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BOOK OF  
ABSTRACTS

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# Organisational Culture and Effect Sizes

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**Abstract:** There is a significant amount of data available concerning the statistical relationships between aspects of organisational culture and performance. However, much of the research considers only narrow aspects of culture or addresses the relationship from very different theoretical positions. This paper presents a new model of culture management (the CAS Organisational Culture Management Model) which provides a framework for understanding how the varying theoretical positions relate to each other and presents some initial research evidence on the size of the predictive relationships between different parts of the model and behaviour and performance. The evidence is drawn largely from two sources: a programme of strategic safety management assessments carried out with the senior management teams of 59 rail companies in the United Kingdom (including both train operators and infrastructure companies); and a set of safety culture assessments carried out with front line staff from a further 19, mainly construction and infrastructure, companies.

**Keywords:** Organisational Culture, Safety Culture, Safety Performance, Operational Performance

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## 1. INTRODUCTION – WHY IS CULTURE IMPORTANT?

Over the past 50 years, better and better technological and methodological solutions have become available for tackling the problems facing companies undertaking safety critical activities. A vast range of techniques which were not available even ten years ago have now been adopted as standard practice. So, why is it that companies are still failing to realise the full benefits and gains expected from these advances?

The problem, of course, is people. They just cannot be relied upon to do what you want them to do. Actually, this problem is not restricted to people. Anything which is not an automaton has a tendency to behave quirkily and even automatons are not entirely reliable.

This does not mean that behaviour is entirely unpredictable. Regularities can be found in the behaviour of most people and systems. The problem has been, and continues to be, how to achieve a greater understanding of the causes of unpredictability and, through this, how to eliminate those behaviours which are counter-productive or, in some cases, downright dangerous. Most recently in the UK, the legislative eye has begun to turn towards organisational culture as a key explanation of unpredictable and unreliable behaviour. This has happened in response to the finding that, once you have dealt with the more obvious aspects of personal competence, such as training, licensing, staff appraisals, responsibility statements, and the like, errors keep happening which are attributable to personal failings. The argument is that the beliefs, attitudes, values and opinions held by employees are not always conducive to consistent, dependable behaviour no matter what sorts of formal controls you have in place.

Lord Cullen [1], in the second part of his report on the train crash at Ladbroke Grove in West London in 1999, wrote that "there is a clear link between good safety and good business". Several implicit assumptions underpin this statement. For example:

- Organisations which are managed better will have better safety records.
- There will be significant positive correlations between safety performance and other aspects of organisational performance.
- Organisational culture will be related to organisational and safety performance.

There is evidence supporting all three of these assumptions. So, for example, Zacharatos et al [2] have presented evidence supporting the notion that workplaces characterised by high performance work systems result in safer performance. Similarly Barling et al [3] report that high quality work, characterised by good quality training, job variety and autonomy, is associated with lower workplace injury rates. The American Society of Safety Engineers [4] state that it "knows" from data and anecdotal evidence that investment in a Safety, Health & Environment programme is a sound business investment. A meta-analysis conducted by Viswesvaran et al [5] suggests that there is a strong general work performance factor and, in particular, reports high correlations between ratings of productivity, work quality and aspects of safety performance such as compliance with rules and procedures. In another meta-analytic study, Clarke [6] reports moderately high correlations between safety climate and safety participation and compliance.

However, Combs et al [7], in a meta-analysis of 92 studies relating high performance work systems to safety performance, suggest that the average effect size is quite small, with an average correlation of 0.2. Clarke [6] notes that the correlations between safety climate and safety participation and compliance do not translate fully to correlations with accident and injury rates. Average reported correlations between accident / injury rates and safety climate, participation and compliance are reported as 0.22, 0.09 and 0.14 respectively. Wallace and Chen [8] report finding negative correlations between safety performance and production performance (-0.34) and between safety climate and production performance (-0.28). They argue that production demands and safety requirements are often in conflict and that the task for most organisations is to find an optimal trade-off.

The question that arises, therefore, is whether the inconsistent evidence relating to the above assumptions is a necessary result of a trade-off between safety and productivity or whether there is another cause. If the former is true, there would be no chance of ever optimising both at the same time.

In our work on organisational culture and performance, we often come across companies who have undertaken organisational or safety culture and climate surveys. A common response is that although the results are very interesting, the companies have no idea how to use them or how to translate them into an action plan for cultural change. This could be, as suggested above, because there is only a weak relationship between organisational culture or climate and performance. However, there are other explanations. One concerns the nature of culture and climate surveys. These are rarely more than descriptive taxonomies. Items are clustered into scales on the basis of apparent semantic links. There is little agreement in the research literature about how many scales there should be or what they should focus on. For example, organisational culture is described by Chatman and his colleagues (e.g. O'Reilly, Chatman and Caldwell, [9]) as having seven dimensions: Innovation and risk-taking; Attention to detail; Outcome orientation; People orientation; Team orientation; Competitiveness / Aggressiveness; Stability. Hofstede [10] identifies five dimensions: Individual vs Collective orientation; Power-distance orientation; Uncertainty avoidance; orientation; Dominant values orientation; Short-term vs long-term orientation. Xenikou and Furnham [11], in an analysis of four organisational culture questionnaires, suggest that there are six readily interpretable factors.

