Safety culture in railway maintenance

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Abstract

This paper discusses the practical problems of understanding and addressing unsafe behaviour and negative safety culture in rail maintenance. A well grounded qualitative approach informed the research methodology. Analysis of interviews with staff enabled identification of forty main factors that influence safe behaviour and safe culture. These factors ranged in proximity of their connection to the unsafe event, from those that could be found at trackside and which directly influence the behaviour of the track workers on the day (e.g. weather), to more medium term and distanced factors (e.g. supervisors’ style of management), to those at considerable distance in terms of where they emanate and can be changed, such as contradictory rules. As a result of this deep, structured qualitative enquiry, the maintenance company most concerned has disseminated findings throughout the organisation and has set a strategy to improve both safety systems and behaviour.

Keywords: Safety culture; Railway maintenance; Qualitative; Methodology

1. Introduction

The suggested link between safety culture and major accidents, for instance as found at Chernobyl in 1986 (Cooper, 2000) and Ladbroke Grove (Cullen, 2001),
has encouraged high risk industries to reduce their reliance on accident and incident data and to direct health and safety systems towards investigating the culture and climate that may contribute to incidents (Flin et al., 2000).

The variety of risks associated with high-risk industries can be managed in different ways, for instance through rules and procedures, training, supervision or risk assessment. The promotion of a positive safety culture is now considered to be a viable way of managing risk, creating a culture within an organisation where everyone is personally involved in ensuring safety (Hudson, 1999) and where the values of safety are evident in every activity, from general company policy and philosophies to the one-off actions of a front line operator. Without a positive safety culture and climate it could be said that there is already resistance in the environment into which safety schemes and programmes are being implemented, possibly dooming any programme to failure at the outset. This may explain the initial resistance often met by safety initiatives and go some way to explain the lack of staying power of such initiatives in bringing about a permanent change or at least the degree of change that was anticipated.

The term safety culture generally explains how safety is placed as a priority within an organisation. This is reflected in the decision and policies of the organisation and filters down through these into every aspect of operational performance. A single definition for the term ‘safety culture’ has yet to be agreed upon. This is in fact one of the stumbling blocks in working with this relatively new, potentially very valuable, but also rather vague concept. A lack of consensus on definition can result in an uncertain framework on which to base research or practice.

Nonetheless, the Health and Safety Executive have captured the essence of the various definitions, as follows:

“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 preventative measures.” (HSE, 1999, page 45).

Another term, safety climate, is also referred to within the literature, described as ‘the workforce’s perception of the organisational atmosphere’ (Gonzalez-Roma et al., 1999). Climate is seen as the ‘surface features’ of a culture (Schein, 1990) and if measured can provide an understanding of the workforce’s attitudes and perceptions at the time of measurement; that is, it is a snapshot, generally collected by thorough surveys (Cox and Flin, 1998) such as the Safety Climate Questionnaire (HSE, 1997b). At present one tool does not exist to measure all features relating to culture, and more qualitative research (interviews and focus groups for example) is suggested as the most effective way of understanding culture and the underlying factors that influence it (Flin et al., 2000; Cullen, 2001; Cox and Cheyne, 2000).

This paper describes a study of safety culture which was carried out to understand the factors that influence safety related behaviour in UK railway maintenance. A detailed account is given of the practical process for dealing with relevant qualitative
data for researchers and practitioners, and there is explanation of findings and how these were used to inform a programme of strategic change. The intention is not to determine the components of a positive or negative safety culture in general terms. This was a specific piece of work for a UK rail infrastructure maintenance contractor (IMC) with the basic remit of discovering why track workers sometimes behave unsafely and what factors within the IMC could be contributing to a negative safety culture and unsafe behaviour. It is the approach rather than the specific findings of this that are considered of possible value to organisations wishing to manage the issue of unsafe working behaviour in the context of safety culture and as such form the focus of this paper.

2. Safety culture, rule violations and understanding unsafe behaviour

2.1. Factors that contribute to a safety culture

Several factors have been identified as supporting the development of a positive safety culture within various industries. Key amongst these are: management (Cox and Cheyne, 2000; DePasquale and Geller, 1999; Elzer et al., 2000a,b; HSE, 1997a; Lingard and Rowlinson, 1997; Pidgeon, 2001; Reason, 1997; Simard and Marchand, 1997), immediate supervisors (O’Dea and Flin, 2001), individual and behavioural (workforce) factors (Cooper, 2000; Geller, 1997; Van Vuuren, 2000), reporting systems (Brown et al., 2000; Cullen, 2001), rules and procedures (HSE, 1997a), communication (Brown et al., 2000) and organisational subcultures and subcontractors. A breakdown of the components of these factors is shown in Table 1.

