**Planning and Transport Research Centre**

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**Preliminary investigation into benchmarking the safety culture in the Australian rail industry**

**Izumi Hart**

*PhD Candidate, School of Psychology, Murdoch University*

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# Report on

# Rail Safety Culture Survey 2005

**"Preliminary investigation into benchmarking the safety culture in the Australian rail industry"**

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Izumi Hart
School of Psychology
Murdoch University/PATREC

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## *Executive Summary*

### 1. <u>Background</u>

A strong interest exists amongst the Australian rail industry in benchmarking safety culture. As signified by the revised Australian Standard 4292 Railway Safety Management (Standards Australia, 2006), it is now mandatory that rail operators implement systems to develop and maintain a positive safety culture. Railway operators will need to know how to develop such systems and will need tools to assess their effectiveness. Regulators will need to know what to look for in approving such systems and auditing their implementation.

Currently a number of safety climate surveys are available that enable respondents to express their attitudes and perceptions about safety within their workplace. These questionnaires however do not provide a clear indication of the assumptions, values and expectations underlying these attitudes, e.g. why they may be held.

### 2. <u>Aims</u>

The current project aimed to construct and pilot a survey to measure underlying dimensions of rail safety culture. This 5-month pilot study was conducted as a preliminary investigation for a 3-year PhD research project, due to start in Semester 1, 2006 at the School of Psychology, Murdoch University. Researchers agree that assessments of safety culture should involve the triangulation of

data from a number of different sources using different techniques (see Triangulation p.9). The aim of the PhD study will be to combine both quantitative and qualitative methods to construct a range of instruments for more reliably evaluating safety culture of any rail organisation in Australia.

In preparation for the PhD project, this preliminary investigation focused on:

1) the construction of a questionnaire to evaluate the safety culture of rail organisations; and
2) piloting the questionnaire in select organisations to evaluate its validity and relevance to the industry.

## 3.  Methodology

Interviews, focus groups and literature review identified current safety culture issues within the Australian rail industry, from which six main cultural dimensions were developed:

      1) Safety Values, Beliefs and Assumptions
      2) Leadership and Safety
      3) Structure of Safety (The Social Meaning of Safety)
      4) Cognitive Styles
      5) Behavioural Norms
      6) Drivers of Safety Performance

A 193-item self-report questionnaire "Rail Safety Culture Survey" was constructed based on the 6 main dimensions with a total of 17 sub-dimensions (see p. 11-12 for details). Two rail operators in Western Australia participated in a pilot study using the above questionnaire. A total of 67 staff members (62 men and 5 women) responded to either an electronic or pen-and-paper version of the questionnaire during the period from 29 Nov. – 12 Dec. 2005. The overall response rate was 23.93%.

The questionnaire assessed the demographics including the participants' accident/injury history, 17 sub-dimensions of each organisation's safety culture, and the respondents' feedback regarding its ease of use and relevance to the rail industry (see p.10 for details).

## 4.  Overview of Results/Findings

Four questions asking for the respondents' feedback to the questionnaire revealed:
1. 93.8% found it easy to understand.
2. 52.4% rated it easy to complete. (47.6% said it was average.)
3. 56.5% said the length was acceptable. (43.5% said it was too long.)
4. 83.3% said it was relevant to the industry. (8.3% said no, 8.3% said unsure.)

As anticipated the survey was too long. Most participants in group sessions completed the questionnaire within the allocated 30-minute period. However, such factors as literacy and ESL led some to persevere for up to an hour. A majority of the participants suggested the questionnaire raised points and issues **relevant to the rail industry**. As suggested, condensing the survey to a more manageable length will be one of the goals of future research.

Both the pen-and-paper and electronic versions appear to have worked well. Future studies would benefit from utilising these complementary formats, online completion via a web site being particularly desirable. Data analysis revealed that most of the scales for the sub-dimensions were internally consistent (highly reliable) and independent of one another (see p.13 for details).

## 5.  Overview of the Recommendations

*Methodology of Deployment*

Staff participation in the pilot study was encouraged both via intranet promotion and direct word-by-mouth approach. Further collaboration between organisations and researcher will be required to maximise these complementary approaches. It is critical that the researcher forms and maintains a close liaison with participating organisations to ensure that the study's purpose and value are clearly understood and supported and that optimum co-operation is achieved. Advance briefing of conduit

staff members (e.g. supervisors and team leaders) is essential for survey administration deployment, thus assuring anonymity and facilitating honest responses. Enhancing staff participation through incentives that satisfy the requirements of NHMRC's Human Research Ethics Guidelines (see p.13 for details) should also be explored.

### Measurement Issues

This project has applied the principles and methodology of the more established field of organisational culture research, including the questionnaire style and format, presentation of results and measures of objective safety outcomes. Measurement of these cultural factors may be possible using surveys of this kind as well as scenario-based options. In order to identify the most effective means of measuring aspects of *safety culture*, further theoretical and methodological refinement is recommended for the PhD research project, including format of questionnaire items and response scale (see p.14 for details).

### Scope of the Survey

Access to a representative sample is vital for formulating a reliable measurement strategy. A pool of over 500 participants is highly desirable to assess the psychometric properties (e.g. validity & reliability) of the questionnaire "Rail Safety Culture Survey". With the cooperation of a select number of organisations, a sample of this size in a long-term (2-3 years) program could result in adequate investigation of the questions and dimensions to arrive at an effective measure.

Longitudinal tracking is another crucial area. Safety culture of a specific sample can be assessed at one time with progress/change being tracked after an appropriate period (e.g. 18 months). This would provide a measure of the effectiveness of an intervention or impact of an incident or change. Similarly, comparison could be made between a control group and a treatment group which has experienced an intervention to improve safety performance. The research strategy will be planned taking cognisance of the desirability of nation-wide participation, longitudinal tracking and intervention as well as time and budgetary constraints.

### Profiling & Presentation Format

This preliminary investigation provided scope for experimentation with graphic diagrams of data analysis. The Advisory Panel's feedback about usefulness of style and complexity of presentation of the dimensions in the diagrams is welcomed, if simplifying the dimensions and regrouping sub-dimensions appear to be warranted.

One potential outcome of future research could be to produce a software package for computer-based survey administration and profiling. Organisations could then 'self-administer and report' without impacting on the quality of analysis. This could be feasible through inter-disciplinary collaboration (including IT specialists) and requisite funding.

### Advisory Panel

The value of an advisory panel involving industry experts was amply demonstrated during this preliminary investigation. It would be ideal to have a similar arrangement for the PhD research project.

## 6. Outcomes

This preliminary investigation revealed a high level of industry interest and support for a larger, long-term research program to investigate benchmarking of rail safety culture. On the whole, this project has succeeded in developing a potential tool for rail organisations to measure their safety culture for the improvement of their safety performance.

## *Introduction*

### Background

A number of tragic rail accidents have occurred in recent years, particularly in NSW.  This had led to increased public and industry scrutiny (e.g. McInerney, 2001, 2005) and contributed to a heightened awareness of human and other factors that may help improve safety in the Australian rail industry.  The quality of the 'safety culture' of an organisation is widely believed to be an important factor associated with safety outcomes (Cox & Cox, 1991; Cox & Flin, 1998; Mearns & Flin, 1999).  This has led the rail industry to develop a strong interest in finding out how an organisation's safety culture may be measured or otherwise characterised and associated with the quality of its safety performance (e.g. Clarke, 1998; McInerney, 2005).

### Aims of this Research

This preliminary investigation explored the construction of a survey instrument to benchmark the safety culture of rail organisations in Australia in preparation for a more extended PhD study.  The PhD will aim to develop a range of safety culture instruments by triangulating various quantitative and qualitative approaches.   However, this preliminary investigation has focused on only a part of this plan and aimed to:

1) Construct a survey instrument to measure organisational safety culture and evaluate its psychometric properties; and
2) Identify key factors underlying the Australian rail safety culture relevant to the development of the survey tool as well as the long-term benchmarking of safety culture.

### Process:

This preliminary investigation has been constructed in two parts.

- **Phase 1**: Investigation of current safety issues within the Australian rail industry.  This was done in two steps:
  a) Interviews with people who work in rail-related industries to identify potential factors that characterise the safety culture in the industry; and
  b) Construction of a questionnaire based on an analysis of the interviews.

Interviews were held with over 30 people from rail-related industries representing a wide cross-section of roles and expertise, in WA, NSW, Canberra, Victoria & South Australia.  They included drivers, maintainers, operators, managers, trade union officials, investigators and regulators.

A questionnaire was constructed in both pen-and-paper and electronic formats.  It contained a total of 193 items (questions) (see Methodology, p.10 for details).

- **Phase 2:** Piloting a questionnaire specifically designed for the rail industry with select participating organisations.  Again, this phase was carried out in two stages:
  a) Administration and analysis of the survey in 2 organisations to identify validity and relevance of the questionnaire to the industry; and
  b) Development of a proposal for a more extensive validation research program (PhD) based on the results of the pilot study.

### Definition

The term 'safety culture' rapidly gained popularity in safety management vocabulary after the Chernobyl nuclear disaster in 1986.  It arose from a common presumption that a positive safety culture would contribute to improved safety performance (Cox & Flin, 1998; Mearns & Flin, 1999).  However, this presumption emerged before academic research could substantiate the existence, theoretical definition and validity of the construct (Cox & Flin, 1998).

Furthermore, the terms *safety climate* and *safety culture* have been used interchangeably, which has added to the theoretical confusion amongst both theorists and safety practitioners (Mearns & Flin, 1999). Recently, however, theorists have converged on the view that the two are inter-related and that <u>safety climate is a component of safety culture</u> (Cox & Flin, 1998). They have also reached some agreement on the definition, measurement and utility of the two constructs (Cox & Flin, 1998; Glendon & Stanton, 2000).

*Safety climate* is conceptualised as a surface manifestation of the underlying safety culture as illustrated by observable safety behaviours and expressed attitudes of employees (Cheyne *et al*., 2002; Mearns *et al*., 2001, Flin, 2003; Guldenmund, 2000; Pidgeon, 1991). It can be "viewed as a *temporal state* measure of culture" which provides a "shared perception of the organization at a discrete point in time" (Cox & Cheyne, 1998; cited in Cheyne *et al*., 1998; p.256).

Conversely, *safety culture* is defined as something an organisation *is* - the beliefs, attitudes, values of its members regarding safety and as something an organisation *has* - the structures, practices, controls and policies designed to enhance safety (Reason, 1998). Safety culture is considered to have *trait*-like qualities that are not easy to change, which can be described as an *enduring personality* of the organisation pertaining to safety (Cheyne *et al*., 1998).

As the safety culture consists of the values, beliefs and assumptions, which form the <u>core</u> of how the organisation is in relation to safety, understanding the safety culture will elucidate why the organisation's safety climate is the way it is at a given time. This may also assist in planning ways to bring about fundamental changes to enable an organisation to improve its safety performance (Cameron & Quinn, 1999).

As *safety climate* and *safety culture* have become more clearly differentiated, it is recognised that a majority of so called "safety culture" studies conducted over the past two decades have in fact been dealing with *safety climate* rather than safety culture. No study has been reported so far that explores the *safety culture* rather than the safety climate within any industry, or more specifically of the Australian rail industry. Furthermore, few studies have looked at the relationships between safety culture and objective safety outcomes (review by Mearns & Flin, 1999).

## Measurement of *safety climate* and *safety culture*

How do we measure safety climate and safety culture?

### *Safety Climate*

Typically, *safety climate* measures have focused on evaluating employees' perception of how the company is positioned with regard to safety issues. Dov Zohar (1980) began the safety related survey trend, when he assessed safety climate in production companies in Israel. A review of safety climate questionnaires reveals there are 5 core themes to safety climate (Flin *et al*, 2000):

- Perceptions of *management and supervisor attitudes* to safety, production, or other HR or business issues
- Aspects of the *safety systems* (safety management system, safety policies, safety equipment, permit to work systems, safety officers, safety committees)
- Perceptions of *risk* and *risk taking behaviour* (self-reported risk taking, perceptions of risk/hazards, attitudes towards risk and safety)
- *Work pressure* (work pace, work load, balance between production and safety)
- Perceptions of workers' <u>competence</u> in relation to safety and HR processes relevant to selection, training, competence standards and their assessment.