Safety culture is often conceived of as a subset of organisational culture (e.g. Cooper, [12]). As such, you might expect it to have similar dimensionality to organisational culture. However, Table 1 presents the dimensions identified in a sample of safety culture questionnaires and models. Wiegmann et al [13] suggest that there are five factors. The UK Health & Safety Executive (HSE) suggest there are ten in their Safety Culture Maturity Model (HSE, [14]) and ten slightly different ones in their Health and Safety Culture Survey Tool (HSE, [15], [16]). The UK Rail Safety & Standards Board (RSSB, [17]) has recently introduced a questionnaire which has 11 factors, which overlap to some extent with the HSE dimensions, and are grouped into four main elements.

**Table 1: Examples of safety culture dimensions**

<b>Wiegmann et al</b>	<b>HSE - SCMM</b>	<b>HSE - HSCST</b>	<b>RSSB</b>
1. Organisational commitment	1. Management commitment and visibility	1. Perception of managerial commitment to H&S	1. Barriers and Influences
2. Management involvement	2. Communication	2. Communication	2. Training
3. Empowerment	3. Productivity versus safety	3. Pressure for production	3. Communications
4. Reporting systems	4. Learning organisation	4. Perception of personal involvement in H&S	4. Organisational Commitment
5. Accountability systems	5. Safety Resources	5. Merits of the H&S procedures / rules	5. Management Commitment
	6. Participation	6. Job security and job satisfaction	6. Supervisor's Role
	7. Shared perceptions about safety	7. Training and competence	7. Personal Role
	8. Industrial relations and job satisfaction	8. Accidents / incidents / near misses	8. Workmates Influence
	9. Training	9. Rule breaking	9. Risk Taking Behaviours
	10. Trust	10. Workforce view on state of safety culture	10. Employee Participation
			11. Organisational Learning

Attempts to replicate these dimensions across different samples have not been entirely successful. For example, Gibbons et al [18] attempted to replicate the Wiegmann et al [13] model but concluded that it "did not fit as well as hypothesised" and developed a revised model with four main factors and eleven sub-factors. This appears superficially the same as RSSB's structure but, in fact, they only partially overlap. RSSB (Roels, private communication) has also found that its factor structure does not consistently replicate across different samples. Flin et al [19] in a review of 19 safety climate questionnaires report anything from 2 to 19 factors. Lee and Harrison [20] identified 28 factors in their study of safety culture in nuclear power stations.

Two explanations for the inconsistent number of dimensions and the difficulty in replicating these dimensions suggest themselves. Firstly, there is still a tendency in many of these questionnaires to confuse culture and climate. Wiegmann et al [13] review a large number of definitions. Their most relevant conclusions are that culture refers to the shared values of everyone in the organisation, is relatively enduring, stable and resistant to change and impacts on the way staff behave at work. Climate refers to staff perceptions of the state of the organisation and is, therefore, a relatively unstable snapshot which is subject to change. Within Table 1, dimensions such as perceptions about safety, view on state of safety culture, trust, job satisfaction and individual perceptions all

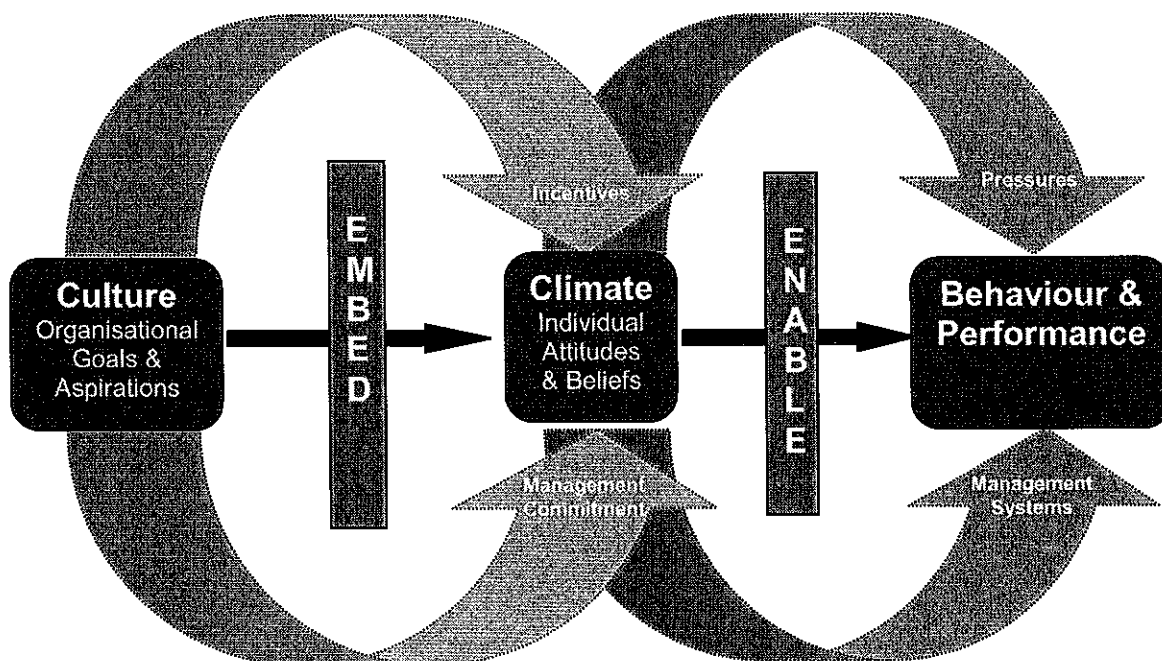
belong in the climate category. Management commitment, productivity versus safety and positive organisational attributes all belong in the culture category. The balance of climate to culture dimensions varies significantly across different questionnaires.

