoek is vooralsnog onvoldoende aangetoond. Veiligheidsklimaat kan wellicht dienen als prestatie-indicator, maar dan dient er een significante relatie tussen dit concept en de veiligheidsprestatie worden aangetoond. Toekomstige aandacht dient dan meer uit te gaan naar de validiteit van beide concepten dan naar de ontwikkeling van 'nieuwe' instrumenten om veiligheidsklimaat te bepalen.

Het nawoord van Hoofdstuk 1 brengt de literatuurbespreking *up-to-date* aan de hand van de volgende belangrijke aspecten: (1) het verschil tussen veiligheidscultuur en veiligheidsklimaat; (2) de definitieve definitie van veiligheidscultuur; (3) een model voor veiligheidscultuur en; (4) de keuze tussen een kwantitatieve en een kwalitatieve onderzoeksbenadering.

Ad 1. Volgens Denison hebben veiligheidscultuur en veiligheidsklimaat niet zozeer betrekking op verschillende organisatorische fenomenen, maar zijn het eerder verschillende interpretaties van dezelfde fenomenen. Veiligheidscultuur legt meer de nadruk op de geschiedenis en de context van de organisatie. Veiligheidsklimaat benadrukt de huidige situatie en de invloed daarvan op de medewerkers. Bij veiligheidscultuur gaat het dus meer om *begrijpen* en bij veiligheidsklimaat meer om *veranderen*.

Ad. 2. Veiligheidscultuur is lastig operationeel te definiëren omdat van te voren niet duidelijk is hoe een cultuur zich manifesteert. In het onderzoek naar veiligheidsklimaat gaat de aandacht meer en meer uit naar het formuleren van veiligheidsbeleid en de uitvoer en handhaving van veiligheidsregels. Het recente raamwerk dat Zohar heeft geponeerd, waarin hij veiligheidsklimaat combineert met werkeigenaarschap en beide op verschillende niveaus definieert, zal het klimaatonderzoek van de komende jaren stimuleren. De casestudy van Brooks, waarin hij Dawkins' notie van *memes* en de zes dimensies van Schein hanteert als kapstok voor de veiligheidscultuur van een klein bedrijf, zal cultuuronderzoekers eveneens inspireren.

Ad 3. Modellen behoren vooral tot het domein van het veiligheids*klimaat*onderzoek waar zij worden gebruikt om statistische verbanden tussen concepten en, bijvoorbeeld, prestatie-indicatoren te onderzoeken en te toetsen. Er zijn niet veel modellen voor veiligheids*cultuur* voorhanden maar met een verzameling casestudies die elk op dezelfde manier zijn uitgevoerd, kan wellicht een algemeen model of een taxonomie van veiligheidsculturen worden ontwikkeld.

Ad. 4. Ten slotte, over het gebruik van hetzij een kwalitatieve, hetzij kwantitatieve onderzoeksmethodologie is geen controverse ontstaan. De keuze voor een methodologie lijkt eerder een kwestie van voorkeur dan van theoretische noodzaak.

Meer recente overzichtsartikelen proberen het begrip van veiligheidscultuur verder uit te diepen en praktisch hanteerbaar te maken; bijvoorbeeld voor HSE inspecteurs in de UK (Collins & Gadd), de nucleaire industrie (Sorensen) of de bouwindustrie (Choudry et al.). Glendon vat het veiligheidscultuur en -klimaatonderzoek samen in een diagram en geeft aan waar de lacunes zijn. Hij is voorstander van een hybride aanpak (kwantitatief en kwalitatief) en stelt voor de aandacht van onderzoek eveneens te richten op het midden- en kleinbedrijf zowel als minder ontwikkelde economieën. Daaraan voeg ik de cultuur van beroepsgroepen toe.

Hoofdstuk 2

Het gebruik van vragenlijsten in veiligheidscultuuronderzoek wordt in Hoofdstuk 2 verder uitgediept. De vragenlijst is de meest gebezigde techniek in veiligheidsklimaatonderzoek. Wat betreft dit onderzoek kunnen vooraf de volgende observaties worden gedaan:

1. er is een groot aantal dimensies, of factoren voor veiligheidsklimaat in omloop, die teruggebracht kunnen worden tot een beperkte set thema's;
2. in driekwart van de studies is sprake van een managementfactor, in tweederde een factor die naar het veiligheidssysteem refereert;
3. factoroplossingen blijken lastig repliceerbaar;
4. de empirische relatie tussen veiligheidsklimaat en veiligheidsprestatie is zwak.

Vragenlijstonderzoek kan als snel maar onnauwkeurig worden getypeerd. Betoogd wordt dat vragenlijstgegevens veel ruis (kunnen) bevatten, o.a. omdat het doorgaans een meting op ordinaal niveau betreft, de data soms te heterogeen zijn en de populaties te klein zijn om de ruis voldoende uit te middelen. Daarnaast wordt (andermaal) voorgesteld om veiligheidsklimaatonderzoek 'attitudeonderzoek' te noemen. Een vragenlijst biedt daarom slechts ruwe data voor cultuuronderzoek, geen kant-en-klare uitkomsten.