In Australia, Dr. Ian Glendon has pioneered the assessment of *safety climate* of the rail industry as exemplified in the RailCorp Safety Survey in the Special Commission of Inquiry into the Waterfall Rail Accident (McInerney, 2005). It was designed to collect the staff's perception of the safety standards within the organisation. The RailCorp Safety Survey (Glendon, in McInerney, 2005) is a

self-report paper-and-pencil questionnaire. The respondent is asked to rate the degree to which he/she agrees with a statement/description from a 5-point Likert scale. A majority of items deals with the workers' perceptions of the 5 core themes, as outlined above. For example, out of 48 questions in the RailCorp Safety Survey (Glendon, in McInerney, 2005), 34 questions asked how the respondent perceived the company in areas including communication, staff involvement, leadership, training, resources, environment and procedures in relation to safety; e.g. "Staff are encouraged to consider safety as more important than keeping to schedule." and "Operational equipment is maintained to a safe standard.", to a response scale ranging from "Strongly Disagree" to "Strongly Agree".

### Safety Culture

Measurement of *safety culture* remains less explored, as researchers have traditionally tended to look at safety climate under the guise of safety culture (review by Mearns & Flin, 1999; Glendon & Stanton, 2000). In a broader perspective, however, *organisational culture* has much to offer, as one can draw upon the considerable wealth of knowledge accrued from rigorous research methodology that has been established through robust empirical evidence (e.g. Schein, 1992). As safety culture is generally viewed "as a subset of organizational culture (underlined by the author), where the beliefs and values refer specifically to matters of health and safety" (Clarke, 1999, p.185), the current investigation aims to extend the principles and methodology of the more established field of organisational culture research.

*Organisational culture*, the overall culture of an organisation, refers to "the taken-for-granted values, underlying assumptions, expectations, collective memories, and definitions present in an organization. It represents 'how things are around here.' … (abbreviated by the author)… An organization's culture is reflected by what is valued, the dominant leadership styles, the language and symbols, the procedures and routines, and the definitions of success that make an organization unique (Cameron & Quinn, 1999, p.14)."

Measurement of organisational culture has tended to be categorised in a number of dimensions. I present two examples. The Organizational Culture Inventory (OCI) (Cooke & Szumal, 2000) is a self-report paper-and-pencil diagnostic instrument designed to measure normative beliefs and shared behavioural expectations in organisations. The respondent is asked to rate the degree to which he/she agrees with a statement/description from a Likert scale. (Limited details are available as this inventory is copyrighted.)

The twelve dimensions of the OCI are; 1) Humanistic-Encouraging norms, 2) Affiliative norms, 3) Approval norms, 4) Conventional norms, 5) Dependent norms, 6) Avoidance norms, 7) Oppositional norms, 8) Power norms, 9) Competitive norms, 10) Perfectionistic norms, 11) Achievement norms, and 12) Self-Actualising norms.

The results of the OCI's data analysis are plotted in a circumplex. The twelve dimensions are grouped into three broad categories, 1) constructive, 2) aggressive/defensive, and 3) passive/defensive styles. The further out towards the edge of the circumplex the score is, the more likely the organisation is to have these characteristics.

A second example of dimension-based analysis is the Organizational Culture Assessment Instrument (OCAI), designed to illustrate how an organisation operates and the values that characterise it (Cameron & Quinn, 1999). This inventory is based on a theoretical model the *Competing Values Framework*. After extensive review of literature and analysis of empirical data, this model has been found to demonstrate "a high degree of congruence with well-known and well-accepted categorical schemes that organize the way people think, their values and assumptions, and, the ways they process information" (Cameron & Quinn, 1999, pp.29-30).

The OCAI is a self-report paper-and-pencil diagnostic instrument with six core questions. Four statements are provided in response to each one of the six questions. The respondent is asked to

rate the degree to which he/she agrees with each of the four statements by assigning points that add up to 100 points across the four questions.

Dimensions of the OCAI are broadly categorised in two groups; *content* and *pattern* dimensions. Content dimensions reflect "fundamental cultural values and implicit assumptions about the way the organization functions" (Cameron & Quinn, 1999, p.137). The OCAI captures organisational culture in the following six content dimensions (Cameron & Quinn, 1999, p.137):

1) the *dominant characteristics* of the organization
2) the *leadership style* and *approach* that permeate the organization
3) the *management of employees* or the style that characterizes how employees are treated and what the working environment is like
4) the *organizational glue* or bonding mechanisms that hold the organization together
5) the *strategic emphases* that define what areas of emphasis drive the organization's strategy
6) the *criteria of success* that determine how victory is defined and what gets rewarded and celebrated.

The pattern dimensions, on the other hand, refer to "a cultural profile that is produced by scoring a culture assessment instrument" (Cameron & Quinn, 1999, p.137). The OCAI can identify an organisation's *cultural strength*, *congruence* and *type*, which represent the three pattern dimensions that appear most prominently and frequently in the literature.

The results of the OCAI's data analysis are profiled and plotted in a multi-dimensional graph. Through the observation of the overall cultural profile of an organisation as assessed by the six content dimensions, it is possible to measure the strength of the dimension. By reviewing the profiles in relation to each of the six scenario-based questions separately, it is possible to detect the extent the six profiles are congruent/incongruent with one another. Finally, the culture profiles as expressed in the quadrant consisting of 1) Clan, 2) Adhocracy, 3) Market, and 4) Hierarchy enables an easy identification of the culture type of that organisation. The OCAI also allows profiling of sub-cultures, and desired vs. actual state of an organisation's culture.

The above are examples of established and valid methodologies for diagnosing organisational culture, the principles of which could be extended to measurement of *safety culture*. These measures focus on the underlying assumptions and values expressed in the organisation and do this by using question-and-response scales focused on observable behaviours. They are different from the diagnostic tools for gauging *safety climate*, as illustrated earlier (e.g. Zohar, 1980 and Glendon in McInerney, 2005), which seek levels of agreement with statements to provide an overview of perceptions and attitudes.

### *Triangulation*
Researchers agree that different approaches to the measurement of safety culture should be treated as complementary and not as alternatives as they each contribute to the safety culture picture (Cox & Flin, 1998; Mearns & Flin, 1999; Glendon & Stanton, 2000; Glendon, 2005). The qualitative approaches include case study analysis, behavioural observation, interviews, focus groups, and archival reviews. Quantitative approaches include measurement of LTIs, TRCs, number. of incidents and near-misses (Cox & Flin, 1998; Mearns & Flin, 1999; Glendon, 2006). The pilot study for this project has focused on testing a quantifiable culture measure rather than combining a range of different approaches. A further investigation could look at how all these could be triangulated (combined).

### Rationale for this Study

The author has witnessed a strong interest in and support for this research during her current preliminary investigation. This was apparent during interviews with a wide cross-section of stakeholders in the rail industry across Australia. The author observed comparable enthusiasm and co-operation during her interactions with the Advisory Panel members and with rail operators who participated in the pilot study in Western Australia.

This project has applied the principles and methodology of the more established field of organisational culture research with measures of objective safety outcomes, e.g. questionnaire style and format, as well as the presentation of results.   Its unique contribution to the literature will be its conceptualisation and measurement of *safety culture* (not *climate*), and its specific cultural relevance to the Australian rail industry.

A safety culture measure of this kind has a wide industry application including comparison of *sub-cultures of safety*, diagnosis of desired vs. actual state of the safety culture, implementation of cultural change interventions with select rail organisations across Australia, and the consequent longitudinal tracking of their safety cultures.   Once this measure has been validated at the organisational level, additional questionnaires could then be developed at the team and individual levels to evaluate organisations and individuals to measure and to target specific levels and areas for cultural change.

## *Methodology*

### *Participants*
Two rail operators in Western Australia participated in a pilot study using a measure for evaluating the safety culture of their respective organisation.   Sixty-seven staff members (62 men and 5 women) completed a self-report questionnaire.

### *Materials*
The questionnaire "Rail Safety Culture Survey" was made available in both pen-and-paper and electronic formats.   It contained a total of 193 items (questions), 18 of which pertain to demographics including the participants' accident/injury history. Of these 193 items, 170 items referred to questions regarding the organisation's general beliefs, values and assumptions about responsibility for safety, leadership style in safety management, cognitive style, social meaning of safety, behavioural norms, competing priorities and driving forces behind safety culture.   They included items such as "Co-workers commend me for raising safety concerns" (group interactions regarding safety) and "They tend to challenge and disregard safety advice & recommendations" (colleagues' awareness).   Respondents rated the items on a 5-point Likert-type scale ranging from 1 (*Definitely not true*) to 5 (*Definitely true*), indicating to what extent, in their belief, the items reflected their organisation.   The remaining 5 items included respondents' feedback regarding the ease of the language used and the ease of filling in the questionnaire, its length and relevance to the participants' organisation and the rail industry.   The items included "How did you find filling in this questionnaire?" with Likert-scale responses "The format was ☐ easy ☐ average  ☐ difficult".

### *Response*
Organisation A promoted the E-version on their intranet system directed to all staff from 29 Nov. – 7 Dec. 2005. Forty-nine responses were received (over 200 hits).   Organisation B promoted the pen-and-paper version via the team supervisors.   Out of possible 60 respondents 18 people participated in group sessions on 12 Dec. 2005.   The overall response rate was 23.93%.

## *Safety Culture Dimensions*

*The following section describes the 17 individual safety factors (sub-dimensions) that make up the overall Safety Culture scores.*

There are six main dimensions to this scale and each has a number of sub-dimensions.   The aim is to profile the organisation on each of these 17 sub-dimensions.   The last dimension *Drivers of Safety Performance* provides an assessment of the influences on or context for the safety culture described.

1. <u>**Safety Values, Beliefs and Assumptions**</u>

*Responsibility for Safety*

- Measures general beliefs and assumptions towards *responsibility* for workplace safety within the organisation**.**

*General Values, Beliefs, and Assumptions regarding Safety*

- Measures general values, beliefs and assumptions towards workplace safety within the organisation.

2. <u>**Leadership and Safety**</u>

*Management Approach to Safety*

- Represents management's approach to safety including their involvement and the example they set in encouraging a safe working practice/environment.

*Supervisor's Approach to Safety*

- Represents supervisor's approach to safety including their involvement and the example they set in encouraging a safe working practice/environment.

*Safety Communication between You and Management*

- Measures the level and quality of communication between management and employees with regard to safety issues, and whether management encourages employee input in such issues.

*Safety Communication between You and Your Supervisor*

- Measures the level and quality of communication between supervisors and employees with regard to safety issues, and whether supervisors encourage employee input in such issues.

*Trust/Cynicism*

- Represents the general level of trust vs. cynicism amongst organisational members regarding one another's safety behaviour.

3. <u>**Structure of Safety (The Social Meaning of Safety)**</u>

*Structure of Safety*

- Measures the general management of safety within the organisation including; the existence of safety policies and procedures; the enforcement of safety rules; and the availability of safety training.

*Safety Environment*

- Measures the safety environment within the organisation including; the availability and maintenance of safety equipment; the availability of safety instructions; and the presence of procedural safety information.

*Communication of Safety within the Organisation*

- Measures the quality of communication within the organisation and between divisions concerning safety initiatives.

4. <u>**Cognitive Styles**</u>

*Rational Thinking*

- Measures ability and engagement in rational, analytical and logical thinking.

*Experiential Thinking*
- Measures ability and engagement in intuitive, automatic thinking based on experience.

*Consideration of Future Consequences*
- Measures the extent to which workers consider the potential implications of their action on future consequences.

## 5. Behavioural Norms

*Group Interactions*
- Measures the group interaction regarding safety within the organisation such as how co-workers behave with regard to one another's safety.

*Colleagues' Awareness of Safety Rules and Procedures*
- Measures co-workers' awareness of safety rules and procedures at work and their willingness to act in a safe manner.

## 6. Drivers of Safety Performance

*Priorities*
- Measures the extent to which safety is a main priority within the organisation in comparison to other issues such as productivity and public scrutiny.