Secondly, a number of authors have identified two different approaches to defining culture (e.g. Bate, [21]; Thompson et al, [22]): describing what the organisation and its members are like (e.g. attitudes, beliefs, values, priorities, etc.); or what the organisation has in place (e.g. practices, procedures, policies, etc.). The Wiegmann et al [13] model is entirely concerned with the latter. The other examples in Table 1 have varying mixtures of both. It is hardly surprising, therefore, that different models have different numbers of dimensions and that the relationship between these dimensions and measures of company and safety performance vary considerably.

## 2. A MODEL OF COMPETENCE MANAGEMENT

Wiegmann et al [13] differentiate two perspectives on culture, the socio-anthropological, which is more concerned with describing the origins, evolution and dynamics of culture, and the organisational psychological, which is more concerned with “functional significance of organisational culture and the means by which it might be manipulated to improve productivity”. As a consultant trying to help organisations improve their performance, I am much more interested in the latter perspective than the former. It is also why questionnaire approaches to culture assessment that do little more than describe cultural characteristics are of little value. In order to help clients, you must be able to identify what they need to do to improve. The CAS Organisational Culture Management Model (OCMM) is, therefore, designed to help identify where an organisation is in the development of its culture and where interventions are likely to have most impact. Figure 1 presents an overview of the model.

Figure 1: Overview of CAS Organisational Culture Management Model (OCMM)



The model works in two ways. Firstly, it can be thought of as a causal chain. People within the organisation create, consciously or unconsciously, a preferred culture for producing the behaviour

and performance which will allow the organisation to achieve its goals. Managers attempt to make sure that the desired culture is embedded in the members of the organisation through a mix of incentives (motivational processes) and the demonstration of management and organisational commitment. However, even if everyone in the organisation shares and supports the same culture, the desired performance and behaviour may not be realised. The organisation and its members may not be ready to perform effectively. Therefore, a set of support systems need to be put in place to achieve readiness. Even then, individuals may not behave in the desired ways. They may be subject to a range of social, cultural and environmental pressures which push them to behave in counter-cultural ways. In addition, as Ajzen [23] has noted, individuals are capable of simultaneously holding several contradictory attitudes. In such cases, individuals may claim to hold an attitude which conforms to a desired culture but actually behave in accordance with a different attitude. Recognising and removing such pressures is as crucial as any of the other embedding and enabling mechanisms.

Re-considering the examples of cultural dimensions in Table 1 in the light of this model, it is clear that:

- Dimensions such as empowerment, job security, job satisfaction, personal involvement, increasing competence and reinforcement and incentives belong amongst the motivational embedding mechanisms
- Dimensions such as organisational commitment, management involvement, safety resources and trust belong in the management commitment embedding mechanisms
- Dimensions such as reporting systems, accountability systems, training, merits of H&S procedures / rules and strategic flexibility belong in the support system enablers
- Dimensions such as productivity versus safety and pressure for production belong in the conflict enablers
- Dimensions such as accidents / incidents / near misses and the incidence of rule breaking are measures of behaviour and / or performance and so are neither embedding mechanisms nor enablers.

One of the hypotheses of the model is that all four of the embedding and enabling mechanisms need to be well developed if the desired behaviour and performance is going to be achieved.

A different way of using the model is to consider that each of the elements of the model contains potential barriers which may result in the organisational culture not being realised in desired behaviour and performance. In this conception, the model can be thought of as the obverse of Reason's 'Swiss cheese' model of accident causation (Reason, [24]). In that model, the probability of an accident occurring is reduced by placing a number of barriers between a hazard and the possibility of an accident. Unfortunately, the barriers always have holes in them corresponding to either active failures or latent error conditions. Fortunately, the holes are not usually lined up so accidents do not occur but every now and then a peculiar concatenation of events result in the holes being lined up and an accident occurs.

In the OCMM, the problem is to try to get the desired organisational culture realised in desired behaviour and performance. The assumption is that there are many barriers to that happening and, in the absence of any interventions, the holes in the barriers will not, naturally, line up. The task for culture management is, then, to find ways of enlarging the holes or of manipulating the barriers so that the holes do line up.

### **3. IMPLICATIONS OF THE ORGANISATIONAL CULTURE MANAGEMENT MODEL**

Many details of the OCMM have still to be worked out. In particular, the detailed content of the various mechanisms of the model has yet to be completed and the structure of this content identified. Therefore, the full set of predictions that might be made from the model has not been worked out.