Veiligheidsattituden behoeven objecten – elke attitude heeft namelijk een object – en, gezien de verschillende lagen waaruit een organisatie bestaat, is het van belang deze voor verschillende niveaus te identificeren. Hier worden drie niveaus binnen de organisatie onderscheiden, die door vele anderen ook worden gehanteerd: het (hoogste) *organisatieniveau*, het *groepsniveau* (*inclusief* de supervisor) en het *individuele niveau*. Gelet op de resultaten afkomstig uit vragenlijstonderzoek, blijkt dat de belangrijkste factoren die dit onderzoek oplevert, betrekking hebben op het hoogste organisatorische niveau.

Met behulp van het Delfts model van veiligheidsmanagement, dat bestaat uit negen verschillende elementen (risico's, hardware, onderhoud, procedures, personele planning, competenties, toewijding [*commitment*], communicatie en monitoren & verandering), is het mogelijk attitudeobjecten te definiëren op de drie niveaus voor ieder van deze negen elementen.

Als aangenomen wordt dat veiligheidsklimaatonderzoek in feite attitudeonderzoek is, dan kan eveneens worden betoogd dat de resultaten hiervan een sterk affectieve component met betrekking tot het management van de organisatie hebben. Omdat attituden doorgaans bestaan uit een cognitieve, een gedragsmatige of een affectieve component, en de eerste twee voor uitvoerend personeel minder relevant zijn, lijken de resultaten van veiligheidsklimaatstudies dus vooral een evaluatie van het management op te leveren, gebaseerd op affect.

Aanvullend wordt betoogd dat, indien er factoren worden gevonden die een substantieel deel van de variantie in de data verklaren, dit mag worden opgevat als overeenstemming binnen de organisatie over het onderwerp dat de factor beschrijft. Indien het onderwerp van de factor een attitudeobject is op organisatorisch niveau, dan betekent dit dat verondersteld mag worden dat er binnen de organisatie overeenstemming bestaat over dit object. Indien het onderwerp een attitudeobject betreft op groepsniveau, dan betekent dit dat verondersteld mag worden dat er overeenstemming bestaat over dit onderwerp op *zowel* groeps- als organisatorisch niveau binnen de organisatie over dit attitudeobject.

Aan een organisatie kunnen drie niveaus onderscheiden worden: de structuur, de processen en de cultuur. Deze aspecten staan in een onderling dynamisch verband. Veiligheidsmanagementprocessen op het hoogste niveau bepalen de feitelijke ervaring en beleving van veiligheid van de werknemers op de niveaus daaronder, daarbij gebruikmakend van de organisatiestructuur. De organisatiecultuur is hiervan zowel een product als een determinant.

De empirische relatie tussen veiligheidsklimaat en veiligheidsprestatie is niet overtuigend. Dit kan verschillende oorzaken hebben, waaronder de veronderstelling dat sommige klimaatcomponenten (o.a. een algemene evaluatie van het veiligheidsbeleid) geen directe relatie hebben met het plaatsvinden van, bijvoorbeeld, ongevallen.

Concluderend wordt gesteld dat de belangrijkste dimensies van veiligheidsklimaat een algemene evaluatie opleveren van het vigerende veiligheidsmanagement. Dit management is gemodelleerd aan de hand van negen samenhangende processen. Naast deze werkgerelateerde processen spelen ook waarden met betrekking tot veiligheid een rol. Deze waarden zijn echter moeilijk via een vragenlijst te bepalen, maar zullen herkenbaar zijn in de realisatie van de negen managementprocessen. Een audit waarin de kwaliteit van de negen managementprocessen wordt bepaald, maar waarin eveneens ruimte is gemaakt voor het onderzoeken van organisatorische waarden met betrekking tot veiligheid, lijkt een ideale, holistische manier om de organisatorische driehoek van een organisatie te evalueren.

In tegenstelling tot wat eerder in het hoofdstuk wordt gemeld, geven de statistieken ICC(1) en ICC(2) geen indicatie van overeenstemming, maar van betrouwbaarheid; andere statistieken voor overeenstemming zijn ontwikkeld.

Meer recent veiligheidsklimaatonderzoek concentreert zich op het bestaan, de ontwikkeling en handhaving van veiligheidsbeleid en –procedures. Om een duidelijker relatie met veiligheidsuitkomsten te kunnen leggen (meestal gedrag

of incidenten/ ongevallen) zijn twee intermediërende variabelen in het leven geroepen: volgzaamheid (*compliance*) en participatie.

