NOPSEMA
Australia's offshore energy regulator

INFORMATION PAPER

Human Factors – Perception Surveys

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Key Messages

- Perception surveys are used by the majority of offshore petroleum companies in Australia.
- Conclusions drawn from perception survey data may not be objectively accurate.
- Perception survey data is subjective and influenced by a range of factors at an individual level.
- Perception survey data does not measure safety culture.
- Perception survey research is correlational; survey scores do not reliably predict safety outcomes, particularly major accident events.
- Perception surveys can contribute to a broader analysis of culture, but should not be used in isolation.
- Organisations using perception survey data for safety culture analysis should seek additional sources of information to allow for meaningful analysis and outcomes.
- Perception surveys may not represent the best use of limited safety resources.

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Key Definitions for this Information Paper

The following are some useful definitions for terms used in this information paper. They are a suggested starting point only and are not prescriptively defined, unless otherwise indicated.

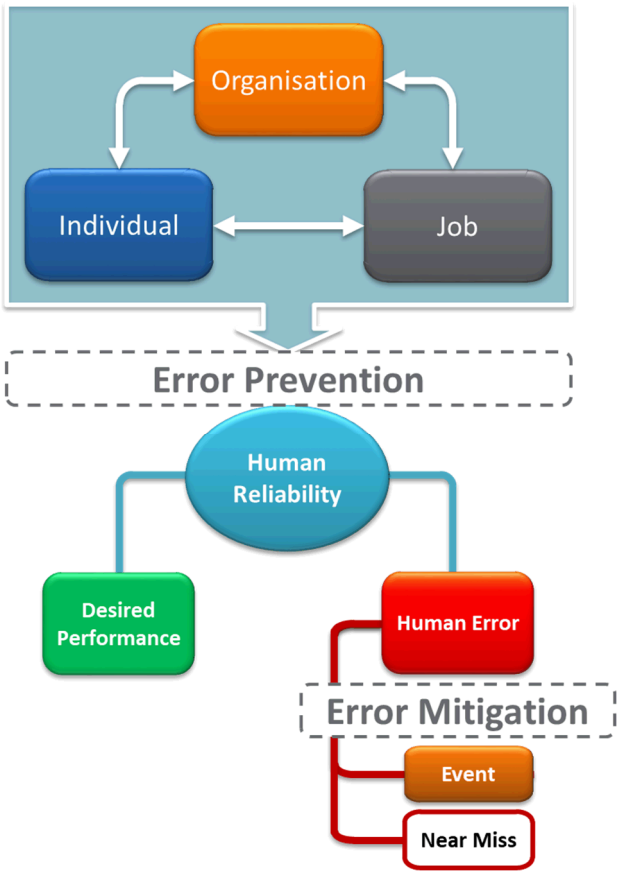
Artefacts	*Observable manifestations of culture within an organisation, which are easy to identify, measure and change, but difficult to interpret.*
Basic Assumptions	*"The taken-for-granted, underlying, and usually unconscious assumptions that determine perceptions, thought processes, feelings and behaviour which form the basis of an organisation's culture" (Schein, 1990, p. 112).*
Espoused Values	*An organisation's members' descriptions of organisational practices, values, norms and ideologies.*
Hazardous Event	*A collective term encompassing safety, integrity, and environmental incidents, used for readability purposes within this information paper.*
Human Factors	*The ways in which the organisation, the job, and the individual interact to influence human reliability in hazardous event causation.*
Human Reliability	*The likelihood that an individual will make an error while performing a task.*
Major Accident Event	*An event connected with a facility, including a natural event, having the potential to cause multiple fatalities of persons at or near the facility. [OPGGS(S) Regulation 1.5]*
Safety Culture	*The shared basic assumptions, held by most members of an organisation, which create and reinforce group norms of thoughts, language and behaviour in relation to major accident event prevention.*
Triangulation	*A data collection technique where multiple measures of a construct are utilised to improve the accuracy of measurement. This technique increases the likelihood that all aspects of a construct are captured.*
Validity	*The extent to which a tool measures and predicts that which it claims to be able.*

1. Introduction to the Human Factors Information Paper Series

'Human Error' has long been identified as a contributing factor to incident causation. Commonly cited statistics claim that human error is responsible for anywhere between 70-100% of incidents. It seems logical, therefore, to blame incidents on individuals or small groups of people and to focus remedial actions at the individual level (e.g. training, disciplinary action, etc.). However, by taking this approach in addressing human error, organisations ignore the latent conditions in their work systems that contribute to human error across the workforce. Rather, human error should be recognised as an outcome of combined factors, instead of the root cause of an incident. Organisational, job, and individual factors all interact to influence human reliability, that is, the likelihood that an individual will perform their task effectively or make an error.