*Main Driving Forces behind Safety Culture*
- Identifies the main driving forces behind workplace safety within the organisation.

## *Results and Outcomes of the Pilot Study*

### *Completion of the Questionnaire*
Both the pen-and-paper and electronic versions appear to have worked well. Some difficulties were encountered with the e-version, which included an overload of the responses due to the questionnaire's large data file. Some participants did not attach the completed questionnaire or tried to incorporate the questionnaire into the URL, rendering the data inaccessible. These issues could be resolved in future studies by investigating the possibility of online completion via a web site.

Four questions asking for the respondents' feedback to the questionnaire revealed:

1. 93.8% found it easy to understand.
2. 52.4% rated it easy to complete. (47.6% said it was average.)
3. 56.5% said the length was acceptable. (43.5% said it was too long.)
4. 83.3% said it was relevant to the industry (8.3% said no, 8.3% said unsure.)

A majority of the participants suggested the questionnaire raised points and issues relevant to the rail industry. The main area for improvement suggested is to condense the survey to a more manageable length. This will be one of the goals of future investigations.

Internal consistency (Cronbach-$\alpha$) for the respective sub-scales were as follow:

1. Responsibility for Safety: 0.74
2. General Values, Beliefs and Assumptions regarding Safety: 0.78
3. Management Approach to Safety: 0.90
4. Supervisor's Approach to Safety: 0.91
5. Safety Communication between You and Management: 0.93
6. Safety Communication between You and Supervisor: 0.91
7. Trust/Cynicism: 0.88
8. Structure of Safety: 0.76
9. Safety Environment: 0.92

10. Communication of Safety within the Organisation: 0.88
11. Rational Thinking: 0.91
12. Experiential Thinking: 0.50
13. Consideration of Future Consequences: 0.88
14. Group Interactions: 0.67
15. Colleagues' Awareness of Safety Rules and Procedures: 0.91
16. Priorities: 0.87
17. Main Driving Forces behind Safety Culture: 0.74

With the exception of sub-dimensions 12 and 14, data analysis revealed that the scales for the sub-dimensions were internally consistent (highly reliable) and independent of one another.

## *Review of the Pilot Study*

*The following section provides an overview of the learnings from the pilot study.*

### Methodology of Deployment

Staff participation was encouraged both via intranet promotion and direct word-by-mouth approach. Intranet seemed an effective means of communicating the purpose and the nature of the pilot study. The verbal approach, on the other hand, was dependant on the supervisor who promoted the pilot, e.g. to what extent he/she understood and appreciated the value of the study and communicated clear expectations to the staff. A strategy for improving deployment is discussed below. In addition, modest incentives could be considered for future surveys. However, this will need to be within the bounds of NHMRC's Human Research Ethics Guidelines. For example, gift vouchers for a few randomly selected individuals as token of participation are allowed, while anything that could be construed as payment or coercion to participate is not.

### Liaison with Clients

Due to the extreme time constraints, the researcher was not able to sufficiently liaise with the participating organisations, particularly in terms of directly briefing people who acted as the conduit (e.g. supervisors and team leaders) for deploying their team members for group administration. This is a critical issue that needs to be addressed to ensure clear expectations and honest responses.

### Briefings made to Participants

Insufficient briefing resulted in some confusion and a lack of information about the purpose and intent of the survey. For instance, some participants attended group sessions not quite knowing what sort of survey they came to participate in. The researcher clarified the purpose of the survey at the beginning of each group session.

### Openness to the Researcher:

Good levels of communication with the researcher occurred when no supervisors were present during the group sessions. Questions included:
- Was it their organisation that requested the survey to be administered? (The answer was "No. It was the researcher who requested their organisation to participate in the pilot study.")
- Are the results going to be shared with the participants? (The answer was that a report will be made available to management.)

As expected the survey was too long (despite the feedback - 56.5% said the length was acceptable vs. 43.5% said it was too long. See the Results section, p.12). The participants visibly tried hard to answer the items. Some were non-English speakers and it seemed rather taxing to tackle the long list of heavy-worded items. Although 30 minutes were allocated to each group session, some people (both native and non-native English speakers) spent nearly an hour carefully considering and answering the questions. A reliable measure can be developed only through an evolutionary

process. It requires data collection from an extensive representative sample, followed by critical analysis to identify those questions that add the most value and those that can be eliminated.

## *Conclusions and Recommendations for Future Studies*

*The following section provides an overview of research ideas raised by this study.*

### Measurement Issues

As mentioned previously, there is agreement that assessments of safety culture should involve the triangulation of data from a number of different sources using different techniques (Cameron & Quinn, 1999). Currently a number of safety climate surveys that enable participants to express their perceptions and attitudes about safety within their workplace are in use. These questionnaires however do not provide a clear indication of the assumptions, values and expectations underlying these attitudes, e.g. why they may be held. The measurement of these cultural factors could be possible using surveys of this kind as well as scenario-based options. Some ideas for the development of a cultural measure are outlined below.

### *Scenario-based Items*

When conducting a culture survey, it is of primary importance that items in a questionnaire address the underlying values and assumptions (*culture*) and not only superficial attitudes or perceptions (*climate*). It is argued that a scenario-based approach can best accomplish the task, whereby written scenarios serve as emotional and cognitive cues to bring forth underlying core cultural attributes (e.g. Cameron & Quinn, 1999). Using scenarios enables the respondent to report to what extent the written scenarios are indicative of their own organisation's culture (Cameron & Quinn, 1999).

### *Response Scale*

In the "Rail Safety Cultural Survey", the items are also scenario-based although framed in a single, more simplistic frame than those suggested above. The 5-point Likert-scale for the responses was designed to address the cultural aspects by asking the respondent to rate the given scenario in terms of how "True/Untrue it was for the organisation". Conscious effort was made to depart from the conventional climate response scale "Agree/Disagree" which addresses the respondent's perception, and move towards a scale that addresses "meaning". This was consistent with the organisational culture questionnaires described previously. Whether the wording makes sufficient difference in what it addresses or whether this is only semantic subtleties needs to be further explored. It may also be plausible to use a response scale that requires rating in terms of frequency or numerical value. For instance, to a question "To what extent does the following statement reflect your organisation?" and a scenario "The workplace is clean and well organised", one could use a response scale ranging from "never" to "always" or from "0-10% of the time" to "90-100% of the time" to capture frequency. Further theoretical and methodological clarity and refinement will be warranted for the PhD project.

### Scope of the Survey

It is essential to formulate a measurement strategy which provides access to a representative sample. For the purpose of assessing the psychometric properties (e.g. validity & reliability) of the questionnaire "Rail Safety Culture Survey", a pool of participants over 500 is desirable. It could be carried out in a large-scale and long-term (2-3 years) program with a select number of organisations. A sample of this size would enable adequate investigation of the questions and dimensions to determine the best and most effective measure.

Longitudinal tracking is another area to be explored. Safety culture of a specific sample can be assessed at one time with progress/change being tracked after an appropriate period (e.g. 18 months). This could provide a measure of the effectiveness of an intervention or impact of an incident or change. Similarly, comparison could be made between a control group and a treatment group which has gone through an intervention to improve safety performance. The research

strategy will be planned taking cognisance of the desirability of nationwide participation, longitudinal tracking and intervention, as well as time and budgetary constraints.

### Profiling & Presentation Format

This preliminary investigation provided scope for experimentation with graphic diagrams of data analysis. The Advisory Panel's feedback about usefulness of style and complexity of presentation of the dimensions in the diagrams is welcomed, if simplifying the dimensions and regrouping sub-dimensions appear to be warranted.

One potential outcome of future research could be to produce a software package for computer-based survey administration and profiling. Organisations could then 'self-administer and report' without impacting on the quality of analysis. This could be feasible through inter-disciplinary collaboration (including IT specialists) and requisite funding.

### Advisory Panel

The PhD research project will benefit from an advisory panel involving industry experts, as was amply demonstrated during this preliminary investigation.

## Sample Report Summary and Outcomes

*The following presents a sample of the safety culture profile and summary comments that can be made using this survey tool. The following is a sample overview using fake data.*

# SAMPLE – *Fake Data*

## Summary of Results and Performance Improvement Ideas

| Findings in Summary | Weaknesses and Proposed Solutions or Ideas |
|---|---|
| **Overall Safety Culture** | |
| ▪ *Safety Values, Beliefs & Assumptions*: In general, employees possess positive values and beliefs towards responsibility for safety within the organisation. <br><br>▪ *Leadership & Safety*: Overall results were slightly positive across all areas of leadership and safety. <br><br>▪ Employees who had been involved in a Lost Time Injury, Team Members, and those in Maintenance & Operations positions predominantly rated the way safety is managed and communicated within the organisation less positively than those who had not been involved in an accident/injury and those in Management positions. <br><br>▪ Managers and Supervisors rated positive scores to a majority of safety culture dimensions. <br><br>▪ It is possible that either the safety approach is not as effective as those implementing safety feel it is; or they are failing to reach a large proportion of employees with their initiatives, or possibly a combination of both. <br><br>▪ *Structure of Safety:* Overall results were slightly negative regarding the structure of safety across most groups. <br><br>▪ Respondents reported that the existence of policies and procedures and the enforcement of safety may be lacking, as is effective communication between the divisions regarding safety initiatives. <br><br>▪ Those who had been involved in any sort of safety incident rated the physical environment as particularly negative with regard to safety. <br><br>▪ *Cognitive Styles:* Use of both rational and experiential thinking styles is positive and well balanced. Results also suggest that employees consider the safety consequences of their actions relatively seriously. <br><br>▪ *Behavioural Norms:* Overall behavioural norms rated slightly to moderately negative in all dimensions. <br><br>▪ This indicates that co-workers often fail to take | *Areas in which scores were not predominantly positive include:* <br><br>▪ The large rating discrepancy between Management and those working in the actual physical environment (Team Members) in relation to the general safety culture of the organisation. <br><br>▪ Ratings by some sub-groups that the organisation's general approach to safety is ineffective and that communication between themselves and their Managers/Supervisors is insufficient. <br><br>▪ Ratings by some sub-groups of the group interactions and their colleagues' safety awareness as insufficient. <br><br>▪ A lack of adequate safety policies and procedures and insufficient enforcement of rules. <br><br>▪ A lack of safety communication between divisions. <br><br>▪ Slightly negative ratings amongst some sub-groups regarding the safety of the physical working environment (including maintenance, equipment etc.) <br><br>*Opportunities for Improvement Include:* <br><br>*Please note that the following is a list of informal suggestions to further stimulate discussion amongst those who are already working on enhancing the organisation's safety standards/performance. It is by no means intended to be a set of prescriptive remedies to address any less desirable aspect of the safety culture diagnosed in this report.* <br><br>▪ Increase employee participation in safety initiatives to increase ownership and encourage more personal responsibility. <br><br>▪ Introduce more formal policies and ensure that employees are aware of those currently in place. <br><br>▪ Introduce more safety training for employees. <br><br>▪ Encourage Management to set an example in safety initiatives and ensure that safety rules are enforced. |