Veiligheidsklimaatonderzoek kan uitnodigen tot bureauonderzoek, maar als cultuur in het geding is, dan is dit niet wenselijk. Daarnaast dient meer aandacht uit te gaan naar de (kwaliteit van de) oordelen of adviezen die op basis van een veiligheidsklimaatstudie worden gegeven; volgens Cronbach is dit de belangrijkste indicator van validiteit.

Hoofdstuk 3

In dit hoofdstuk wordt een overzicht gegeven van de belangrijkste gereedschappen die worden gebruikt in cultuuronderzoek; de nadruk ligt op toegepast onderzoek. De gereedschappen worden van buiten naar binnen besproken in de volgorde van het model van Schein; eerst de gereedschappen om artefacten in kaart te brengen, dan die voor beleden waarden, en tot slot zijn de basisassumpties aan de beurt. Eerst wordt echter het onderzoeksproces besproken.

Het is op de eerste plaats belangrijk om een cultuuronderzoek te starten met een voor de klantorganisatie pregnant probleem om meer openheid en inzet van haar te krijgen. Het onderzoeksproces kan beschreven worden aan de hand van vijf stappen:

1. keuze onderzoeksparadigma;
2. keuze onderzoeksmethodologie;
3. keuze onderzoeksmethode;
4. keuze onderzoekstechniek;
5. keuze onderzoeksinstrument.

De eerste stap is de meest filosofische fase waarin het onderzoeksteam bepaalt hoe het de aard van hun werkelijkheid definieert. Traditioneel vloeit er automatisch hetzij een kwalitatieve, hetzij een kwantitatieve onderzoeksmethodologie uit voort, maar hier wordt een eclectische aanpak voorgestaan. Het model van Schein kan nu gebruikt worden om de verschillende lagen van cultuur verder te typeren en hierbij gereedschappen te kiezen.

Artefacten behoren tot het *Wat?* van een cultuur en kunnen worden verzameld via gedragsobservaties, documentanalyse of in geleide groepssessies. Artefacten zijn onontbeerlijk maar ambigue. Onderzoek van een team i.p.v. een enkele onderzoeker kan bezwaren van subjectiviteit enigszins ondervangen.

Beleden waarden vormen het *Waarom?* van een cultuur en worden verzameld aan de hand van schriftelijke vragenlijsten, persoonlijke interviews en focus group interviews. In het onderzoek naar veiligheidscultuur is deze laag een waardevolle aanvulling. Hoewel een onderscheid tussen beleden waarden en basisassumpties kan worden gemaakt, wil dit echter niet zeggen dat beide behoeven te verschillen.

Basisassumpties ten slotte, kunnen niet worden waargenomen maar dienen te worden afgeleid uit de verzamelde artefacten en beleden waarden. Er is geen

concreet protocol voorhanden om dit te doen; het is een creatief proces van vergelijken en zoeken naar één of meerdere grote gemene delers die de veelheid aan artefacten en beleden waarden en de congruenties en incongruenties daartussen kunnen verklaren. Basisassumpties kunnen door een buitenstaander worden ontcijferd, maar ook bestaat de mogelijkheid tot een zelfanalyse. Dit kan plaatsvinden middels een getrapte brainstormsessie of aan de hand van meer gestructureerde methoden zoals, bijvoorbeeld, Hearts & Minds.

De instrumenten zoals beschreven in dit hoofdstuk behoeven echter niet alleen ingezet te worden om basisassumpties te ontcijferen en de invloed daarvan op veiligheid en risico te bepalen. Afzonderlijke instrumenten leveren op zichzelf nuttige informatie op over gedrag of de beleving van werknemers.

Bij de aanvang van een veiligheidscultuurstudie dient het onderzoeksteam zich te beraden over zijn aannamen over de aard van cultuur alvorens tot een keuze van de methodologie etc. over te gaan. Echter, het paradigma moet niet als oogkleppen gaan functioneren, de probleemstelling [van het bedrijf] moet meer leidend zijn. Gaat het om de betekenis van artefacten en beleden waarden dan is de studie noodzakelijkerwijs dieper dan wanneer het om de huidige status van deze artefacten en beleden waarden gaat. De volgende stap behelst dan het verzamelen en zeven van data om hieruit een betrouwbaar, valide en bruikbaar antwoord te destilleren. Hoewel een onafhankelijk team waarschijnlijk de objectiviteit en betrouwbaarheid van de dataverzameling vergroot, is een team waarvan ook leden van de organisatie deel uitmaken het overwegen waard.

De verwerking van kwalitatieve data kent een eigen proces van verschillende stappen. Visualisatie of groepering van dergelijke data kan helpen deze te interpreteren, alsook het gebruik van computersoftware. Echter het blijft een lastige onderneming, die kan worden verlicht door leden van de organisatie in het volledige onderzoeksproces te betrekken.

Concluderend wordt gesteld dat een vakman meer is dan een persoon met een gereedschapskist. Filosofische zowel als praktische overwegingen bepalen het onderzoek naar veiligheidscultuur. Een slaafs gebruik van instrumenten wordt ontmoedigd alsook een onheus (of onmachtig) gebruik van het concept van veiligheidscultuur.