Nonetheless, a number of high level predictions can be made:

1. The strength of the relationship between measures of culture and climate and measures of performance will depend on how well embedded the culture is in an organisation.
2. This, in turn, will depend on how well motivated staff are to adopt the desired culture and how well and consistently management demonstrate commitment to the cultural goals.
3. The correlations between culture measures and climate measures will vary depending on whether different culture dimensions are subject to the same levels of motivation and commitment.
4. Likewise, the correlations between culture and climate measures and measures of performance will vary depending on whether different culture dimensions are subject to the same levels of motivation and commitment.
5. The strength of the relationship between measures of culture and climate and measures of performance will depend on how well enabled the culture is in an organisation.
6. This, in turn, will depend on whether there are effective support systems in place and whether pressures and constraints which might impact on intentions are identified and controlled. It is assumed that climate is subject to feedback mechanisms in that climate will partially reflect the perception of how well the organisation and its members are performing.
7. The correlations between culture measures and climate measures will vary depending on whether different culture dimensions are subject to the same levels of support and lack of pressures.
8. Likewise, the correlations between culture and climate measures and measures of performance will vary depending on whether different culture dimensions are subject to the same levels of support and lack of pressures.
9. Even when there is a high correlation between measures of culture and climate, the desired behaviour and performance will not be realised if the support systems are inadequate or if there are conflicting pressures operating.
10. Because it is possible for organisations to deal with embedding and enabling culture in a piecemeal fashion, there is likely to be a mix of positive and negative correlations between culture/climate measures, safety performance and productive and operational performance.
11. This mix of correlations is more likely to occur with more poorly managed organisations. The best managed organisations will achieve greater consistency across their culture and different areas of performance.

#### **4. EVIDENCE FOR THE MODEL**

The OCMM is of relatively recent origin. None of the hypotheses set out above have been explicitly tested since its development. However, the model's development has been closely informed by the results of safety culture surveys that CAS has carried for a number of its own clients and by two projects which CAS has undertaken for RSSB concerned with strategic safety management.

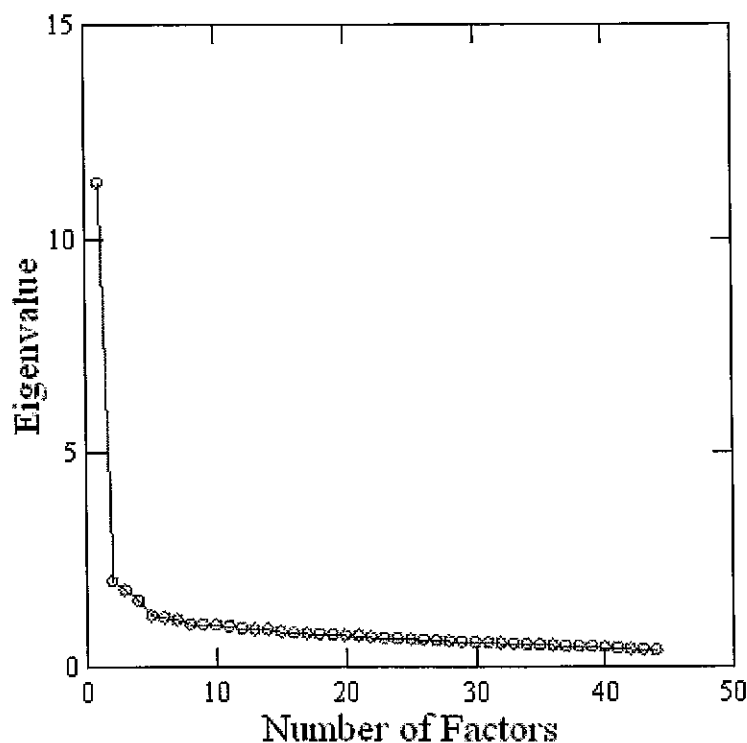
##### **4.1 The Organisational Safety Culture Analysis (OSCA)**

The CAS safety culture surveys are built around a process called the Organisational Safety Culture Analysis (OSCA) which involves the use of a survey questionnaire and the content analysis of comments and discussions / interviews. The questionnaire was devised in response to what we saw as the weaknesses inherent in the questionnaires commonly used in the UK. 5,519 employees from 19 companies who provide services in the rail industry have completed the questionnaire. A range of companies have been involved covering construction, engineering, maintenance and train operations.

The OSCA questionnaire originally produced scores on eight primary dimensions: Personal Involvement; Pressure on Rules; Training; Communication; Organisational Commitment; Attitudes to Culture; Job Satisfaction; Organisational Learning. However, the internal reliabilities of the dimension scores are borderline acceptable with values of 0.64, 0.67, 0.70, 0.83, 0.70, 0.70, 0.69 and 0.73 respectively. Furthermore, as noted earlier for other instruments, the factor structure of the scales is not entirely replicable from sample to sample. Some factors seem stable, such as Training and Commitment, while others such as Attitudes to Culture and Organisational Learning are relatively unstable. Principle components analysis on six different samples large enough to justify the analysis (i.e. more than 400 cases) produced solutions with between 7 and 10 components. In the cases where 10 factors were identified, two of the factors were artefactual such that one factor included only items where were negatively worded and the other only positively worded items. More importantly, none of these solutions account for more than 44% of the variance in the questionnaire responses. A significant number of individual items fail to load on any factor.