This publication forms part of a series of information papers focusing on human factors. NOPSEMA defines human factors as "the ways in which the organisation, the job, and the individual interact to influence human reliability in hazardous event causation". Reliable behaviour results in desired performance, while unreliable behaviour may result in human error, which can lead to events and near misses. This interaction is represented in Figure 1.

Figure 1 – A Model of Human Factors



The Human Factors Information Paper Series is designed to provide information about the ways in which organisational, individual, and job factors influence human reliability, and how organisations can minimise or optimise the effect of these factors, to assist in the prevention and mitigation of hazardous events and drive continuous improvement in safety, integrity and environment performance.

2. Intent and purpose of this information paper

In 2012-13 NOPSEMA conducted a survey of facility operators (NOPSEMA, 2013) which explored the types of safety improvement initiatives implemented across the industry. Responses indicated that 78% of participating organisations conducted safety culture/climate perception surveys on a regular basis. This information paper has been developed in response to the evident popularity of perception surveys within the Australian offshore petroleum industry. It discusses the science behind perception survey development and data analysis, and explores assumptions about the relationship between perception survey scores and safety outcomes.

Safety culture is understood as an organisation-level performance shaping factor within the human factors framework. This information paper addresses the practice of interpreting perception survey data as a measure of safety culture and a predictor of safety outcomes. It provides information that organisations may wish to consider when determining whether to administer a perception survey as a means of safety culture analysis or as a leading indicator of safety performance.

Please note: Information papers provide information, background and practices to foster continuous improvement within industry. NOPSEMA acknowledges that what is good practice, and what approaches are valid and viable, will vary according to the nature of different organisations, offshore facilities and their hazards.

3. Perception surveys

Perception surveys tend to be marketed as a means of measuring the safety climate or culture of an organisation. Claims have also been made about the utility of perception surveys as a leading indicator of safety performance. Perception surveys are typically structured using a Likert scale, where a number of pre-determined items, worded as statements, are presented along with a uniform set of response options. The number and wording of response options varies between surveys. An example of a typical perception survey item is provided below along with a variety of Likert-style response sets.

Example survey item: *Safety is just as important as production.*

Example response sets:

	Strongly Disagree	*Disagree*	*Neutral*	*Agree*	*Strongly Agree*	
Strongly Disagree	*Somewhat Disagree*	*Disagree*	*Neither agree nor disagree*	*Agree*	*Somewhat Agree*	*Strongly Agree*
	Untrue	*Somewhat Untrue*	*I have no opinion*	*Somewhat True*	*True*	
Prefer not to answer	*Strongly Disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly Agree*	*Not observed*

This section provides information about the way that perception surveys are designed and used, and seeks to challenge the conclusions drawn from perception survey data in relation to safety performance outcomes.

3.1. How accurate is perception survey data?

The accuracy of perception survey data relies on people's ability to perceive, interpret, understand, and remember relevant information. Individual responses to survey items are strongly influenced by a broad range of factors such as work history, cognitive ability, literacy, motivation, tendency to think critically, organisational engagement, job satisfaction, and mood at the time of completing the survey. The influence that such individual differences can have over perception survey data is evident in the variability of responses to questions about objective things such as the quality and efficacy of control measures. The existence of such variability suggests that perception survey results are more a reflection of individual differences than of the organisational factors that perception surveys are intended to evaluate.

Hypothetical Example – Response variations in a maintenance crew

A company runs a perception survey and aggregates the data at a crew level. The results from the maintenance crew show that perceptions about the quality of the safety management system (SMS) are strongly divided, with positive responses from half of the crew members and negative responses from the other half.

A closer look at the demographics of this crew shows that about half of the crew personnel are relatively new to the industry, with this company being their first employer within the industry. The remaining crew members have had many years of industry experience, and have worked for a number of companies within the industry.

The SMS in question is the first formal safety management system that the new personnel have worked with, and so their perceptions about it are overwhelmingly positive. However, more experienced personnel are able to compare the current SMS against other more robust systems that they have worked with in the past, and so their perceptions about it are unfavourable.

In this case, the variation in responses shows that the perception survey data does not provide information about the quality or efficacy of the SMS; rather it reflects how people feel about the SMS. The results are entirely subjective and provide no meaningful information about the drivers of safety outcomes within the organisation. It is only through further investigation that the information starts to become meaningful.