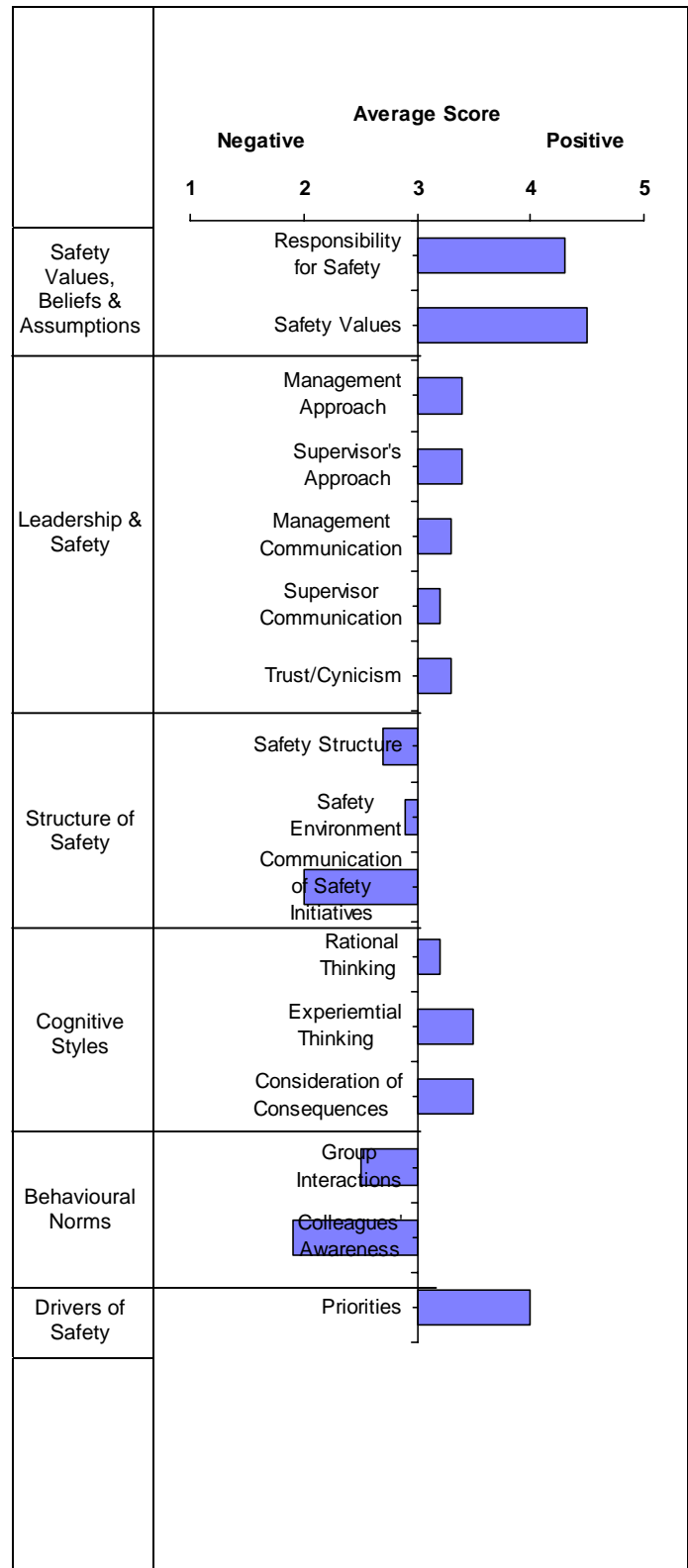| Findings in Summary | Weaknesses and Proposed Solutions or Ideas |
|---|---|
| into consideration the safety of themselves and others in their behaviours at work; and that employees are generally unaware of, or do not abide, by safety rules and procedures.<br><br>▪ *Drivers of Safety:* Overall results indicated that safety is definitely a main priority within the organisation in comparison to other factors such as productivity. | ▪ Management needs to be made aware of the differences in the ratings in job levels and types and perhaps look at safety from a more ground level approach.<br><br>▪ Work on reducing the employees' dismissiveness towards the current safety approach, which they see as owned by Management.<br><br>▪ Implement and encourage employee input on safety initiatives to increase their ownership and feeling of involvement in the process. This is particularly important for Team Members and those in Maintenance & Operations positions.<br><br>▪ Encourage feedback from all employees on workplace safety.<br><br>▪ Ensure that Managers and Supervisors are effectively communicating safety initiatives and are encouraging feedback. It may be that the initiatives do exist and could be effective but are not readily seen by other employees.<br><br>▪ Ensure safety equipment is supplied and maintained regularly, that safety instructions are readily available and that the work environment is continually monitored for safety. This may be particularly important for high risk positions (such as Maintenance & Operations workers).<br><br>▪ Ensure that awareness of workplace safety is factored into employment selection criteria. |

## Analysis of 16 Sub-Dimensions

# SAMPLE – *Fake Data*
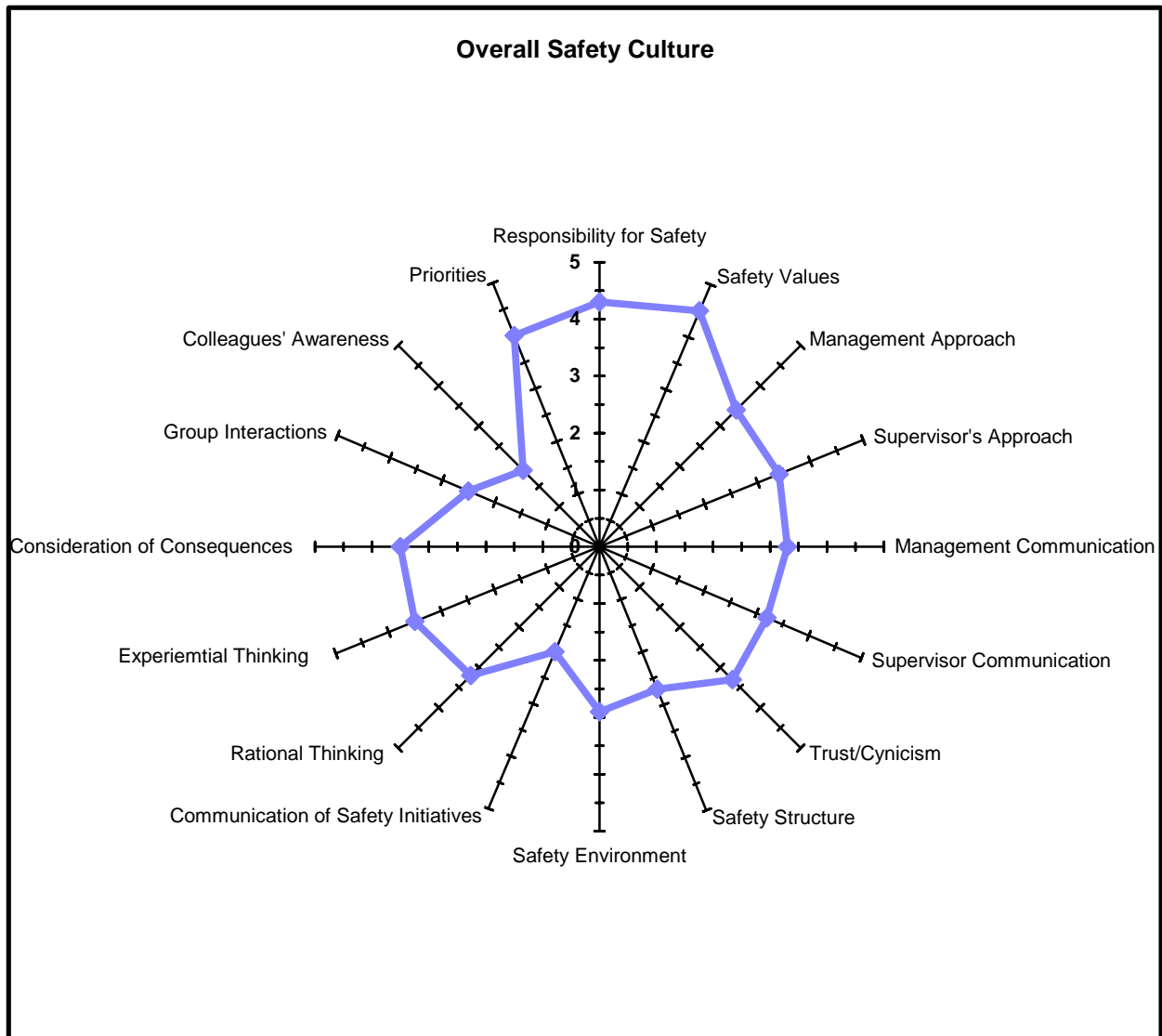
## Overall Safety Culture

*The information below shows your organisation's Safety Culture. Higher scores on the charts represent a more positive culture in each sub-dimension.*

**Summary of Results**

- The first dimension *Safety Values, Beliefs & Assumptions* rated highest in terms of safety culture.

- The most positive sub-dimension was *General Values, Beliefs, and Assumptions regarding Safety* (labelled *Safety Values* in the chart), followed by sub-dimension *Responsibility for Safety*. These suggest that employees have good general values towards safety and understand their responsibility in preventing accidents.

- Results also indicated that *Priorities* were moderately positive suggesting that safety is a main priority within the organisation in comparison to other factors such as productivity.

- Negative results (below score 3) were reported in relation to the overall *Structure of Safety* in the organisation. Repondents rated communication between divisions regarding safety initiatives as insufficient.

- *Behavioural Norms* also rated negatively; in both sub-dimensions *Group Interactions* and *Colleagues' Awareness of Safety Rules and Procedures.* This suggests that employees may not be putting their safety values to practice in the work team setting.

| | | Average Score |
|---|---|---|
| | | **Negative**          Positive |
| | | 1        2        3        4        5 |
| **Safety Values, Beliefs & Assumptions** | Responsibility for Safety | |
| | Safety Values | |
| **Leadership & Safety** | Management Approach | |
| | Supervisor's Approach | |
| | Management Communication | |
| | Supervisor Communication | |
| | Trust/Cynicism | |
| **Structure of Safety** | Safety Structure | |
| | Safety Environment | |
| | Communication of Safety Initiatives | |
| **Cognitive Styles** | Rational Thinking | |
| | Experiemtial Thinking | |
| | Consideration of Consequences | |
| **Behavioural Norms** | Group Interactions | |
| | Colleagues' Awareness | |
| **Drivers of Safety** | Priorities | |

# SAMPLE – *Fake Data*

**Overall Safety Culture**

## Safety Culture and Gender

*The information below shows your organisation's Safety Culture, differentiating between males and females. Higher scores represent a more positive safety culture in each sub-dimension.*
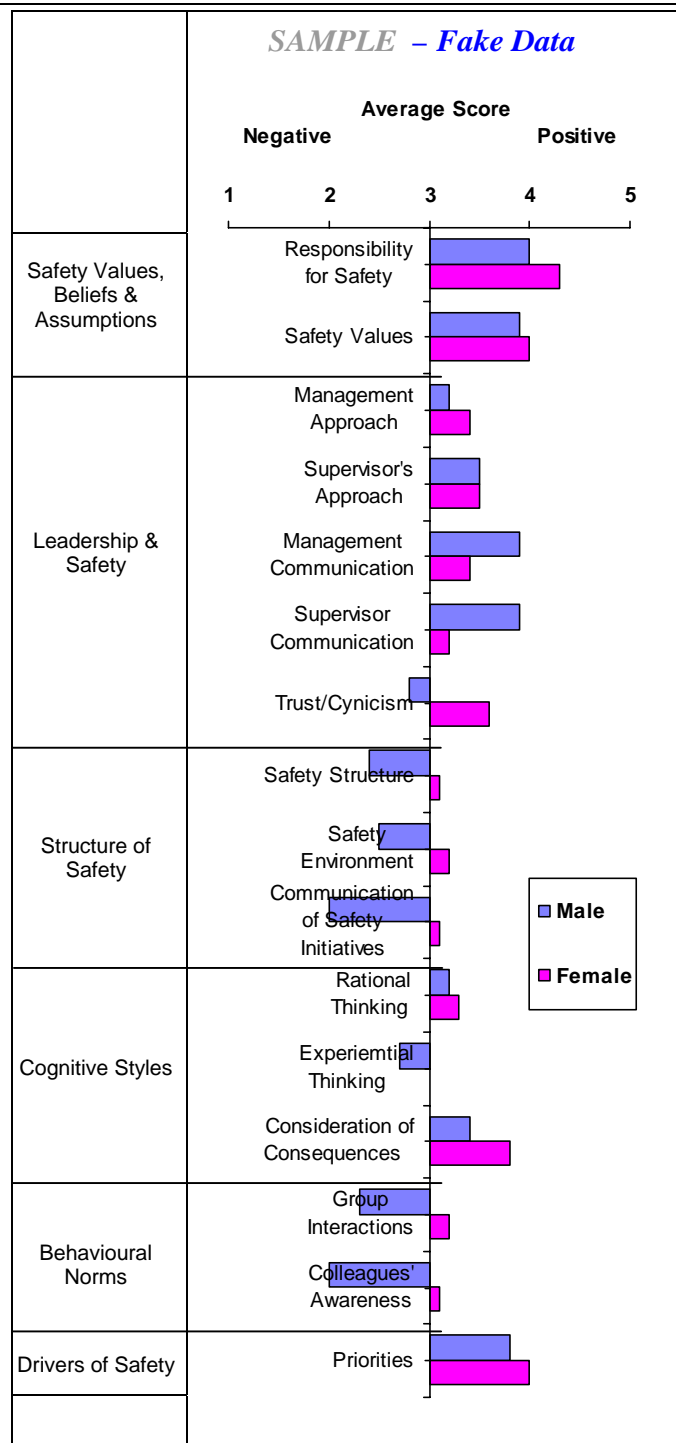
*SAMPLE – Fake Data*

- 75 respondents were male and 25 respondents were female.
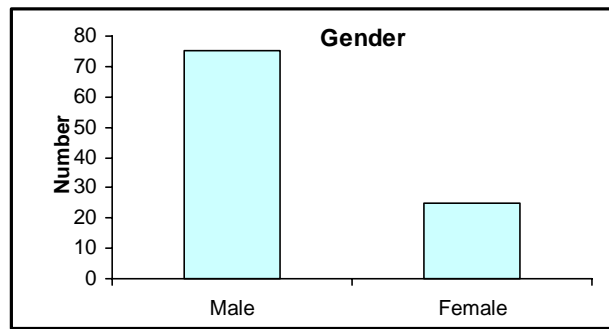


**Summary of Results**

- Results on the differences between males and females in terms of safety culture revealed that females almost consistently reported a more positive safety culture than males did.