Structuring the questionnaire items around the OCMM produces better results. The four main mechanisms (Incentives, Management Commitment, Management Systems and Pressures) all produce acceptable internal reliabilities of 0.71, 0.85, 0.88 and 0.72 respectively. However, the problem of the factor structure remains. Figure 2 shows a plot of the eigenvalues for one of the larger samples (n=1235). It is typical of the plots produced for all the samples. Although, through using the eigenvalues greater than 1 rule, it is possible to find 7 or more principal components, it is clear that there is one, large general factor, which is concerned with how happy respondents are with their employment, and then a variable number of secondary factors.

**Figure 2: OSCA eigenvalues plot**



There is an argument, applying a scree test, for a two component solution since the second eigenvalue is at the top of the elbow of the plot. Forcing a two-factor solution consistently produces one factor which includes embedding mechanisms and a second which includes enabling mechanisms, although there is some overlap. Table 2 shows the solutions from two samples, one for 1,235 employees from a large infrastructure maintenance company and the other for 505

employees from a civil engineering company. It indicates two higher order factors derived from the OSCA scales with embedding mechanisms, such as personal involvement and organisational commitment, producing their highest loadings on one factor and enabling mechanisms, such as training, communication and pressure on rules, producing their largest loadings on the other factor.

**Table 2: Higher order factor loadings in OSCA**

	Sample 1: Factor 1	Sample 1: Factor 2	Sample 2: Factor 1	Sample 2: Factor 2
Job satisfaction	0.868	0.265	0.641	0.510
Personal involvement	0.743	0.432	0.726	0.501
Organisational commitment	0.700	0.563	0.810	0.373
Organisational learning	0.661	0.545	0.763	0.413
Pressure on rules	0.325	0.760	0.172	0.814
Training	0.312	0.842	0.326	0.764
Communication	0.490	0.797	0.442	0.761
Attitude to culture	0.426	0.706	0.229	0.802

We believe that the variation in the number of safety culture factors reported by different researchers is a result of how extensively the total domain of embedding and enabling mechanisms is sampled. All that any researcher in this area has done so far is include a small subset of all the possible items that might have been used. Often, these have been selected in an atheoretical way, relying on opinions about what might be the most important items rather than ensuring adequate coverage of the total domain. The most recent version of the OSCA survey, therefore, sets out to sample the domain more widely and covers a wider range of embedding and enabling mechanisms. However, we do not have sufficient data as yet to test whether this consistently produces the four higher order factors.

#### **4.2 The strategic safety management projects**

The two strategic safety management projects mentioned above were the Strategic Safety Management (SSM) Programme and a "Special Topic Report" on the relationship between safety and operational performance. Both were sponsored by RSSB and run on its behalf by CAS.

The Strategic Safety Management (SSM) Programme was a confidential scheme designed to help senior management teams measure some of the intangibles affecting the safety performance of their organisations. The first phase of work was started in 1999 and resulted in the production of a good practice guide on competence in strategic safety management (RSSB, [25]) The Programme was started in March 2002 and was built around the guide. It involved the senior management teams of participating businesses undertaking a guided self assessment of their competence in strategic safety management. The process was guided by a set of diagnostic questions which were delivered using a computer based programme, the SSM Software, which was developed to support the adoption of the good practice and is also available from RSSB.

A more detailed description of the SSM Programme, the technical characteristics of the tools and early validation results can be found in Johnson and Nelson [26]. However, at the time, the number of safety performance indicators which could be attributed to individual businesses was small as was the number of participating businesses. Subsequent improvements made by RSSB to the organisation and management of its Safety Management Information System (SMIS) database meant that a much larger set of safety performance indicators could be examined. Also, the number of businesses participating in the Mentoring Programme grew significantly allowing for more reliable and valid interpretation of findings.

The Special Topic Report, therefore, extended the earlier analysis and included a wide range of operational performance measures that were not available to the earlier project. Safety data from 59 organisations for the years 1999 – 2003 were included in the analyses, comprising:

- 29 Passenger Train Operating Companies
- 4 Freight Train Operating Companies
- 26 Infrastructure (maintenance and renewal) Businesses and/or Divisions

Business performance data were available for 25 of the 29 Passenger Train Operating Companies for the years 2000 to 2003 from the annual reports of the Strategic Rail Authority (four were not available for all these years because of changes in operating franchises). 42 of the 59 businesses had been involved to some extent in the SSM Programme but only 24 of them provided sufficient data of the right sort to be included in the data analyses. Finally, performance data was available for 11 of the Infrastructure companies and divisions from Network Rail's TRUST and FRAME databases from 2001 to 2003.

A large number of performance measures were available. There were 16 safety measures for the Passenger Train Operating Companies, 14 for the Freight Operating Companies, 22 for the Infrastructure Companies and 19 for Network Rail Territories. There were 19 operational performance measures for the Passenger Train Operating Companies and 8 each for the Infrastructure Companies and Network Rail Territories. The SSM self assessment provided 16 scores for strategic safety management competence plus information on the types of evidence managers used to substantiate their claims for competence and the major concerns they had about their organisation's systems and processes.