Hoofdstuk 4

Na het overzicht van alle instrumenten om veiligheidscultuur te bestuderen, wordt nu een casestudy van een Nederlands inspectiebedrijf besproken aan de hand van een aantal van deze instrumenten. De leiding van het bedrijf was geïnteresseerd in de veiligheidspercepties van zijn werknemers en de communicatieve ondersteuning die men daarbij van het hoofdkantoor ontvangt. Omdat werknemers veelal alleen of in kleine groepjes buitenshuis werken, was men eveneens benieuwd naar de handhaving van de regels, vooral als deze de uitvoer van het werk lijken te belemmeren of te vertragen.

Voor de studie is gebruik gemaakt van drie afzonderlijke benaderingen: de academische, de analytische en de praktische benadering Deze benaderingen worden in Hoofdstuk 5 in detail uitgewerkt. De benaderingen leiden tot de volgende onderzoeksmethoden; een schriftelijke vragenlijst ontwikkeld door Zohar & Luria, semi-gestructureerde interviews en focusgroups (groepsinterviews) en het afnemen van de Hearts & Minds matrix tijdens de focusgroups.

De analyse van de vragenlijst middels PCA levert drie maal twee componenten op: één set van twee componenten die betrekking heeft op de bedrijfsleiding (M_1 & M_2), één set van twee componenten die betrekking heeft op de direct leidinggevenden (S_1 & S_2) en één set van twee componenten die betrekking heeft op het uitvoerend personeel (W_1 & W_2). Iedere set bestaat globaal uit een component die *compliance* representeert (conventionele veiligheid) en een component die een pro-actieve instelling aangeeft. De analyse van de focusgroup interviews van twee groepen werknemers levert respectievelijk zeven en twaalf ontwerpen op, waarvan er drie overlappen. De analyse van de Hearts & Minds matrix, afgenomen bij zowel het MT als werknemers levert, over het algemeen, een 'reactief' beeld op. De interviews ten slotte, leveren uiteenlopende onderwerpen op waarvan er 21 tweemaal of meer worden genoemd. De dagelijkse gang van zaken (w.o. cultuur), veiligheid en de verschillende overnames worden het meest genoemd.

Gebruik makend van de demografische vragen in de vragenlijst kunnen vervolgens verschillen op de zes componenten worden getoetst. De meeste, statistische significante, verschillen worden gevonden op de componenten S_1 en S_2. Met behulp van de zes componenten worden vervolgens lineaire regressievergelijkingen opgesteld voor W_1 en W_2. W_1 wordt het best voorspeld door M_1 en S_2; W_2 wordt het best voorspeld door M_2, S_1 en S_2.

Met behulp van bovenstaande resultaten is een antwoord op hun vraag en een uitgebreid advies aan het bedrijf gegeven dat het belang van een verdere ontwikkeling van het veiligheidsmanagementsysteem benadrukt en het vertrouwen tussen werkvloer en leiding vergroot. Hierdoor kan belangrijke informatie meer vrij door de organisatie gaan stromen. Daarnaast wordt aandacht gevraagd voor de rol van de direct leidinggevenden en planners.

In het nawoord van Hoofdstuk 4 wordt dieper ingegaan op het ontcijferen van de basisassumpties van onderhavig bedrijf. Deze basisassumpties worden geclassificeerd volgens de zes dimensie van Schein, i.e. de aard van de [1] werkelijkheid en de waarheid; [2] tijd; [3] ruimte; [4] menselijke natuur; [5] menselijke activiteit en; [6] menselijke relaties. De klant is koning is een dominante assumptie bij dit bedrijf, maar ook andere assumpties lijken een belangrijke doorwerking op de veiligheid te hebben.

Afsluitend worden de verschillende dataverzamelingstechnieken andermaal besproken en wordt bezien in hoeverre de resultaten die zij opleveren 'waarheidsgetrouw' dan wel 'bruikbaar' (of relevant) zijn; dit hoeft namelijk niet altijd hetzelfde te zijn. Als de techniek goed wordt toegepast, levert dit waarheidsgetrouwe resultaten op, althans binnen de aannamen die voor het instrument

gelden. De bruikbaarheid van de gegevens kan slechts in de praktijk en na enige tijd beoordeeld worden.

Hoofdstuk 5

In dit hoofdstuk wordt het concept van veiligheidscultuur en de theoretische grondslag ervan andermaal kritisch onder de loep genomen en besproken in de grotere context van organisatiecultuur en nationale cultuur. Op basis van gepubliceerd empirisch onderzoek kunnen drie benaderingen onderscheiden worden:

– de academische benadering;
– de analytische benadering;
– de praktische benadering.