The safety culture literature reviewed for this study was examined to determine how it relates to unsafe and safe behaviour, particularly for track workers within a UK rail infrastructure maintenance company (IMC). Although there has been some research on safety rules and violations in rail work (Lawton, 1998) there has been little work on safety culture and (un)safe behaviour in rail track maintenance. The exception is work by Hale et al. (2003). In general the work available on railways is much less than for other high-risk industries such as offshore oil and gas (Cox and Cheyne, 2000; O’Dea and Flin, 2001).

2.2. Factors that contribute to rule violations

Research in rule violation also provides valuable information on the causes of unsafe acts and of negative safety culture. The UK Health and Safety Executive have classified violation types and some of the mechanisms contributing to their occurrence, based on work by Reason et al. (1990) and HSE (1999). This classification is shown in Table 2.

The different types of violations and the mechanisms that drive them provide important clues about the factors that affect unsafe behaviour (Lawton, 1998).
### 2.3. Changing safety culture

There is a considerable body of knowledge of work describing safety culture in terms of what makes a good or positive safety culture and what makes a bad or negative safety culture (Cheyne et al., 1998; Cooper, 2000; Flin et al., 2000; O’Dea and Flin, 2001). There are also a large number of studies reported where the approach to changing unsafe behaviour is through behaviour–based programmes (Barton et al., 1997; DePasquale and Geller, 1999; Geller, 1997; Geller, 1999; Lingard and Rowlinson, 1997; Vassie, 2000; Williams and Gellar, 2000), goal setting (Duff et al., 1994), and incentives (Johnson, 1997; Haines et al., 2001).

Whilst the literature enables better understanding of safety culture and climate, and can help support systems of reliable measurement, an organisation with a safety culture problem will want to make sense of their own problems. They will want to determine the best course of action to address a negative safety culture. Reason (1998) describes managing safety culture through the management of five aspects of culture—learning, reporting, just, flexible and informed culture. This approach acknowledges the contributions to operator unsafe acts from more distal sources within an organisation. Any organisation might perhaps use the five aspects of culture as top-level goals. A translation into tactical and strategic actions requires goals to be made tangible. A possible route to achieving this is to look at what influences the attitudes, beliefs and behaviour related to safety for the people in their own organisation.

### 2.4. Safety as a priority in the railways

Safety on the railways, especially in the UK but in many other countries also, has been looked at very differently in the last few years, by the general public, govern-

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**Table 1**

<table>
<thead>
<tr>
<th>Management</th>
<th>Reporting system</th>
<th>Reporting near misses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management commitment</td>
<td>Open door policy</td>
<td>Analysis</td>
</tr>
<tr>
<td>Ability</td>
<td>No blame culture</td>
<td>Risk/incident analysis</td>
</tr>
<tr>
<td>Leadership</td>
<td></td>
<td>Confidentiality</td>
</tr>
<tr>
<td>Participatory style</td>
<td></td>
<td>Feedback</td>
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<tr>
<td>Communication</td>
<td></td>
<td></td>
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<tr>
<td>Flexible culture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Co-ordination</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Individual and behavioural factors</th>
<th>Immediate supervisor–subordinate relationships</th>
<th>Leading by example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Involvement</td>
<td>Open door policy</td>
<td>Participation</td>
</tr>
<tr>
<td>Competency</td>
<td>Participation</td>
<td>Support correct behaviour</td>
</tr>
<tr>
<td>Training</td>
<td></td>
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</tr>
<tr>
<td>Attitude</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Behaviour</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Rules and procedures</th>
<th>Communication</th>
<th>High visibility of leadership</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear Practical</td>
<td></td>
<td>Style Commitment</td>
</tr>
</tbody>
</table>
ments, the media, passengers and the industry itself. Like many other organisations or industries—the Health Service for example—there is a constant trade-off between safety, efficiency (embracing cost considerations), quality and reliability of the service, all in the context of a system with limited capacity. The reaction in the UK for instance to incidents such as Ladbroke Grove, and particularly following Hatfield and Potters Bar, is now increasingly recognised as something of an over reaction which caused even more problems for the network. Although it is difficult for people to say this publicly, we cannot have 100% safety, on the railways nor in general, and certainly not at a realistic price. This is why calculations are made for the value of a life or serious injury saved in order to make rational investment decisions. It is this debate that lies for instance at the heart of difficult decision making over investment in train warning and protection systems (to reduce the likelihood of SPADs—Signals Passed at Danger)—with the more expensive systems perhaps meaning that the railways will be priced out of the market on worst case calculations, and also behind debates on whether it is sensible to run the railways so carefully (e.g. after Hatfield)