- Analysis of these results reveal that females reported a positive (over 3) or neutral score (3) on ALL safety culture sub-dimensions while males recorded negative scores on all sub-dimensions within *Structure of Safety* and *Behavioural Norms* and in the sub-dimension Experiential *Thinking*. This implies that males regard the structural aspect of safety management (procedures, environment and inter-divisional communication) as insufficient. Males are less trusting of their colleagues and that tend to regard experience-based thinking to be slightly less valid at work than females do.

- On the dimensions *General Values, Beliefs, and Assumptions regarding Safety* (labelled *Safety Values* in the chart) and *Supervisor's Approach,* both males and females reported fairly equal results, suggesting the existence of positive values and a similar evaluation of their supervisors' approach to safety.

- Males only rated more positively than females on two safety sub-dimensions, *Management Communication* and *Supervisor's Communication*. This suggests that males' evaluation of the level and quality of communication with Management and their Supervisors is slightly higher than that of females.

# *SAMPLE – Fake Data*



Safety Culture by Gender
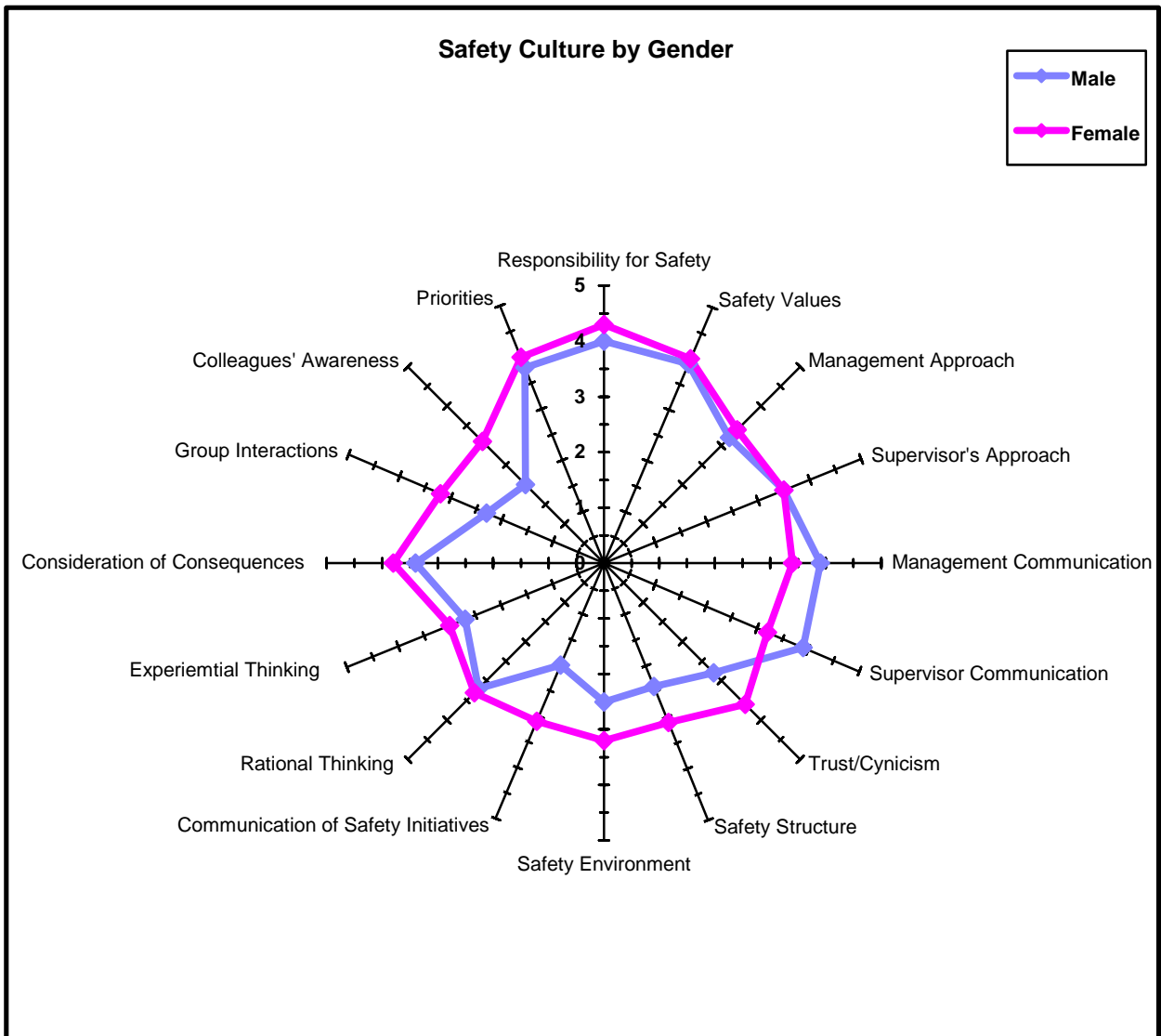
## Safety Culture and Job Level

*The information below shows differences in your organisation's Safety Culture between individuals at 3 different Job Levels. Higher scores represent a more positive safety culture in each sub-dimension.*
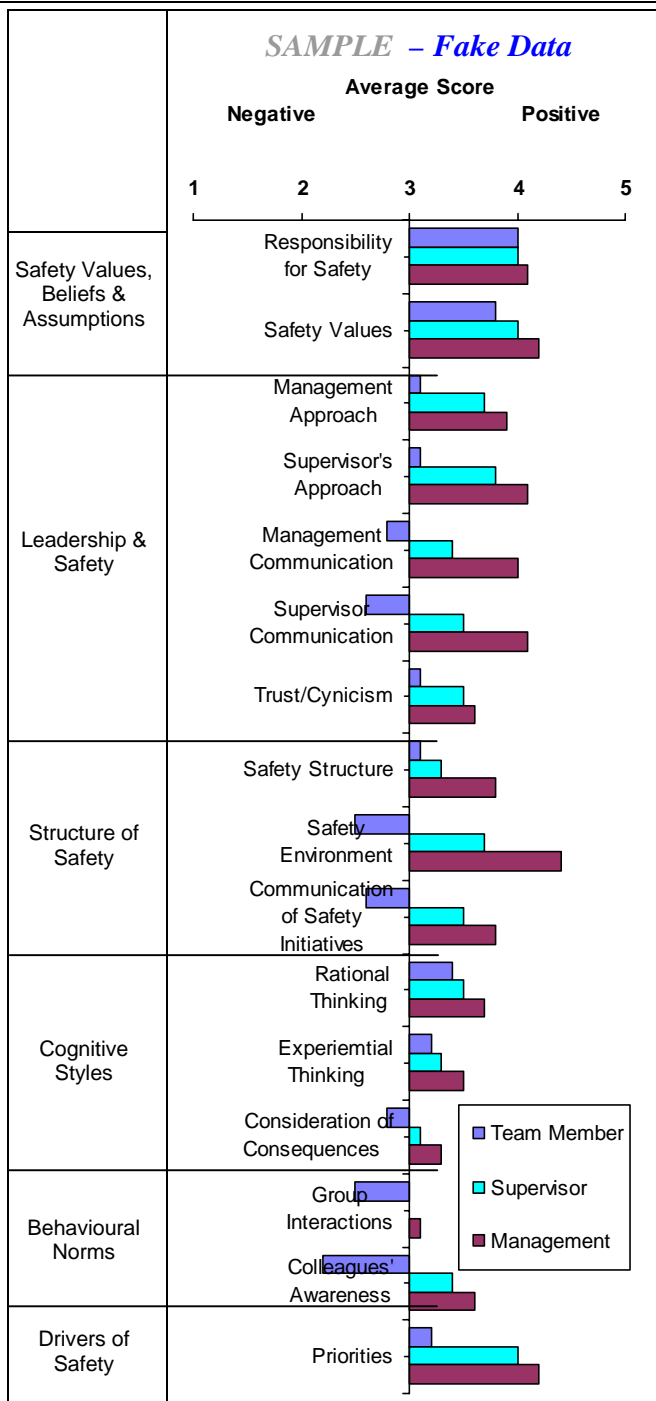
*SAMPLE – Fake Data*

- Respondents were grouped into three Job Level groups.

- They consisted of 50 Team Members; 33 Supervisors; and 17 Managers.
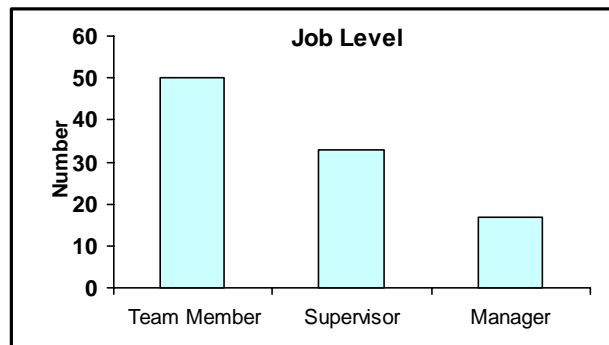


**Summary of Results**

- Consistently more positive results were reported by those in Management and Supervisory positions.

- In areas relating to the dimension *Leadership and Safety*, Managers rated both Management and Supervisor communication to be moderately positive. A similar tendency was observed with the rating by Supervisors, although to a lesser degree.

- In contrast, Team Members rated the level of communication between themselves and Management/Supervisors regarding safety to be slightly negative.

- Ratings by Management, Supervisors and Team Members regarding safety differ considerably, particularly regarding communication of safety becoming progressively less positive.

- Team Members also reported that their colleagues often did not consider other employees' safety, while those in Management and Supervisory positions did.

- Similarly, while Managers and Supervisors definitely viewed safety as a priority within the organisation, Team Members' rating was only slightly positive.

- Results may suggest that while Management believe they are effectively communicating safety initiatives and commitment, this view is not held by Team Members, who clearly regard communication from above as insufficient.