De academische benadering valt grofweg samen met etnografisch veldonderzoek, dat vooral is uitgevoerd in de antropologie en sociologie. Dit is een, in principe, waardevrije studie naar de betekenis die de leden of dragers van een cultuur hechten aan de waarneembare aspecten van hun cultuur Met andere woorden, alle verzamelde data dienen te worden ontcijferd en geïnterpreteerd in het licht van een onderliggende cultuur, alsook de relatie met veiligheid. De uitkomst is een uitgebreide beschrijving of een theorie van de cultuur van een organisatie. Het gaat in deze benadering vooral om het begrijpen van een cultuur en men kijkt daarbij voornamelijk naar het *verleden* van een organisatie. Cultuur is daarbij iets dat een organisatie *is*, i.e. de organisatie is doordrenkt van cultuur.

De analytische benadering maakt vooral gebruik van schriftelijke vragenlijsten waarmee, doorgaans van te voren bepaalde, dimensies worden gescoord. Dergelijke gegevens kunnen vervolgens statistisch worden getoetst en vergeleken. Het is echter van belang bepaalde aspecten van dergelijk onderzoek niet uit het oog te verliezen. De data afkomstig van vragenlijstonderzoek worden vaak, zonder controle vooraf, geanalyseerd alsof er sprake is van een interval meetniveau. Omdat het bij dit type onderzoek gaat om een eigenschap van een *groep*, dient eveneens gecontroleerd te worden of de data voldoende coherentie vertonen. Ten slotte, groepen moeten kunnen worden geïdentificeerd met betrekking tot betekenisvolle organisatorische niveaus. Binnen dergelijke groepen zal voldoende gelegenheid kunnen bestaan tot de vorming van gedeelde opvattingen. In deze benadering kijkt men naar de *huidige staat* van de cultuur van een organisatie en cultuur is daarbij vooral iets dat een organisatie *heeft*.

De pragmatische benadering gaat primair uit van de meningen van experts over veiligheidscultuur en maakt daarbij gebruik van verschillende niveaus of ontwikkelingshiërarchieën. De nadruk in deze benadering ligt op verandering en verbetering; met andere woorden, op de *toekomst* van een organisatie. Cultuur wordt hier in interactie met organisatiestructuur en -processen beschouwd.

Sterker nog, de benadering richt zich vooral op de organisatorische processen om aan de hand daarvan de veiligheidscultuur te beïnvloeden.

Het onderzoek naar cultuur kent aldus reeds een lange traditie in zowel de antropologie als de sociologie. Een belangrijke functie van cultuur is het reduceren van onzekerheid waardoor ook meer continuïteit in het dagelijks leven wordt verkregen. Cultuur is het gevolg van gewenning en aanpassing, wat weer verband houdt met het voortbestaan van een groep. Het blijkt lastig om cultuur eenduidig te definiëren omdat het nu eenmaal een complex en 'vaag' begrip is dat zowel attituden, overtuigingen, assumpties, waarden als allerhande gedragsmatige conventies omvat. Hierdoor zijn mensen wél in staat zich in uiteenlopende situaties te handhaven en het gedrag van anderen daarin te begrijpen. Cultuur wordt wel eens opgevat als de collectieve programmering van de geest en gecontrasteerd met de menselijke natuur (gedeeld met iedereen) en de persoonlijkheid (individueel).

Wat het bepalen of meten van culturen betreft, verschillen onderzoekers van mening of deze feitelijk onderling vergelijkbaar zijn. Een zinvolle vergelijking impliceert namelijk een gemeenschappelijke set van aspecten, facetten of dimensies. Anderen zijn echter van mening dat deze set niet bestaat en dat iedere cultuur daarom uniek is.

Over het algemeen wordt een cultuur gemodelleerd als een kern met daaromheen twee of meer lagen. De lagen omvatten de (waarneembare) manifestaties van de cultuur, waarvan de essentie zich in de kern bevindt. Onderzoekers verschillen van mening welke onderdelen van dit model op organisaties van toepassing zijn. Sommigen stellen dat een organisatie zelf een stabiele cultuurkern kan verwerven. Anderen menen dat het wezen van een organisatiecultuur slechts tot de meer oppervlakkige schillen beperkt blijft. De cultuurkern heeft een diepe, fundamentele betekenis voor hen.

Cultuur werd aldus later eveneens betrokken op organisaties. Volgens Schein is cultuur zowel het product van de oprichter van het bedrijf als het resultaat van adaptatie en integratie. Het bestaan van een organisatiecultuur is echter geen vaste regel maar dient empirisch vastgesteld te worden. Men onderscheidt een integratie-, differentiatie- en fragmentatieperspectief. Het integratieperspectief is lastig houdbaar gebleken dus tegenwoordig onderkent men binnen een organisatie meerdere subculturen.

Hoewel de drie beschreven benaderingen van veiligheidscultuur met elkaar conflicterende elementen bevatten, is het wellicht toch zinnig om deze drie in onderzoek te gaan verenigen. Het uiteindelijke resultaat hiervan kan dan uitmonden in een goed onderbouwde, geordende typologie aan de hand waarvan de veiligheidscultuur van organisaties beschreven en wellicht zelfs beïnvloed kan worden.