Full details of these and the processes for standardising the various data sources can be found in Johnson [27] and Lloyd and Johnson [28]. To simplify the presentation of the data, factor analyses were carried out on the various data sets and the following factors identified:

#### **Safety**

- Safety performance under the direct control of managers e.g. incidents resulting from staff behaviour
- Safety performance only under indirect control e.g. incidents resulting from environmental damage
- Train and equipment integrity e.g. rolling stock failures

#### **Operational**

- Travelling / working environment e.g. cleanliness
- Objective performance e.g. punctuality
- Customer care e.g. passenger complaint rates
- Service quality e.g. value for money
- Service reliability e.g. train cancellations

#### **Strategic Safety Management (self assessment)**

- Organisational and risk management e.g. ensuring performance is consistent with strategies; assessing effects of safety risks; creating effective working structures
- Organisational and staff development e.g. developing strategies and policies on safety; ensuring required training is delivered; ensuring organisation meets current safety targets
- Organisational attitudes and response to change e.g. promoting a positive safety climate; motivating staff and contractors to perform safely; ensuring the feasibility of risk control decisions
- Organisational commitment and readiness e.g. setting short-term targets for safety performance; ensuring quick, effective responses to safety problems; ensuring the organisation learns from experience.

It should be noted that the four SSM factors do not correspond directly to the original design although there are some clear overlaps. In the original design, four primary objectives were identified: Develop health and safety performance in the medium to long term; Assess and control health and safety risks; Provide support to health and safety related activities; Review and direct current health and safety performance. Each of these primary objectives has four sub-objectives and each of these 16 sub-objectives has a number of diagnostic items, 95 in total, which relate to specific interventions which management teams might make. Full details of these can be found in the RSSB guidance document [25]. The four factors that emerged can, however, be seen to map onto the OCMM, with organisational and risk management and organisational and staff development belonging to the enabling mechanisms and the other two belonging to the embedding mechanisms.

### 4.3 Findings from the projects

All the data reported in this section use the organisation as the unit of analysis. The minimum number of companies represented in any analysis was 20 of the infrastructure businesses. Note, however, that data were available separately for at least 3 years and, in some cases 4 years, so that the minimum number of cases in any analysis was 60. The largest was 236.

The first point to note is that a mixture of positive, zero and negative correlations was found between safety performance and operational performance measures. Table 3 shows the correlations for train companies. More than half the correlations were statistically significant and positive. Some of the correlations were moderately large. However, the largest and most consistent correlations were between operational performance and train integrity. This makes sense. Companies that make sure that their trains are in good working order are more likely to provide a reliable, clean, comfortable and quality service. However, it does not mean that they are customer focused. Furthermore, it would appear that companies who have good systems in place for managing safety issues under direct management control, such as staff safety performance, are not necessarily customer or quality focused either.

**Table 3: Correlations between safety and operational performance: Train Operators**

	Safety Performance – Direct Management Control	Safety Performance – Indirect Management Control	Safety Performance – Train Integrity
Quality of travelling environment	0.325*	0.217*	0.279*
Objective performance (incentives and cancellations)	-0.034	0.043	0.505*
Customer Care	0.108	0.200*	0.062
Service quality	-0.026	0.258*	0.236*
Service Reliability	0.013	0.042	0.467*

*(Correlations marked with a \* are significant at the  $p < 0.05$  level)*

Table 4 shows correlations between aspects of safety and operational performance for infrastructure companies. There was one substantial significant correlation such that companies that had a good record in areas of safety performance under direct management control also had much lower costs per asset failure. Good safety performance in areas under indirect management control, such as vandalism and injuries to members of the public, was also associated with lower costs per asset failure and with shorter downtimes when an asset fails. However, safety performance related to equipment and machine integrity was not significantly correlated with any of the performance measures and average minutes delay per asset failure was not associated with any aspect of safety performance. More interestingly, good safety performance in areas under direct management control was associated with longer average downtimes.

Making sense of these results requires an understanding of how companies at the time were incentivised. A wide range of performance indicators were used in contractor management. A high percentage of these were input measures. So, for example, the average downtime figure included three components: the time between a failure being detected and a fault team being advised of it; the time between a fault team being advised of a failure and someone arriving on site; and the time taken to actually fix the fault once someone was on site. Different companies placed different priorities on these activities and dealt with them in different ways. For example, some companies emphasised getting a staff member on site as quickly as possible. Sometimes that meant the fault was fixed quickly but sometimes the first person on site was not equipped or not competent to fix the fault and had to wait for other staff to arrive. Other companies were more concerned with fixing high priority faults. They typically had longer advise and arrive times, and often longer fix times, on average but the most important faults which had the biggest financial consequences for them were fixed faster.

**Table 4: Correlations between safety and operational performance: Infrastructure Companies**

	Safety Performance – Direct Management Control	Safety Performance – Indirect Management Control	Safety Performance – Equipment and Machine Integrity
Average cost per asset failure	-0.796*	-0.354*	0.260
Average minutes train delay per asset failure	-0.085	-0.115	-0.010
Average downtime	0.302*	-0.435*	0.101

*(Correlations marked with a \* are significant at the  $p < 0.05$  level)*

Relationships between safety culture and safety and operational performance were also variable. Table 5 shows relationships between safety culture dimensions derived from the SSM self-assessment process and train company operational performance. Where there were statistically significant relationships, the correlations were always positive and some, like those between organisational commitment and readiness and measures of objective performance and service reliability, were substantial. Nonetheless, almost half the correlations were not significant. In particular, the correlations were not strong between safety culture and measures of the quality of the travelling environment or customer care. To be fair, the quality of the travelling environment was not always within the companies' control. Many, for example, had inherited poor quality rolling stock or facilities and had not yet had time to improve them. Nonetheless, customer care

was within their control and performance in this area does not appear to be related to how well the companies believed they were managing their safety cultures.