# *SAMPLE* *– Fake Data*
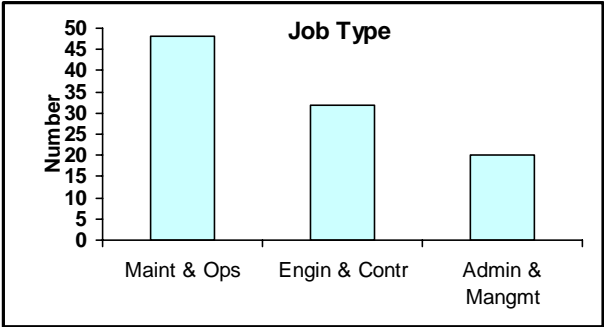


**Safety Culture by Job Level**
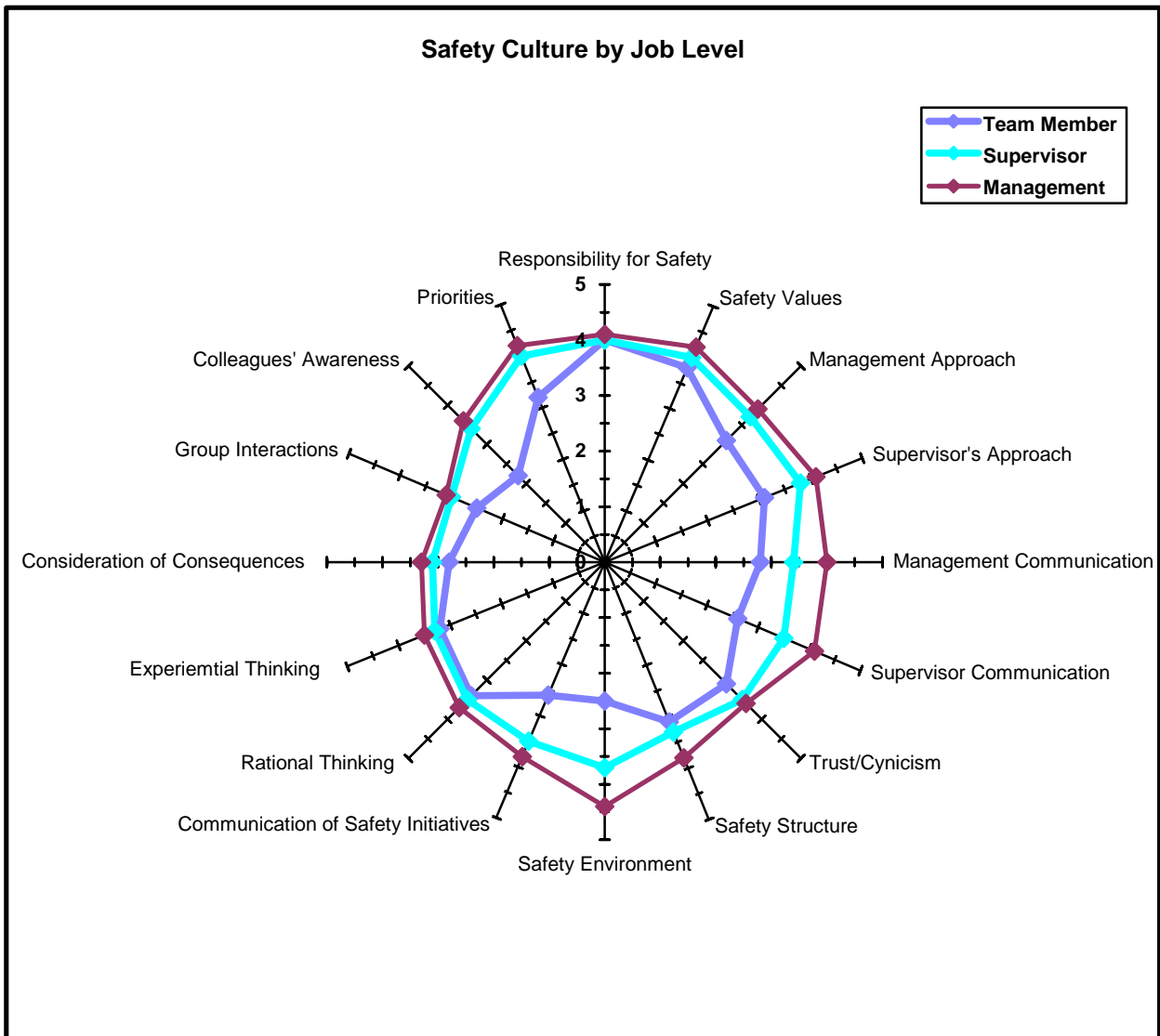
## Safety Culture and Job Type

*The information below shows differences in your organisation's Safety Culture between individuals in 3 different Job Types. Higher scores represent a more positive safety culture in each sub-dimension.*
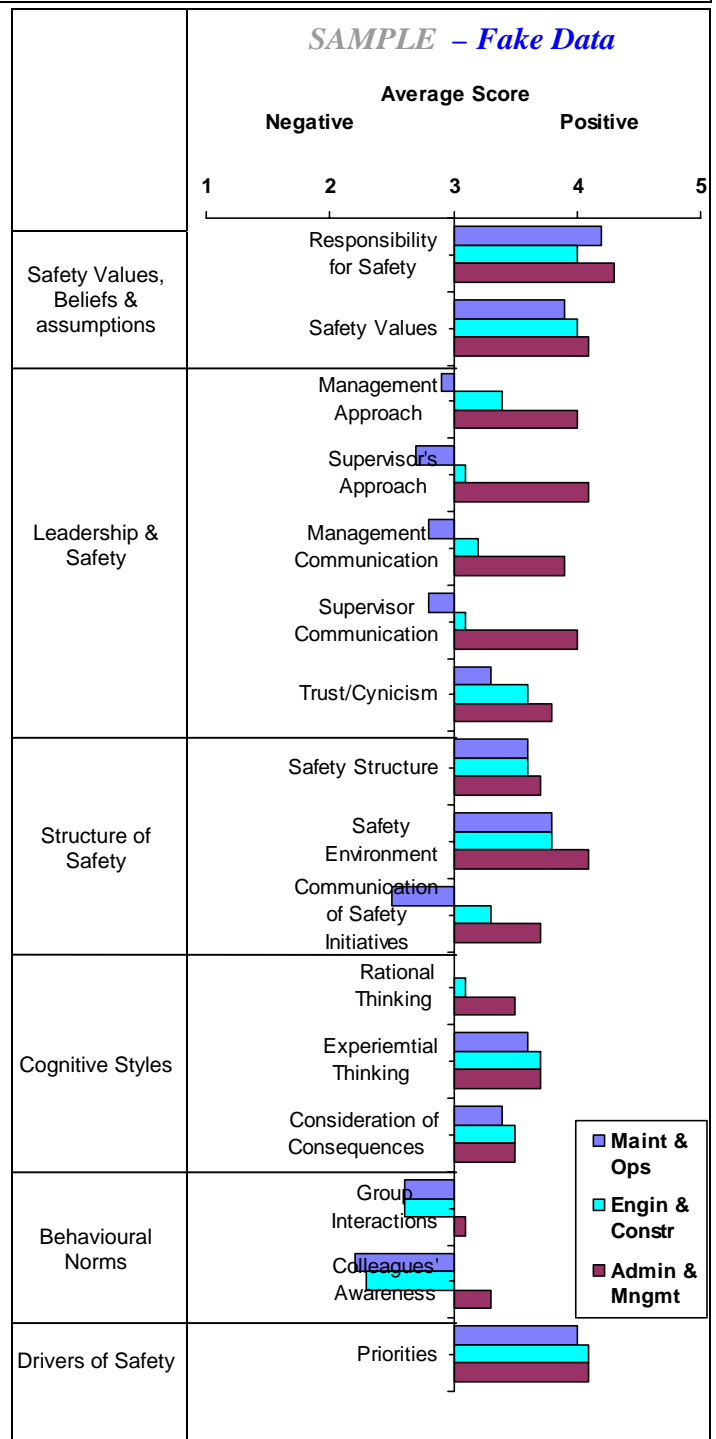
*SAMPLE* – *Fake Data*

- Respondents were grouped into three Job Type categories.

- They consisted of 48 Maintenance and Operations workers; 32 Engineering and Construction workers; and 20 Administration and Management workers.
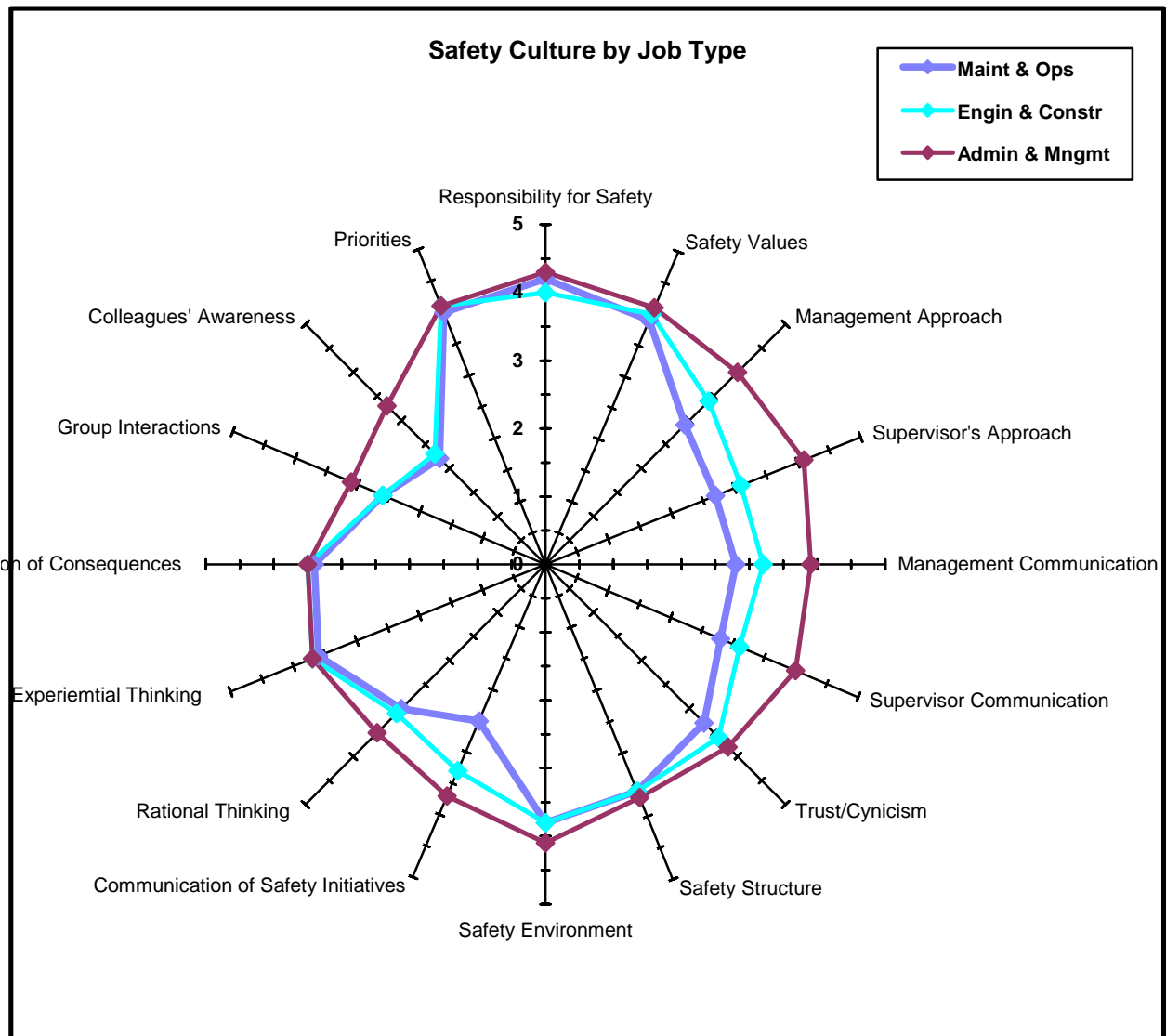
**Summary of Results**

- Analysis of results revealed similar rating patterns across different positions in all dimensions apart from *Leadership and Safety*.

- Respondents in Administration & Management positions gave consistently more positive ratings of safety culture across all sub-dimensions in *Leadership and Safety*.

- While Administration & Management showed relatively positive ratings regarding Management and Supervisor's *Communication* of safety and their general A*pproach* to safety; those in Engineering & Construction positions rated them only marginally positively; and those in Maintenance & Operations positions rated them slightly negatively.

- While Administration & Management gave slightly positive ratings regarding *Group Interactions* and *Colleagues' Awareness of Safety Rules and Procedures*, the other two Job Types rated them negatively.

- Administration & Management also rated sub-dimension *Communication of Safety within the Organisation* (labeled *Communication of Safety Initiatives* in the diagrams) much more positive scores than Maintenance & Operations who gave negative ratings.