<table>
<thead>
<tr>
<th>Violation</th>
<th>Behaviour</th>
<th>Contributing factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine</td>
<td>Breaking the rules and procedures becomes the normal way of working within a group. May be unaware of the rules or unaware they are deviating</td>
<td>Repetitive/automatic work Violations rarely punished Compliance not rewarded Reasons for this type of violation: • cutting corners to save time and energy • rules perceived as too restrictive • belief that the rules no longer apply • lack of rule enforcement and • new workers thinking norm of incorrect practice is correct</td>
</tr>
<tr>
<td>Situational</td>
<td>Difficulty complying with rules due to situational circumstances</td>
<td>Pressure from the job such as: • time • insufficient staff for the workload • correct equipment unavailable • extreme weather conditions and • working at night</td>
</tr>
<tr>
<td>Exceptional</td>
<td>Belief that benefits outweigh the risks</td>
<td>Unfamiliar situations Lack of relevant training Inadequate level of training Time pressures</td>
</tr>
<tr>
<td>Exceptional</td>
<td>Belief that benefits outweigh the risks Working in unfamiliar situation—usually when something has gone wrong</td>
<td></td>
</tr>
</tbody>
</table>
that disgruntled passengers drive on the roads instead, which is a less safe form of transport.

The relevance of these debates to this paper is that the main debate so far has examined safety of running the trains and the train/infrastructure interface whereas maintenance has been under the spotlight only much more recently. Procedures which are brought in which are intended to be related to safety, if this is done reactively in a panic, may not actually improve safety and may impair effectiveness and performance, which may promote a culture of violations. We should also recognise that the behaviours we are studying for track workers can impact on the safety of the network as a whole (for passengers, drivers, the public etc) or on the safety of themselves and their colleagues.

3. Railway maintenance safety behaviour study

3.1. Background

A railway Infrastructure Maintenance Company (IMC) who were concerned about death and injury to staff on the track wanted deeper information following the results of a recently applied safety climate questionnaire survey. They approached the Centre for Rail Human Factors at the University of Nottingham to work with them on this matter. Whilst there is great value in the use of safety climate tools for problem detection and for measuring changes over time and after the implementation of change, there are also limitations to their use. Some of these include: a lack of explanation (the IMC required more in-depth information regarding the issues that the questionnaire had highlighted); a fear of reprisals when writing responses (of particular relevance in the UK rail industry); overuse of questionnaires with little or no feedback; possible misinterpretation of what a respondent intended, and the use of written words for expression in an industry that is traditionally driven by verbal communication. Additionally, the questionnaire results had been sometimes contrary to what the organisation suspected really was happening in terms of working safely. Accordingly they employed an independent group to collect data directly from their staff. Their underpinning question was:

"Why do our experienced staff (sometimes) work unsafely?"

The approach taken was a qualitative and collaborative one. The aim was to provide the client with factors that were perceived by their staff to influence safe behaviour. Schein (1990) describes organisational culture as consisting of seven underlying dimensions, such as “The organisation’s relation to its environment”. These dimensions provide the bases for interviews that attempt to reveal hidden and more implicit factors that constitute corporate culture. Although not an exact replication of this concept, the method for this piece of work utilises this approach. More generic dimensions of safety culture suggested from literature were unpacked and formed a conceptual framework (Fig. 1). The framework was used to obtain a better understanding of the hidden and implicit facets of this specific organisation’s safety culture.
3.2. Data collection

Group and individual semi-structured interviews were employed. The primary question posed was “What makes track workers unsafe?” Follow up probing questions covered areas such as: safety culture, contract staff, the use of a rulebook and procedures in the rail industry, what suggestions they had for improvement of safety and safety culture. The questions were based on the researchers’ considerable experience of railway maintenance and rail human factors (e.g. Wilson et al., 2001) and the relevant safety culture and human factors literature, and were particularly informed by substantial input from trade union safety representatives and management of the IMC. The questions in the interviews evolved with each session; issues were clarified and pursued with the next group once another had raised them. This formed a reflective approach to building on the information obtained with each interview.

Thirty-four respondents were interviewed in six groups. These were front line operational staff and were a volunteer sample from different rail maintenance operations and different geographical areas. The operational functions included: signal and telecommunications (S&T), rapid response S&T teams, permanent way (rail) gangs, and subcontracted teams of both S&T and permanent way. Eight individual interviews were also carried out with line, middle and senior management. All interviews were tape recorded with the permission of the participating staff.

Fig. 1. Conceptual framework developed for coding from literature.
3.3. Gaining participants’ confidence

Inter-organisational “buck passing”, scape-goating and fear of blame have unfortunately become a cultural phenomena within the current UK rail industry. To encourage open and constructive discussion of safety and organisational issues, several measures were put in place:

- Use of an independent research group.
- A confidentiality and anonymity agreement approved by the trade unions.
- A clear system for holding original data and a firewall between the research group and the IMC.
- Union representatives being involved at all stages, including recruitment of participants and a final check on the validity of analysis and interpretation.
- A clear system for an early pilot of the group interviews with trade union representatives.
- Feedback and dissemination of results arranged in advance.
- High profile of the exercise, and prior and continuing organisational commitment.
- Backing of senior management.