**Table 5: Correlations between safety culture and train company operational performance**

	Quality of travelling environment	Objective performance	Customer Care	Service quality	Service Reliability
SSM –organisational and risk management	0.474*	0.640*	-0.018	0.419*	0.622*
SSM –organisational and staff development	0.149	0.282	0.279*	0.218	0.293*
SSM –organisational attitudes to and response to change	.214	0.555*	0.130	0.245*	0.545*
SSM –organisational commitment and readiness	0.137	0.814*	-0.093	-0.020	0.794*

In many ways, Table 6 shows a similar pattern of correlations to Table 4. Companies who rated themselves high on organisational attitudes and response to change typically had lower costs per asset failure. However, companies who rated themselves higher in all areas of safety culture tended to have longer average downtimes. This suggests that companies who were focused on dealing with high priority failures rather than simply meeting the key performance indicators actually had better developed safety cultures. It is also possible that using the various aspects of downtime as performance indicators was interfering with both the development of safety culture and safety performance.

**Table 6: Correlations between safety culture and infrastructure company operational performance**

	Average cost per asset failure	Average minutes train delay per asset failure	Average downtime
SSM –organisational and risk management	-0.166	-0.114	0.626*
SSM –organisational and staff development	-0.088	0.079	0.482*
SSM –organisational attitudes to and response to change	-0.464*	-0.089	0.266
SSM –organisational commitment and readiness	-0.219	-0.085	0.557*

Table 7 shows the correlations between safety culture and safety performance for both train operating companies and infrastructure companies. Safety culture was reasonably well correlated with both measures of safety performance under direct management control and train and equipment integrity. The multiple correlations with these two measures were 0.49 and 0.48 respectively. However, safety culture self-assessments were not well correlated with measures of safety performance under indirect control and the multiple correlation was a very modest 0.28.

Since these safety measures involved the behaviour of people external to the organisation and were affected by such things as environmental conditions, it may not be surprising that the correlations with internal safety culture were low. Nonetheless, as will be shown later, it should not be assumed that no influence can be exerted.

**Table 7: Correlations between safety culture and safety performance**

	Safety Performance – direct management control	Safety Performance – indirect management control	Safety Performance - train and equipment integrity
SSM –organisational and risk management	0.379*	0.069	0.346*
SSM –organisational and staff development	0.235*	-0.073	0.296*
SSM –organisational attitudes to and response to change	0.088	-0.005	0.390*
SSM –organisational commitment and readiness	0.251*	0.172*	0.473*

Content analysis of the reasons that managers gave for giving themselves poor self assessments revealed that the biggest concern was lack of consistency across their organisation. This accounted for a third of all the concerns expressed. Lack of consistency took two main forms:

1. Inconsistent practice in different parts of the organisation.
2. Inconsistencies in the way policy and strategy were realised in procedures and practice.

The incidence of these concerns was significantly related to a number of safety and operational performance measures producing correlations of -0.26 with both customer care and service quality, a correlation of -0.35 with safety performance under indirect managerial control and -0.40 with train and equipment integrity. In other words, performance was generally poorer where there was a concern about lack of consistency.

This finding is important because the single most common piece of evidence that managers used to justify a good self assessment was the existence of formal procedures. Much more rarely did managers say they had evidence that these procedures were applied consistently and effectively. In addition, although the SSM scales and sub-scales generally have good internal consistencies (Johnson and Nelson, [26]), agreement between managers giving independent judgements was low, the average correlation being only 0.15. We can infer from this that a common cause of inconsistency across organisations is that managers in different divisions are often not well informed about what is happening in other divisions.

#### **4.4 Effect sizes and improvement plans**

A series of linear regression analyses were carried out examining how well combinations of scores on the SSM sub-objectives predicted a range of specific safety and operational performance indicators. Full details of these can be found in Johnson [27]. Table 8 presents a selected summary of the results indicating:

1. The multiple correlations (adjusted for sample size) between the total set of predictors and the performance criteria
2. An estimate of by how much the performance of the worst performing company could be improved if their organisational culture and systems, in the areas related to the top three predictors, were as well developed as those of the best performing company.

There are several key points to note in Table 8:

- The impact of improving safety culture and systems is variable with the smallest impact where changes are required to staff attitudes (e.g. workforce injuries) and the largest where changes are required to the approach taken, such as creating more effective barriers (e.g. vandalism).
- The top three target areas for improvement are different for every performance criterion. However, where there are strong conceptual similarities, for example between punctuality and service reliability, there is more chance of the top areas for improvement being shared.
- The top three target areas for improvement always belong to at least two different embedding or enabling mechanisms and often to three different ones. For example, with quality of the travelling environment, the improvement areas covered are, in order, pressures, support systems and incentives.

Within an improvement plan, this would make sense. The bulk of the improvement achievable from improving one type of mechanism will usually be achieved from fixing the single most important. Further significant gains will require weaknesses in other types of mechanism to be fixed.