Vreemd genoeg komt de relatie tussen veiligheidscultuur en veiligheidsmanagement in de literatuur slechts zelden aan de orde. Veiligheidsmanagement heeft met name betrekking op organisatorische processen, maar zal ook herkenbaar zijn in de organisatiestructuur. Omdat, volgens de dynamiek van de

organisatorische driehoek, de structuur en processen de cultuur beïnvloeden (en vise versa), heeft veiligheidsmanagement een directe relatie met veiligheidscultuur. Een veiligheidsmanagementsysteem kan daarnaast ook goed dienen als een raamwerk dat betekenis en richting geeft aan (veilig) gedrag van de werknemers.

Hoofdstuk 6

In het laatste hoofdstuk worden de huidige benaderingen van veiligheidscultuur getypeerd aan de hand van een beeld, een metafoor. Metaforen zijn handig, omdat middels één beeld een vaak complexe omstandigheid kan worden geïllustreerd. Anderzijds hebben metaforen ook hun beperking en dienen zij niet te letterlijk te worden opgevat. Achtereenvolgens worden de volgende beelden van veiligheidscultuur geïntroduceerd:

- Het net – de wetenschappelijke benadering
- Het luchtkasteel – het religieuze perspectief
- Het attenderend begrip – het onbepaalde perspectief
- De spiegel – het ontwikkelingsperspectief
- Het ding – het instrumentele perspectief
- Veiligheidscultuur als essentieel aanvechtbaar concept

De *wetenschappelijke benadering* van veiligheidscultuur wordt gerepresenteerd door het beeld van het *net*. Hiermee wordt gerefereerd naar het nomologische netwerk van concepten en observaties waarmee een wetenschappelijk construct kan worden weergegeven. Concepten zijn hierin met observaties verbonden door middel van de empirische cyclus. Echter, voordat een construct als cultuur kan worden onderzocht dient een wetenschapper zich eerst te vergewissen van zijn of haar aannamen over de aard van de werkelijkheid. Is er een werkelijkheid te onderscheiden los van deze wetenschapper, of is de wetenschapper sterk vervlochten met deze werkelijkheid? In het laatste geval is het onderzoek dat de wetenschapper verricht een persoonlijk product van zijn of haar geest dat niet los daarvan kan worden gezien. In het eerste geval is er sprake van een objectiveerbare werkelijkheid en kunnen de producten van het onderzoek ook een vergelijkbare objectieve status verkrijgen. In dit boek wordt voor een participatieve benadering gepleit, waarin de wetenschapper samen met de cliënt (het bedrijf) de cultuur gaat onderzoeken. Hiermee wordt tevens voorkomen dat het eindresultaat hetzij te algemeen, hetzij te specifiek is.

Binnen de wetenschappelijke benadering worden zowel kwalitatieve als kwantitatieve data verzameld. Kwantitatieve data worden doorgaans verzameld middels schriftelijke vragenlijsten; men spreekt hier eigenlijk van veiligheids*klimaat*. Het meten van veiligheidsklimaat richt zich steeds meer op het bepalen van de mate waarin veiligheidsbeleid en –regels aanwezig zijn en worden gehandhaafd.

De *religieuze benadering* van veiligheidscultuur gaat vergezeld van het beeld van het luchtkasteel. Veiligheidscultuur is in deze benadering een staat van genade, een bijna onbereikbaar ideaal dat slechts voor weinigen is weggelegd. Het uiteindelijk ideaal kan meer concreet omschreven zijn, maar blijft doorgaans onbestemd. In het laatste geval ook omdat eenvoudigweg niet voldoende bekend is wat een dergelijk ideaal zou kunnen inhouden. Daarnaast zou een meer concreet omschreven staat de illusie kunnen geven dat het doel bereikt is en dit zou dan zelfgenoegzaamheid in de hand kunnen werken. Hoewel het doel noodzakelijkerwijs vaag is, de weg ernaar toe is daarentegen een vast, beproefd proces of patroon dat hardnekkig gevolgd dient te worden; een iteratief proces dat doorgaans gelijk is aan of grote gelijkenis vertoont met Deming's bekende PDCA-cirkel (Plan – Do – Check/ Study – Act/ Adjust). Dit proces is eveneens herkenbaar in belangrijke kwaliteits– en veiligheidsmanagementsystemen.