3.4. Analysis and findings

The process for analysis of the interview data is intertwined with the findings and how they were managed.

3.4.1. Analysis

The approach used for this study was qualitative. Qualitative research methods can provide rich and detailed information, often at a considerable depth, but this can come at a cost for the analysis and presentation of results. Also, this study was performed in a commercial environment with very specific practical requirements; transparency and traceability of the process and interpretation was vital but the final presentation had to be in a form that was meaningful to the client and also represented what the participants had conveyed in the interviews. The analysis process is outlined in the steps detailed below. The process overview is shown in Fig. 2.

Step 1: Data preparation

The data preparation step involved transcribing the raw interview data from tape recordings directly into a database. Eight hundred chunks of information formed the original database ready for coding in step 2. A chunk is part of a participant’s comments within a transcript that forms a coherent concept. Half sentences, “ers”, and comments that made no sense on their own were chunked together with adjacent data to form coherent chunks. This is a concept recognised in qualitative analysis where the researcher arranges data in a form that lends itself to the type of coding that will occur. Chunks can be words, sentences, or paragraphs to which codes are attached (Miles and Huberman, 1994).
Step 2: Coding

A conceptual framework (Fig. 1) was developed, based on the literature and rail experience of the investigators and the direction in which the investigation was aimed based on client requirements. Conceptual frameworks are an accepted method for managing data for coding (Miles and Huberman, 1994).

Despite being open to change the framework varied little from the initial categories defined for coding. The database chunks were coded against the conceptual framework by two researchers (authors T. F-D and L. P). A sample line from the database at this stage is shown in Table 3. Coding is a commonly used analysis tool for qualitative researchers but the meaning and use of the codes has to be accurate and reliable. Tests for inter-and intra-rater reliability ensured that the codes were being used consistently and that they were interpreted as intended. A reliability score of 95% agreement was obtained between the coding of the two researchers.

One hundred “influencing factor categories” emerged from this initial wave of coding. These were reported for the client organisation and for the trade union representatives to check. They were used as a reference so that the original comments and the more detailed breakdown of the factors were never completely lost in
subsequent summary analysis. An example of their presentation is shown in Table 4. At this level they were, however, too numerous and too detailed for the practical purposes of the organisation. Further reduction of the data was required.

**Step 3: Data reduction**

The one hundred factors were reduced to forty key factors thought to influence the safety behaviour and safety culture of track workers in rail maintenance. Two main researchers (T. F-D and L. P) performed the data reduction by working together to justify reductions based on the following criteria:

- **Tangible**—Was the factor something that could be detected in some form? i.e. was it some thing that could be directly observed?

### Table 3
A sample line showing the database format including coding of comments

<table>
<thead>
<tr>
<th>ID</th>
<th>Tape</th>
<th>Comment</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>216</td>
<td>G</td>
<td>If you trust your lookout you never bother looking in that direction</td>
<td>T3/T4</td>
</tr>
</tbody>
</table>

### Table 4
Example of some of the original analysis of trust in co-workers T4

<table>
<thead>
<tr>
<th>Lack of trust (Trust in co-workers when working on the track)</th>
<th>Staff perceptions</th>
<th>Staff comments</th>
</tr>
</thead>
</table>
| • Working with those unfamiliar to team, including subcontractors reduced trust within team | • We have people (from IMC not contractors) that we work with that we do not trust, but we know them. If we know them we would not use them but if you do not know them (subcontractors) . . .
• If you do not know your lookout you do not feel as safe. We go down to London and occasionally work with crews that will allocate their own lookouts and occasionally they were blowing a train that had already passed |
• A lack of trust in staff who had just received classroom training | • Recruit people and train them for two years and they are a senior tech. If they are a senior tech they could in effect be in charge. They have been in the classroom on and off for two years. All right they have been out a bit and all of a sudden they are in charge. That grade, they have a lot of knowledge but they have no understanding |
• Importance—Did the factor have far reaching effects on other factors and on other parts of the organisation or organisational activities?
• Salience—Was the factor meaningful to the staff and would it merit being isolated as something that had been expressed as an issue many felt strongly about (i.e. would addressing the factor show commitment to the study)?
• Uniqueness—Did the factors, when examined more closely, overlap or have common root causes with other factors?

The resulting 40 factors were presented in a full final report for the organisation and are shown in Table 5. The form of this presentation is illustrated for just one factor shown in Table 6.

Step 4: Reporting

This work was reported in three ways. First, the client was provided with a comprehensive report including a full description of the methodology, supporting literature and the 100 factors influencing safety behaviour from the interviews. Once the operational and safety management staff in the company had agreed this they requested a second, summary, report for general circulation within the organisation, to enthuse the senior management and to inform the rail industry in general. In this summary report the factors that influence behaviour and culture were presented in terms of how close they are to the individual working on the track and the time at which they are working (this is referred to as “location” in the report). The classifications for this ‘location’ of the influencing factors are shown in Table 7. These were based on the data from interviews (the original sources of the factors) and discussion between the researchers and client.