# *SAMPLE – Fake Data*



**Safety Culture by Job Type**

Legend:
- Maint & Ops
- Engin & Constr
- Admin & Mngmt

Axes:
- Responsibility for Safety
- Safety Values
- Management Approach
- Supervisor's Approach
- Management Communication
- Supervisor Communication
- Trust/Cynicism
- Safety Structure
- Safety Environment
- Communication of Safety Initiatives
- Rational Thinking
- Experiemtial Thinking
- on of Consequences
- Group Interactions
- Colleagues' Awareness
- Priorities

## *Safety Culture and Severity of Accident Involvement*

*The information below shows your organisation's Safety Culture. Higher scores represent a more positive safety culture in each sub-dimension.*
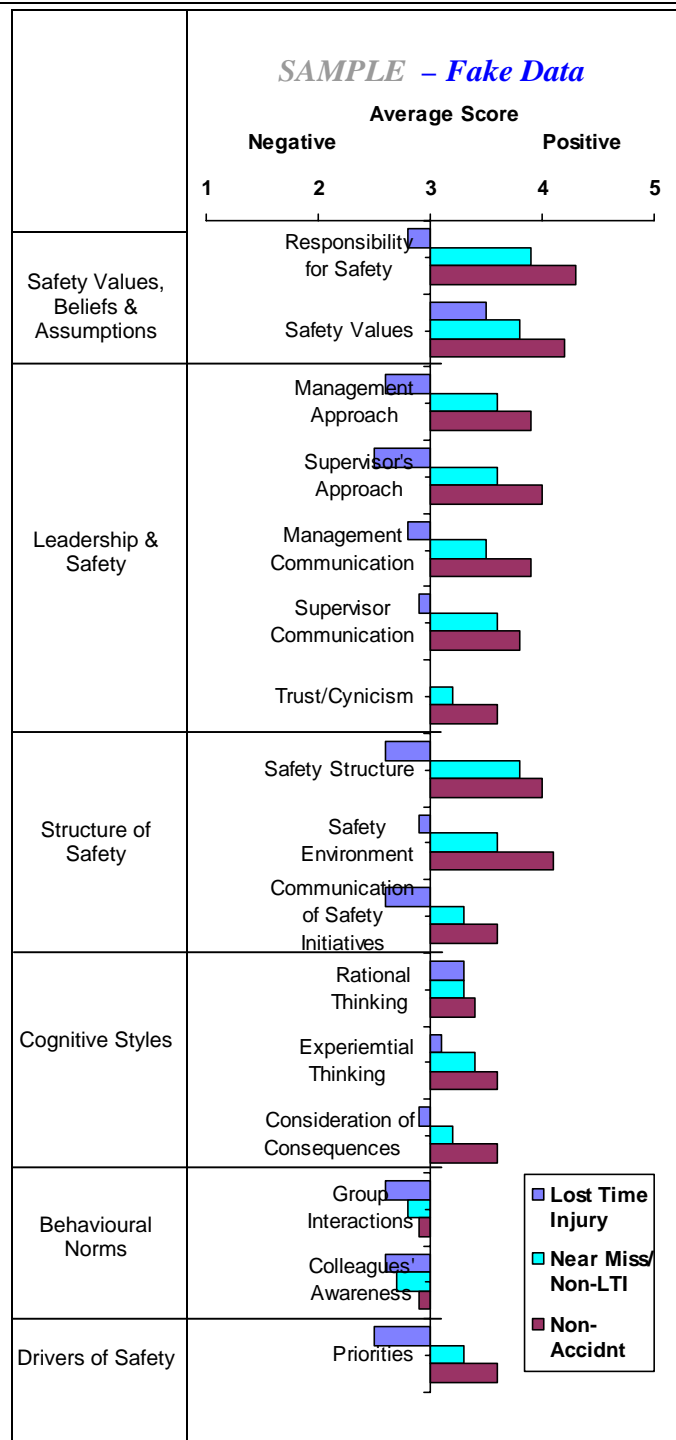
In the previous 2 years:

- A total of 14 respondents had been involved in a Lost Time Injury (LTI group).

- 24 had been involved in either a Near Miss or a Non-Lost Time Injury (Near Miss/Non-LTI group).

- 62 respondents had NOT been involved in any accident (Non-Accident group).



**Severity of Accident Involvement**
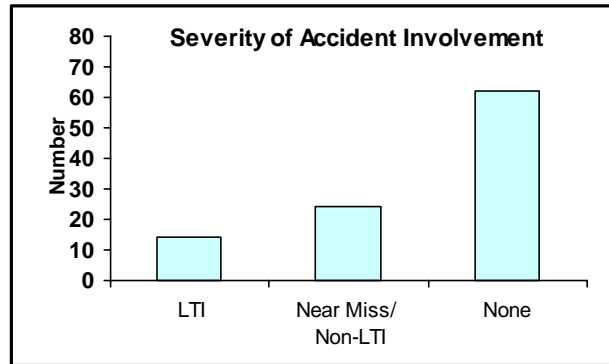
### Summary of Results

- Data analysis by severity of accident involvement revealed the most considerable differences in the rating of safety culture dimensions.

- A markedly more positive safety culture was reported by individuals who had NOT been involved in a safety accident or incident in the past 2 years, with respondents rating safety culture moderately positively on most of the sub-dimensions.

- Individuals who had been involved in a Near-Miss or a Non-Lost Time Injury (Non-LTI) showed slightly positive ratings regarding safety culture.

- On the other hand, the LTI group reported slightly to moderately negative ratings of safety culture on almost all sub-dimensions.

- This trend was particularly pronounced with regard to ratings of dimensions *Leadership and Safety*; *Structure of Safety*; and *Behavioural Norms*.

- Overall, the results suggest that the greater the severity of accident involvement, the more negatively individuals evaluated the safety culture of their organisation.



*SAMPLE – Fake Data*

# *SAMPLE – Fake Data*



**Safety Culture by
Severity of Accident Involvement**

Legend:
- **Lost Time Injury**
- **Near Miss/Non-LTI**
- **Non-Accidnt**
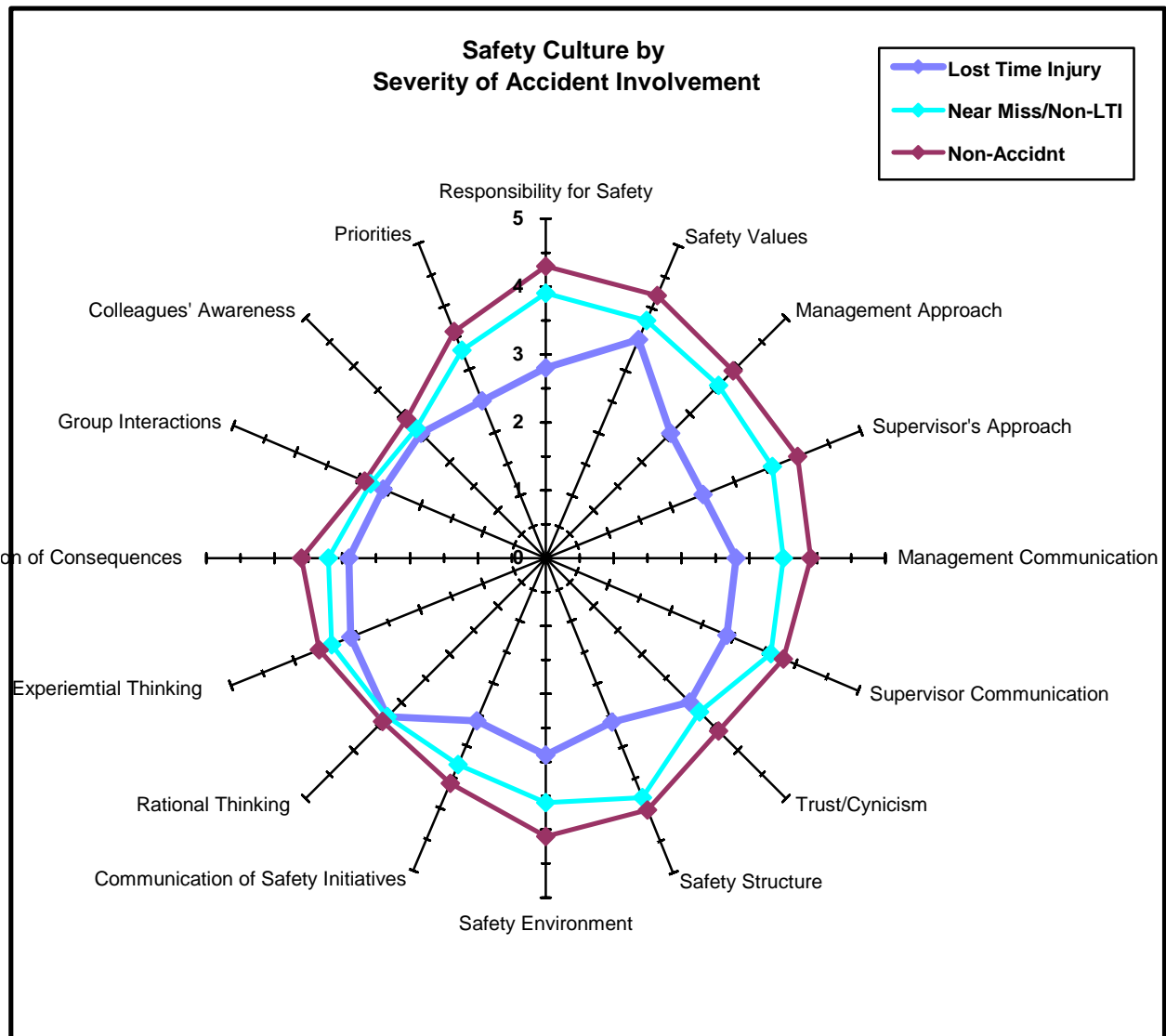
### Analysis of the 17th Sub-Dimension: Main Driving Forces behind Safety Culture

**Analysis of Main Driving Forces:**

The final 10 questions concerned factors that may impact on safe working practice in their organisation. The respondents rated the items on a 5-point Likert-type scale ranging from 1 (*Strongly disagree*) to 5 (*Definitely agree*), indicating to what extent they agreed/disagreed with the statements. The statements were all phrased in a set format: "_____ is/are/am the main driving force behind improving workplace safety in my organisation." The sentences started with the following subjects respectively:

1) The Board of Directors
2) Management
3) Regulators
4) Operations Workers
5) I
6) Our Industry
7) Trade Unions
8) Safety, Health and Environment (SHE) Department
9) Shareholders
10) The Community

### Overall Profile

# SAMPLE – *Fake Data*

The overall profile of the main driving forces behind improving workplace safety is shown below.

- The score distribution is bottom-heavy (in relation to this diagram).

- Negative mean ratings (below 3.0) were reported for five entities:
  1) Board of Directors: 2.3
  2) Management; 2.4
  6) Our Industry: 2.5
  9) Shareholders: 2.5
  10) The Community: 2.1

- Positive mean ratings (above 3.0) were observed for four entities:
  4) Operations Workers: 4.3
  5) I Am : 3.5
  7) Trade Unions: 3.6
  8) SHE Department: 3.2

- Neutral mean ratings (3.0) were observed for 3) Regulators.