Het *attenderend begrip* is bedacht door de Amerikaanse socioloog Herbert Blumer. Hij wilde hiermee het empirisch onderzoek in de sociale wetenschappen een nieuwe impuls geven; theoretische concepten zouden door het gebruik van dergelijke concepten meer gegrond worden in de empirie. Een attenderend begrip is een zorgvuldig gekozen term of korte expressie met een sterk evocatief karakter. Dat wil zeggen, het attenderend begrip roept een duidelijk en richtinggevend beeld van een concept op wat de onderzoeker helpt zijn of haar data beter te kiezen en te interpreteren en staat dus haaks op, bijvoorbeeld, een operationeel begrip. Attenderende begrippen staan niet op zichzelf maar dienen om tot een conceptueel raamwerk te komen. Grounded theory kan beschouwd worden als een verdere uitwerking van het attenderend begrip, maar het is ook herkenbaar in het gebruik van basisassumpties zoals Schein dat doet. Aanvullend kan gesteld worden dat het concept veiligheidscultuur zoals door het INSAG naar aanleiding van de ramp in Chernobyl gelanceerd, feitelijk als attenderend begrip kan worden aangemerkt en dus niet als definitief of verklarend begrip. Voldoende kwalitatieve studies kunnen op den duur leiden tot een conceptueel raamwerk voor veiligheidscultuur.

Het *ontwikkelingsperspectief* is gekoppeld aan het beeld van de spiegel. Organisaties willen doorgaans weten waar zij zich bevinden in hun ontwikkeling wat veiligheid betreft en hebben daarbij baat bij een instrument dat hen een spiegel voorhoudt. Een dergelijke aanpak veronderstelt het bestaan van een ontwikkelingstraject of hiërarchie. Rangorden komen regelmatig voor in de wetenschap; genoemd worden de hiërarchieën van Piaget, Kohlberg en Maslow. Een voorloper op het gebied van organisaties is Crosby's Quality Management Maturity Grid waarop (waarschijnlijk) een drietal benaderingen voor het bepalen van de ontwikkeling van een veiligheidscultuur zijn gebaseerd: de Safety Culture Maturity Matrix (SCMM), de drie niveaus van Westrum en de daarop weer gebaseerde Hearts & Minds (H&M). Alle benaderingen maken gebruik van zgn. behaviourally anchored rating scales; posities op een rangorde worden gescoord met behulp van (zichtbare, gedragsmatige) omschrijvingen. Ondanks de aantrekkelijke kanten aan deze aanpak, gaat het natuurlijk nog steeds om een

verbale respons. Bovendien is er geen empirisch onderzoek voorhanden waaruit blijkt dat het verloop van ontwikkeling van een veiligheidscultuur langs de voorgestelde hiërarchieën verloopt.

Veiligheidscultuur als ding ofwel het *instrumentele perspectief* behandelt de reïficatie van het concept veiligheidscultuur. Reïficatie wordt in de hand gewerkt door een concept te operationaliseren, i.e. tastbaar, onderzoekbaar te maken. In cultuuronderzoek ligt reïficatie op de loer door een (te) eenzijdige nadruk op cultuurmanifestaties, i.e. artefacten (o.a. gedrag) en beleden waarden, of door een normatief gebruik van het concept van veiligheidscultuur (o.a. door het IAEA en diverse ontwikkelingshiërarchieën). Hoewel volgens de cognitieve dissonantietheorie een attitudewijziging kan volgen op een gedragswijziging, gaat het hier primair om individuele attituden, geen groepsattituden. Deze zijn niet in een handomdraai te wijzigen.

Het laatste perspectief vergelijkt veiligheidscultuur met kunst. De Engelse filosoof Gallie verzon het begrip *essentieel aanvechtbaar concept* om de onmogelijkheid te duiden overeenstemming te krijgen over het juiste gebruik van de term 'kunst'. Dit geldt niet alleen voor reeds bestaande kunstuitingen, maar ook voor alle uitingen die nog volgen. Gallie wilde met de term niet een verhit debat afdoen, maar aangeven dat er in de kern van een zeker begrip of concept een interne spanning heerst die dergelijke disputen aanwakkert. Gallie, maar ook filosofen na hem stelden een lijst van 16 kenmerken op waaraan een essentieel aanvechtbaar concept dient te voldoen. Later voegde Gallie ook 'cultuur' toe aan zijn lijst van essentieel aanvechtbare concepten. Het hoofdstuk sluit af met een scenario voor de toekomst, waarin het concept van veiligheidscultuur meer en meer zal gaan samenvallen met het onverzettelijk volgen van een cyclisch proces (het luchtkasteel) in plaats van het streven naar een vaststaand doel.

Epiloog

In de epiloog wordt specifiek ingegaan op het antwoord op de twee hoofdvragen die bij aanvang van het boek zijn gesteld.

Het gelaagde model van cultuur, een kern met daaromheen één of meer lagen, is een nuttige manier om het construct cultuur te benaderen. Het maakt enerzijds duidelijk dat cultuur meer is dan haar manifestaties en anderzijds dat er tussen de diverse lagen van het model verschillen kunnen bestaan, i.e. dat deze niet noodzakelijkerwijs samenvallen. In hoeverre organisaties een dergelijke kern ontwikkelen is een empirische vraag alsook de mate waarin deze kern daadwerkelijk plooibaar is.