The 40 factors summarised in Table 5 were presented as a table, including indications of the most likely sources of possible contributors to solutions (a sample line is shown in Table 8). These were based on the solutions provided by participants, recommendations in the literature for dealing with cultural change, and consultations with the client organisation. The ‘Routes for Action’ were not definitive or exhaustive at this stage, but continued to develop with the co-operation and involvement of staff at all levels. Feasibility of addressing the factors influencing safety was estimated as 1, 2 or 3.1 was for more feasible solutions achievable with relative ease and in the short term; 2 was for solutions that may take longer and require more effort; and 3 was for solutions that require a considerable amount of time and effort possibly from outside the immediate organisation. These ratings are not definitive and were intended as a first estimate in order to begin the process of considering a strategy based on what was considered realistic by the management team with the input of the researchers. The final output was the result of consensus between the researchers and the IMC management team involved in the project.

A third report was produced called the “high impact” report. This report was in the style of a glossy brochure for wider circulation. It utilised a template style based on the logo that had used throughout the research programme, and, in fact is still used to represent any related changes that have been implemented as a result of the project.
<table>
<thead>
<tr>
<th>Factors</th>
<th>Sub-factors</th>
<th>Sub-factors</th>
<th>Sub-factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication on the job (excessive and poor quality)</td>
<td>Poor and underused real time risk assessment skills</td>
<td>Individual perception of what safe is</td>
<td>Track workers knowledge and understanding</td>
</tr>
<tr>
<td>Inconsistent teams/subcontractors</td>
<td>Safety role model behaviour</td>
<td>Social pressure of home life</td>
<td>Setting up site safety on the day</td>
</tr>
<tr>
<td>Rule dissemination</td>
<td>Physical conditions</td>
<td>Peer pressure</td>
<td>Feedback cycle</td>
</tr>
<tr>
<td>Competence capability and certification</td>
<td>Working hours: different behaviours out of normal hours</td>
<td>Manager's communication methods</td>
<td>Information/communication route clarity</td>
</tr>
<tr>
<td>Pre-job information dissemination</td>
<td>Planners knowledge for job resourcing</td>
<td>Job feedback to planners</td>
<td>Volume of paperwork</td>
</tr>
<tr>
<td>Feedback messages from managers</td>
<td>Manager's railway knowledge</td>
<td>Manager's visibility and accessibility</td>
<td>Perceived purpose of paper work</td>
</tr>
<tr>
<td>Supervisors style visibility, communication, representation of staff</td>
<td>Supervisors: (technical competencies and assessment of them)</td>
<td>Supervisors presence (visibility, leading by example, opportunity for verbal communication)</td>
<td>Fatigue, concentration, ability to function (alcohol)</td>
</tr>
<tr>
<td>Equipment (condition, appropriateness and availability)</td>
<td>Practical alternatives to rules</td>
<td>Perceived purpose of the rule book</td>
<td>Rule book usability and availability</td>
</tr>
<tr>
<td>Information pathway flow</td>
<td>Planners competency to plan</td>
<td>Methods for reporting</td>
<td>Information systems use</td>
</tr>
<tr>
<td>Contradictory rules</td>
<td>Recruitment methods</td>
<td>Training needs analysis</td>
<td>Training methods</td>
</tr>
</tbody>
</table>
This section will consider the qualitative process performed within an organisation as an approach to investigating safety culture and unsafe behaviour within an organisation context and providing a guidance on how to manage these topics through discussion of the action taken subsequent to the research.

One of the primary reasons for writing this paper was to provide details of a piece of work that takes theoretical concepts and applies them to aid organisations in understanding their own functioning and how they could develop a strategy for improving it. It is an example of the use of a qualitative methodology being used in the real world as a tool to deal with practical problems and a vehicle for good management practice based on human factors principles of participation and principles that promote positive safety culture such as feedback, involvement, management commitment. The findings from the work are and always were intended to be for the specific application of a particular context, trackside workers in a railway IMC at the time of the research. The approach and follow up actions of the company

Table 6
One of the forty factors influencing safety behaviour and safety culture as presented in the full final report for the client

<table>
<thead>
<tr>
<th>Influencing factors</th>
<th>Definition/explanation</th>
<th>Potential impact on safe working practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inconsistent teams</td>
<td>Preference for non-mixed teams: issues of communication, trust in skill and ability</td>
<td>The effect of mixed teams on trust and knowledge in a working team is considered partly short term/immediate. However the provision of reliable staff that work together consistently could be the result of long term staff level planning and sits at a work organisation level</td>
</tr>
</tbody>
</table>