One final point concerns whether there is such a thing as the best organisational culture. The wording in the opening paragraph of this section was carefully chosen. That is, improvements will come from an organisation's culture being well developed, not from simply adopting the practices of other organisations without thought. It often seems to be assumed in the literature on safety culture that there are good cultures and bad cultures and that good cultures will always have the same characteristics. This is not so. What counts as the best culture for an organisation will depend on its precise circumstances and may not be the same as for another organisation. Consider the position concerning staff empowerment. Staff empowerment is generally thought to be a good thing since it increases job satisfaction and thus will aid the embedding of the desired culture (e.g. HSE, [15]). However, there are circumstances in which empowerment may be counterproductive or even nonsensical (Latham and Pinder, [29]). For example, if empowerment is considered to equate to delegated decision making, in some circumstances it may be the last thing you want. Any organisation with a strict command and control system is likely to be a case in point. So, when we talk about trying to improve an organisation's culture, we should always talk in terms of the desired, beneficial culture being embedded and enabled, not about conforming to some universal model of the best culture.

**Table 8: Relationships between cultural predictors and performance: what to fix first**

Performance criterion	Adjusted Multiple R (all predictors)	Top three areas for improvement	Potential performance gain (top three areas only)
Quality of travelling environment	0.782	<ul style="list-style-type: none"> <li>- Assessing behavioural and attitudinal risk</li> <li>- Training and development</li> <li>- Motivation of relevant people</li> </ul>	63%
Punctuality	0.858	<ul style="list-style-type: none"> <li>- Organisational structure</li> <li>- Motivation of relevant people</li> <li>- Putting safety measures into practice</li> </ul>	86%
Customer care	0.439	<ul style="list-style-type: none"> <li>- Developing policy and strategy</li> <li>- Promoting a positive safety climate</li> <li>- Developing risk control options</li> </ul>	51%
Service reliability	0.854	<ul style="list-style-type: none"> <li>- Organisational structure</li> <li>- Motivation of relevant people</li> <li>- Budgeting and resourcing</li> </ul>	86%
Injuries to passengers	0.338	<ul style="list-style-type: none"> <li>- Setting achievable safety targets</li> <li>- Feasibility of risk control options</li> <li>- Achieving safety targets</li> </ul>	40%
Workforce injuries	0.253	<ul style="list-style-type: none"> <li>- Motivation of relevant people</li> <li>- Identifying safety risk implications</li> <li>- Promoting a positive safety climate</li> </ul>	29%
Vandalism	0.937	<ul style="list-style-type: none"> <li>- Motivation of relevant people</li> <li>- Developing risk control options</li> <li>- Organisational structure</li> </ul>	94%
Train driver errors	0.581	<ul style="list-style-type: none"> <li>- Training and development</li> <li>- Ensuring organisational consistency</li> <li>- Putting safety measures into practice</li> </ul>	42%
Contractor management	0.680	<ul style="list-style-type: none"> <li>- Feasibility of risk control options</li> <li>- Learning from experience</li> <li>- Budgeting and resourcing</li> </ul>	70%

## 5. CONCLUSIONS

In spite of the significance of organisational and safety culture in accident investigations and inquiries and even court cases, it is only recently that consistent definitions have emerged and a clear distinction between culture and climate has been made. However, the same degree of consensus has not been achieved concerning the content of these concepts. The main reason for this is that the domains of culture and climate have not been fully defined and agreed. Therefore, different measures tend to have different numbers of dimensions, scales and items. Accordingly, analyses of these measures tend to produce markedly different numbers of underlying factors.

In addition most models of culture tend to be purely descriptive which does not make it easy to identify, in any consistent or structured way, actions that might be taken to improve and manage culture. This situation is not helped by a common misconception that there is such a thing as a perfect culture. Conceptions of safety culture seem to be particularly prone to such thinking. The CAS Organisational Culture Management Model (OCMM) seeks to provide a model which guides users towards specific interventions which will help improve culture and realise the behavioural and performance benefits of doing so. It assumes each organisation needs to consider what type of culture is most likely to help it achieve its goals and then implement a set of embedding and enabling mechanisms to help create this. Companies will thus differ from each other in the precise set of mechanisms that will give them best value although, of course, they will also be able to identify some similarities with other companies which may guide them in their choice of mechanisms.

The content of the OCMM is not yet fully developed. However, a number of predictions can be made some, but not all, of which have been tested. Embedding and enabling mechanisms do seem to be distinct. It is possible to find large, significant correlations between some of these mechanisms and various aspects of safety and operational performance. The main point is that culture is a complex, multi-dimensional concept as are performance and safety. There is no certainty that organisations which exhibit a good culture will achieve good performance or have a good safety record. Different embedding and enabling mechanisms improve different aspects of safety and performance.

When constructing improvement plans, it is best to consider each of the four types of embedding and enabling mechanisms in turn, identifying the specific mechanisms which are likely to be of most benefit in the specific context the organisation finds itself in. This needs to be done in a risk-based way. Organisations need to be clear about their priorities for the objectives they wish to pursue and target those embedding and enabling mechanisms which will address those priorities. Otherwise, they are likely to find themselves either implementing initiatives which are all drawn from the same category of mechanism, and thus provide ever diminishing returns, or implementing initiatives which might be perfect for another organisation but not for them.

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