Hoe veiligheidscultuur onderzocht dient te worden, hangt samen met wat er met de uitkomst van zo'n onderzoek gedaan wordt. Als een cultuur beschouwd wordt als iets waaraan men zich onherroepelijk moet aanpassen, kan dit onderzoek geheel waardevrij (non-normatief) uitgevoerd worden. Het is dan juist zaak dit zo waarheidsgetrouw (*truthful*, zie Hoofdstuk 4) mogelijk te doen omdat de uitkomst bepaalt hoe interventies of maatregelen eruit gaan zien. Als een

onderzoek wordt uitgevoerd om tot een cultuurverandering te komen, dan is dit onderzoek juist normatief en de norm zal de mate van verandering bepalen. Indien vervolgens wordt aangenomen dat organisatiecultuur, en dus ook veiligheidscultuur, samenvalt met de schillen van het model, en niet de kern, dan zullen beide benaderingen in de praktijk lastig van elkaar te onderscheiden zijn omdat maatregelen nu eenmaal aangepast dienen te worden aan lokale omstandigheden en dan zijn wij weer terug bij de eerste benadering.

Tot slot de vraag naar het nut van het onderzoek naar veiligheidscultuur. Sommige onderzoekers zijn van mening dat een set van (ongeveer) vier kernwaarden of basisassumpties voldoende is om mensen in een organisatie op een gewenste manier, en in geval van veiligheid, bedachtzaam te laten functioneren. Onderzoek zoals beschreven in dit boek moet uitwijzen of dit inderdaad zo is.

Acknowledgements

From the many years of this endeavour, Andrew Hale has been my supervisor and mentor. We have had innumerable discussions about What? How? Why? Why not? Explain, Elaborate and, especially, When? I am truly grateful for his enduring support and confidence in me.

John Kingston has been a kind of daily supervisor to me for the past two years. We talked about many things, and we even managed to talk about the book. I am thankful for his jovial support and for pointing out that 'The best is the enemy of the good'.

I would also like to thank my colleagues at the Safety Science Group in Delft for providing me with the space to work undisturbed on this project for longer periods of time. Pei-Hui Lin supplied the Chinese characters also seen in the (Japanese) woodcut on the cover.

A great many thanks go to my brother Jules for transforming this 'thesis' into a real and beautiful 'book'. Furthermore, Lindy Melman nitpicked through various drafts patiently and suggested subtle improvements.

This book has been some time in the making. The following people (in reverse alphabetical order) have proven to be quite indispensable during this process: Sandra Wielaert, Guus Teuns, Joy Oonk, Wilma Kleiboer, Sissy Hamers and Kees Cornelissen. Thank you so much!

Delfgauw, November 2009

Curriculum vitae

Frank Guldenmund was born in The Hague on January 5, 1960. There he attended the Edith Stein College and received his VWO-diploma in 1978. In 1985 he enrolled at Leiden University to study Psychology. He graduated *cum laude* in 1991 in both the directions Methods and Statistics ('Methoden en Technieken van Psychologisch Onderzoek') and Cognitive Psychology ('Functieleer'). In February 1992 he joined the Safety Science Group at Delft University of Technology, primarily as a methodologist but later became a full staff member, joining in the research and educational tasks of the Group. His research gradually became focussed on various aspects of safety management systems and the assessment of the quality and efficiency of these systems. Within this context his interest was raised in the topic of organisational safety culture, which he has been pondering since the late 90s.

Understanding and Exploring Safety Culture

Frank W. Guldenmund

The match between safety and culture was made around 1986, when the INSAG delivered its initial report on the Chernobyl accident. Whether the marriage is a happy one is still a matter of debate, but it is most definitely a fruitful one. In the past twenty years, many researchers have devoted much effort to both the theoretical development of the concept as well as its assessment. Moreover, various attempts have been made to relate the concept of safety culture to several other concepts as well as various safety performance indicators. It is, of course, the latter relationship that should provide safety culture with its raison d'être, because what would be the purpose of the concept of safety culture if it has nothing to do with safety (outcomes)?

This book brings together six papers written over a period of about ten years, which are devoted to the concept of safety culture and safety climate, and which reflect the overall aspiration to come to terms with both concepts, conceptually as well practically. This quest has been guided by the following research questions: What is safety culture actually and how can it be properly explored?

The first chapter provides a critical review of the safety culture literature. In the second chapter, the use of questionnaires, safety climate's preferred research technique, is explored in depth. In Chapter 3 the safety culture toolbox is opened and equipped; the toolbox is thereupon taken to Chapter 4, in which a full case study is described. In Chapter 5 the three broad approaches to the assessment of safety culture are outlined and discussed, and its relation with the process of safety management is deliberated. The book ends with a synthesis, a description of six images depicting the most prevalent viewpoints on safety culture.

ISBN 978-90-8891-138-5