Table 7
Safety behaviour influencing factors classification system

<table>
<thead>
<tr>
<th>Classification</th>
<th>Definition/explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate/short term (I)</td>
<td>The influencing factor has an almost immediate effect on an unsafe situation. These immediate influencing factors are often more obvious to identify and are faster acting, with usually easier or more feasible solutions</td>
</tr>
<tr>
<td>Medium term (M)</td>
<td>These factors influencing unsafe behaviour occur at a time or place further back from the work. Their origins can be traced back through the process of work planning and organisation, and are generally under the control of supervisors and planners</td>
</tr>
<tr>
<td>Long term/strategic (L)</td>
<td>The effect of these factors is ongoing and originates from deeper within the organisation. The paths of these influencing factors from their origin to the worker on the track are often less clear and the effect is often less obvious. They tend also to be less clear cut in their management and solutions</td>
</tr>
</tbody>
</table>

The ‘organisation’ is considered to include other companies within the rail industry with which the IMC interface on a day to day basis.

4. Discussion

This section will consider the qualitative process performed within an organisation as an approach to investigating safety culture and unsafe behaviour within an organisation context and providing a guidance on how to manage these topics through discussion of the action taken subsequent to the research.

One of the primary reasons for writing this paper was to provide details of a piece of work that takes theoretical concepts and applies them to aid organisations in understanding their own functioning and how they could develop a strategy for improving it. It is an example of the use of a qualitative methodology being used in the real world as a tool to deal with practical problems and a vehicle for good management practice based on human factors principles of participation and principles that promote positive safety culture such as feedback, involvement, management commitment. The findings from the work are and always were intended to be for the specific application of a particular context, trackside workers in a railway IMC at the time of the research. The approach and follow up actions of the company
Table 8
Sample final high impact report presentation of the forty factors influencing safety behaviour and safety culture in railway maintenance track workers

<table>
<thead>
<tr>
<th>Influencing factor</th>
<th>Location</th>
<th>Routes for action</th>
<th>Feasibility</th>
<th>Illustrative quotes taken directly from interview tapes</th>
</tr>
</thead>
</table>
| Inconsistent teams/subcontractors      | ✓        | ✓ ✓              | ✓           | We could be COSSing a job and I have said ‘don’t go over there’ but they go over there and you can’t say anything to them because they are paying your wages  
If you don’t know your lookout you don’t feel as safe... occasionally work with crews that will allocate their own lookouts and occasionally they were blowing a train that had already passed  
We know each other’s strengths and weaknesses |

- Review of number of subcontract companies and style of contract
- Adequate control and supervision of subcontractors by SRM, using specifically trained ‘Site Agents’
- Including subcontractors in dissemination of research findings
are considered. The findings from this study are not in themselves surprising or unique when you consider the literature base used to code them. It is for these reasons that the focus of the discussion is the approach rather than the specific findings.

4.1. Qualitative approach

The qualitative methodology, using semi-structured group and individual interviews with staff working for the IMC and coding of results against a conceptual framework, was considered appropriate for the practical needs of the client and to develop an understanding of safety behaviour and safety culture and the contributors to them. The process was transparent and data were not lost at any stage of the data handling including even the final presentation, where the findings were required to be in a concise and meaningful form.

Data from the interviews are acknowledged as perceptions that have, to some degree, been interpreted by the researchers, but they have always been presented in that way. Perceptions are shaped by individual participants and those who recorded them. The organisation were clear about this and bore it in mind, balancing findings with other information they had to create a better picture of what could be leading to unsafe working practices.

This work does not claim to provide the whole answer to why people—rail maintenance staff—are unsafe and why a negative culture, may exist in an organisation, but it does present some tangible starting points for a strategy for the organisation concerned.

4.1.1. Qualitative research within an organisation

Performing research within organisations can present many obstacles (Buchanan et al., 1988) not least the practical problems of dealing with logistics and recruiting participants. The collaborative approach that ran through the entire project ensured commitment from the organisation and the independent trade unions and reduced many of the potential problems of access, credibility and response openness. The involvement of trade union representatives, we believe, was crucial to the success of this work, from initial recruitment, to vetting the interview and study process, to examining the interview contents and reports, through to the dissemination activities. Collaboration also ensured that the expertise of the Centre for Rail Human Factors was complemented by the in-depth knowledge of the organisation held by the staff and that their understanding of specific needs was always part of the research process.

4.1.2. Sampling

Sampling of the staff for the interviews was not, nor could be, completely representative of the staff working for the organisation. Some functions were not interviewed (e.g. Overhead Line) and there was little scope to assess the views across a range of competencies. For instance, it may have been useful, if politically difficult, to interview managers who were perceived by operators as being less skilled in their role as supervisors.
4.1.3. Limitations

With more time, the rich data in the database could have been analysed with a different emphasis, exploring different avenues and questions, but qualitative analysis is notoriously time consuming. Estimates vary, with suggestions that transcriptions alone may take five times the time of the interview (Bainbridge and Sanderson, 1995); a trial using a full transcription and coding of one interview required nine hours for one hour of interview time.