**Main Driving Forces - Overall**
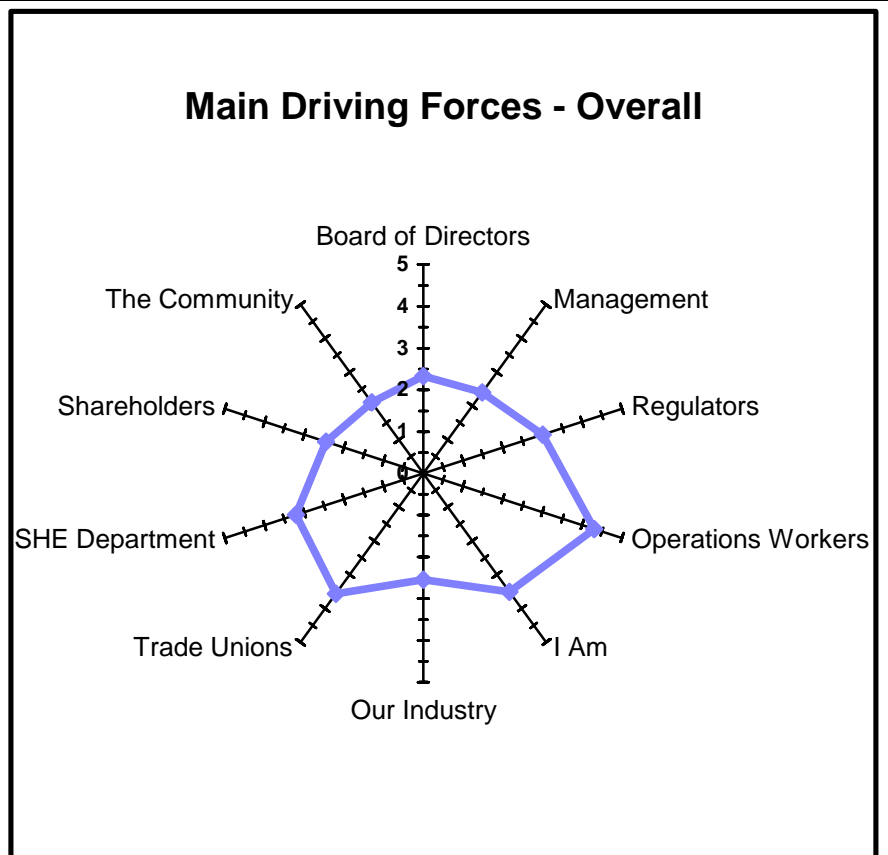
## Comparisons by Gender, Job Level and Job Type

### SAMPLE – *Fake Data*

*Comparison by Gender*

Gender comparison (Figure 1) showed only slight differences. Entities that females rated particularly higher than males were: 6) Our Industry; and 8) SHE Department.

*Comparison by Job Level*

As can be seen in Figure 2, Job Level comparison also showed mostly slight differences. The most pronounced differences were observed in the ratings of 2) Management (mean 2.5 by Team Member, 3.2 by Supervisor and 4.2 by Management), and also in the ratings of 7) Trade Unions (mean 3.6 by Team Members, 2.7 by Supervisors and 2.5 by Management).

*Comparison by Job Type*

▪ As can be seen in Figure 3, Job Type comparison showed relatively similar profiles between the three groups, particularly between the Engineering & Construction and the Admin. & Management. These two groups' profiles tended to be relatively top-heavy (in relation to the diagram) with an emphasis on 2) Management.

▪ Conversely, the Maintenance & Operations group had a slightly bottom-heavy (in relation to this diagram) profile. In this group particularly higher ratings were observed in 7) Trade Unions. Lower scores were reported in entities 1) The Board of Directors; and 2) Management.

▪ Interestingly, all three groups converged in the ratings of 4) Operations Workers. It could be argued that all three groups recognise that the Maintenance & Operations group has an immediate impact on/from safe working practice in the physical environment. However, there appear to be different beliefs regarding the extent of impact that Management, the SHE Department and Trade Unions make in driving improvement of workplace safety.
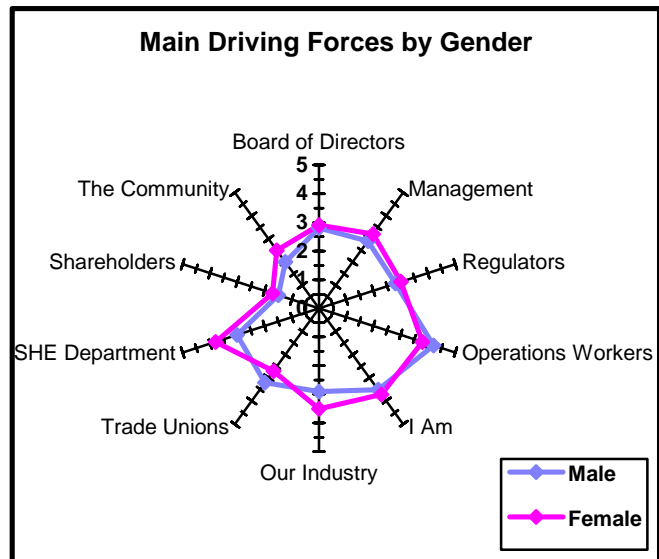
*Figure1*



Main Driving Forces by Gender

*Figure 2*



Main Driving Forces by Job Level
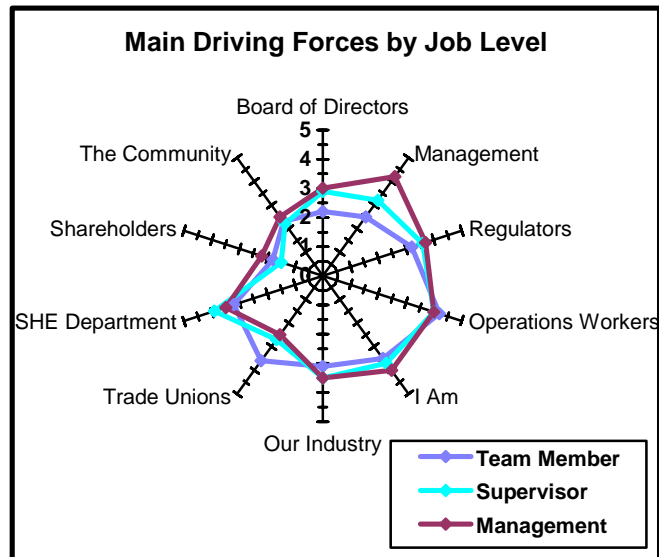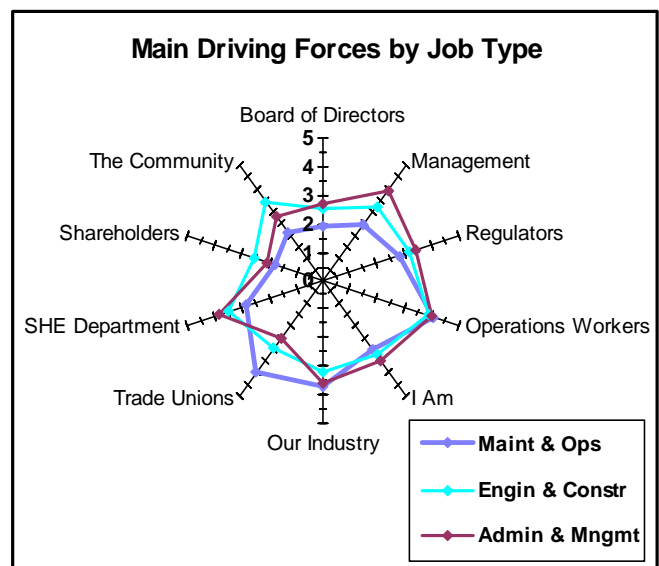
*Figure 3*



Main Driving Forces by Job Type

## Comparison by Severity of Accident Involvement

▪ As can be seen in Figure 4 and 5, pronounced differences were observed in ratings when compared by severity of accident involvement in the previous 2 years.  The three groups were:
1)  LTI Group
2)  Near Miss/Non-LTI Group
3)  Non-Accident Group

▪ Relatively similar profiles were seen between Near Miss/Non-LTI and Non-Accident groups. The Non-Accident group rated comparatively higher scores in entities: 3) Regulators; 4) Operations Workers; 5) I; and 8) SHE Department.  These two groups' rating of other entities ranged narrowly around the mid-score (3.0 *Neither agree nor disagree*).

▪ In contrast, the LTI group showed higher ratings for all entities, to varying degrees.  Their scores formed a bottom-heavy distribution (in relation to this diagram).  Particularly high scores were reported for 4) Operations Workers; and 7) Trade Unions.

▪ Those in the LTI group were all from Maintenance and Operations division, and were predominantly Team Members (82%), followed by Supervisors (18%).  There was no Management staff in this group.

▪ In interpreting the high ratings of some entities in the 17th sub-dimension *Main Driving Forces behind Safety Culture*, it is apposite to evaluate the implications in conjunction with the low ratings by the LTI group for the 16 sub-dimension analysis (p. 26 and 27).  Possible interpretations of these seemingly contradictory profiles, particularly by the LTI group are:

1) The LTI group evaluated various aspects of their organisation's current safety culture negatively (as in the profile of the 16 sub-dimensions in p. 26 and 27).

2) The profile of the 17th sub-dimension (Figure 5) suggests that the LTI group attributed responsibility to the high- scoring entities for the current negative state of safety culture. Alternatively, it is plausible that the LTI group signified their recognition of the high-scoring entities as potential channels for future change and improvement.

3) The polarised ratings may reflect the experience of those Maintenance and Operations Workers in the LTI group, where they found Trade Unions more responsive at the time of the accident/injury than Management.

*SAMPLE* – *Fake Data*

*Figure 4*
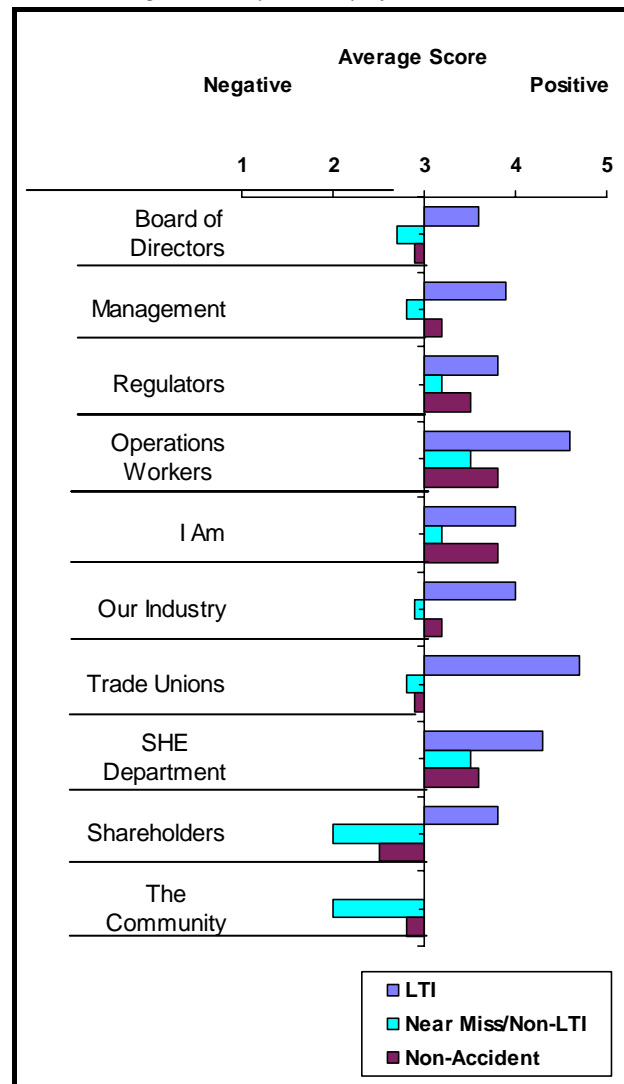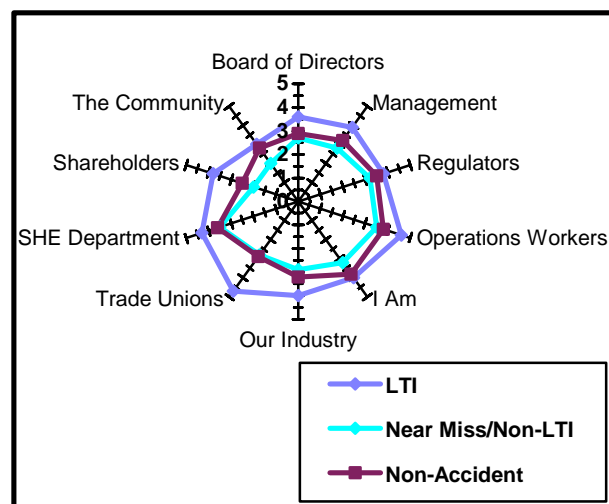*Main Driving Forces by Severity of Accident Involvement*



*Figure 5*
*Main Driving Forces by Severity of Accident Involvement*

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