4.1.4. Comparison of the use of questionnaire and interview

A safety climate questionnaire had been administered within this IMC prior to the study reported here, but they wanted to know more about the factors behind safety issues and particularly some of the more negative ratings. They were also unsure about discrepancies between some of the more positive ratings from the questionnaire with what they believed. In order to inform future initiatives at the company the findings from this study using interviews and the data obtained through the safety climate questionnaire were made.

The comparison suggests that the some of the higher questionnaire scores for evidence of a positive safety culture within the IMC were not supported by the interview data. For example 85% of the questionnaire respondents reported that “if a serious problem arose compromising safety they would stop work”. This may be a truthful answer and possibly representative of responses from staff within the IMC, what it fails to tell us however, is what serious problems compromising safety as perceived track side workers, and what effect other factors such as social pressure, time pressure and competence and reporting pathways have on this element of safety behaviour for this particular group. This approach differs between the questionnaire and the interviews. The questionnaire aims to determine and measure the safety climate of the organisation and provide generic guidance for good practice based on a snapshot of the current climate. The interviews aim to understand why this climate may exist and to identify some of the factors specific to that organisation as a basis for action by the IMC. It is a more exploratory approach, which is what the IMC required.

The interview process provided other advantages for the purpose of meeting the IMC’s specific requirements. An ongoing relationship between the researchers, trade union representatives, the IMC and the study participants was cultivated through the face to face contact of interviewers, who continued to be involved in the project after the initial data collection and analysis and into dissemination and strategy formation. Questionnaires may sometimes be viewed as objective because of the distance between the researchers and respondents, but this distance can also explain why questionnaire response rates are low and the data may not always represent what is believed or observed to occur. There was even a suggestion in this study that meeting the independent researcher face to face may have encouraged honesty in the interviews, as participants can then make their own judgement on the trustworthiness of researchers. The continued commitment and feedback by the original interview participants was taken as a sign of a degree of success with this approach.
The lack of complete anonymity (more evident in the interview approach than questionnaire) meant the participants developed a sense of ownership of the project and the actions that were a result of the findings, exemplified especially in interactive briefing sessions.

The differences between the questionnaire approach previously used to evaluate the IMC’s safety culture and the interview approach of this study are not limited to the data collection methods but the whole research approach including data representation, information dissemination and follow up actions.

4.1.5. Analysis and validity issues

The final forty factors were derived from data that had been coded against a conceptual framework provided by literature in the area of safety culture, providing content validity to the analysis process (Dane, 1990). The first 100 factors based on the conceptual framework were presented to the organisation and the trade union representatives allowed member validation of data and any interpretations made of data (Miles and Huberman, 1994). The methods for the study and the final 40 factors were presented to other IMCs during an industry wide gathering as well as to human factors researchers and consultants working in rail at The Ergonomics Society Conference 2003. These measures are considered as attempts to validate the work in terms of face validity (Dane, 1990). Whether objectivity was achieved in order to capture truth about why railway maintenance workers are sometimes unsafe and whether we captured elements of their safety culture or climate is perhaps more difficult to answer. Miles and Huberman (1994) suggest a pragmatic view to the validation of qualitative research and that was the approach adopted for this work. The term utilisation is proposed as one type of validation that tests whether research findings are applicable and the actions taken as a consequence help to solve the problems being addressed. In light of the organisation requesting a second phase of work to assist with the implications of action plans that were recommended from the interview findings, this suggests the validity and credibility of this work within the field.

4.2. Findings

The forty influencing factors identified represent a range of contributions to safety behaviour. The inclusion of both expected (those factors closer to the frontline operators and their environments often targeted in safety campaigns) and less expected factors (more distal factors that lie within the systems and processes of an organisation and are dealt with less often when managing safety) and the detailed explanatory examples given reflect the commitment and insight shown by all participants. The “blame”, and “us and them” cultures that were evident from what was said in the interviews (and reported by many other rail groups informally over the years of our other studies) did not prevent track workers and managers throughout the organisation from openly recognising the variety of sources for unsafe behaviour and negative safety culture that existed (increasing the awareness of more distal causes of accidents as described by Reason, 1997).
There was also a strong underlying sense that safety was not perceived as just the responsibility of those who perform the work, and that the planners and supervisors had a strong influence on safety and how this was to be achieved. Many staff admitted that they look for an easy and comfortable way of achieving a task goal even if that may involve risk, or do not consider some risks because they have become the norm (routine violation).

Further from the sharp end, the senior management and policy makers within the organisation were seen as having considerable influence on how easy or difficult it was to be safe on the track. This was via the culture that was encouraged through examples set, their messages (direct and indirect through actions and statements), and their policies on everything from recruitment and training to dealing with the demands from their client, the railway infrastructure controller.

The separation of factors into the three categories denoting temporal and distance proximity to unsafe acts at track side whilst not an exact description enables those within the organisation to see how unsafe acts and culture permeate an organisation in many of its functions and in many of the roles within it.

5. What happened next?

It was agreed with the organisation that for implementation of any change strategies, the emphasis would be on a participatory approach, in sympathy with the way the information was originally gathered. The philosophy behind any changes and actions to be taken would be that of Reason’s (1997) five aspects of safety culture. The organisation has acted on the findings through several routes.

5.1. Risk assessment training

Risk assessment training was planned to address how some of the study findings could be included as factors considered in risk assessments at all levels, formal and informal. This was planned to be carried out through the company’s in-house training school. At the same time the influence of the training staff on operational staff perceptions and reinforcement of culture has been highlighted and particular attention was given to the crucial role of the training staff. They were seen as a key group for moving organisational messages that promote safety.

5.2. Interactive briefings

A dissemination programme began shortly after the completion of the interview and production of the various reports. Dissemination included “interactive briefing sessions,” where real world problems were worked through in groups, and the causal factors identified, with emphasis on the framework from this study. The more distal factors have become more apparent through this mechanism. High quality posters and pamphlets were produced to present results and disseminate and gain feedback, distributed widely within and outside the company.
Key individuals were trained to tease out the factors from the framework in interactive briefs, and disseminate the research findings to a wider audience. These individuals were made familiar with the research and the case studies, and were provided with training on facilitation techniques.

5.3. Safety critical role training

Controller of Site Safety (COSS) training and recruitment were reviewed, with emphasis beyond technical skills on the provision of those skills that are required to perform the important safety critical role of COSS.

5.4. Communication

Efforts to reduce unnecessary telephone calls to track staff, and appropriate diversion of these communications to supervisors and managers were begun.

5.5. Contractual staff

A working party was already reviewing the management of subcontractors and they were informed of the relevant issues from this study and how they relate to safe working practices and safety culture in general. One particular focus was the training of site agents (staff from the IMC who dealt directly with subcontractor staff on site).

5.6. Reporting systems

Accident and incident reporting systems were being reviewed as part of a second phase of work with the IMC; a reporting culture was seen as essential for the development of informed and learning aspects of safety culture within the IMC.

5.7. Management commitment

An overall company strategy that included all the above and the higher level safety related systems was worked upon. Safety was considered to be endemic in all systems and the organisation was keen to break down the demarcation between safety and performance. Safety and performance are still considered by many within rail to be incompatible goals since privatisation of the rail industry. The company wanted to look to manage safety in a way that would also help them move towards performance goals. At the same time it was important that this aim was made clear in the way that this work was communicated. The company wanted to begin breaking down the perception that actions required to achieve the two different goals were always different.

Many of the actions implemented as a result of this work were well received but the company has since ceased to exist in the form that it was when the work was performed. The maintenance function has begun to be taken back in house (becoming part of Network Rail) which will potentially result in an amalgamation of people from different IMCs and under new management.
The objective of this study was achieved in that an understanding of what lay behind the questionnaire responses was obtained through the interview approach. The project follow up actions including the dissemination of the study findings and the consultation with the organisation to set in motion a strategy for utilising the findings in a practical way is also evidence of achieving a major objective for this work. Some form of evaluation of the actions taken and their success would have provided a useful conclusion to the research; however the ever changing shape of the rail industry’s organisation prevented this.

6. Conclusions

All the evidence suggests that creating a positive safety culture is a challenge for most organisations. The general consensus appears to be that, although the individual does have a part to play, the environment created by the organisation largely determines the relevant attitudes, beliefs and perceptions of safety. Behaviour, safe or unsafe (including violations) is determined partly by the attitudes, beliefs and perceptions of individuals, and so the organisational safety culture can be considered to be what ultimately shapes behaviour.

The research reported in this paper concentrated on a specific organisation working in rail maintenance. Through careful and traceable identification of perceptions of the staff, from track workers to senior management, we have determined forty primary factors that are considered to influence track workers’ safety behaviour and the organisation’s safety culture. These factors span immediate “at the time of the job” factors, such as the behaviour of someone in a safety critical role, medium term factors such as supervisors’ visibility and longer term strategic factors such as the quality of organisational accident and incident reporting systems.

The findings of the study were of value to the IMC for whom this work was performed. It is the approach including the study design, data collection, data analysis and the dissemination of findings, that is considered to be of potential value to those investigating and applying the concepts surrounding safety culture.

Acknowledgement

The time and effort of staff that participated in this study including the safety representatives, trade union representatives and the managers who were the driving force behind the project was key to its success.

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