Individuals may also interpret the same survey item in different ways. The wording of the example item used in section 3, "*safety is just as important as production*", is ambiguous. In responding to this item, one person may believe that safety is more important than production while a second person may believe that safety is less important, yet in both cases their response would be "disagree", providing a meaningless result. Alternatively, one person may respond to the question reflecting their personal attitude about safety while another person may respond in relation to the way that the organisation approaches safety – an entirely different concept. Again the data becomes meaningless as there is no way to identify the concept to which each response relates. Further, the wording of response sets may cause confusion or uncertainty for respondents, depending on the ambiguity of language used (e.g. is "somewhat agree" stronger than "agree"?), the number of response options within a set (i.e. too many or too few), and the

availability of non-response options such as "no chance to observe" which might otherwise be recorded as a "neutral" response and interpreted quite differently.

Finally, the accuracy of any self-report measure is dependent on honest responses. People's willingness to respond honestly to perception surveys will be subject to a variety of influences, such as their belief in the anonymity of the data, levels of cynicism within the organisation, individual agendas, organisational politics, expected outcomes, previous experiences, and 'priming' that may have occurred prior to the survey administration. Even when people are committed to responding honestly, they are likely to experience *selective memory*, whereby an individual will preferentially remember events that are consistent with their own motivations. For example, people may like to think of themselves as 'good' employees, part of which includes adherence to rules and assimilation to espoused values. When completing perception surveys, individuals experiencing selective memory may genuinely forget the times when they have knowingly broken safety rules to achieve production targets, they may overestimate the frequency with which they conduct risk assessments prior to starting a job, and they may forget those times they saw a hazard and didn't report it or when they saw a colleague behaving unsafely and didn't talk to them about it.

Because of the subjective nature of perception survey responses, it is difficult to interpret raw data in meaningful or useful ways without reference to additional data sources. Interpretations made from perception survey data should not attempt to make claims about anything other than people's perceptions unless that data is collated with other sources of organisational information.

3.2. Do perception surveys measure safety culture?

Commercial and academic perception surveys have generally been subject to psychometric analysis to determine factor structure and validity. Such analyses are intended to provide evidence for the integrity of the survey and resultant claims based on analysis of survey data. Some commercial surveys offer 'tailoring' for different industries or organisations. This rarely involves modification of existing questions, as this would invalidate any psychometric information already established. Rather, tailoring typically consists of the addition of questions specific to the organisation in question, which are excluded from factor-level analyses.

The use of a pre-determined set of items is a questionable approach when seeking to understand safety culture. Culture is built over time, where a group of people with a shared history experience and solve problems. This repeated process of successful problem solving leads to the development of basic assumptions which then inform future behaviour. Basic assumptions represent the central focus of culture analysis as they explain why observed phenomena occur. Given the way that culture develops, it is unlikely that different organisations will hold the same basic assumptions about a problem. Additionally, where basic assumptions may be similar, the ways in which they influence organisational outcomes are likely to vary. The administration of a survey involving the use of a pre-determined set of items is unlikely to uncover those unique basic assumptions which influence the safety outcomes of the organisation in question. Perception survey data may provide information about an organisation's espoused values and as such can contribute to a broader cultural analysis process. However when used in isolation, perception surveys do not measure safety culture.

Further information regarding safety culture can be found in the ***Safety Culture Information Paper*** on the NOPSEMA webpage.

3.3. Do perception surveys predict safety outcomes?

Irrespective of whether perception surveys measure safety culture or not, arguably the most important question is whether they are able to reliably predict relevant safety outcomes. In the case of perception survey research, overall scores are generally compared against recorded injury frequency rates, with the resulting correlation used to claim a causal relationship. This is problematic for a number of reasons, which are briefly outlined below.

In perception survey analysis the Likert scale is used as an interval scale, allowing for linear analysis techniques including correlations, means and variances. However, it is debatable whether Likert scales are indeed interval scales. The criterion for an interval scale is that the distance between each response category is equal. In this case, the assumption is that the distance between, for example, "neutral" and "disagree" is equal to the distance between "disagree" and "strongly disagree". This is doubtful given the subjective nature of the response options. Further, even if the use of linear analysis such as correlations between survey scores and frequency rates were considered appropriate, the conclusions that are commonly drawn are not scientifically justified.

Safety culture research using perception survey data has reported weak to moderate correlations ($r \approx 0.3$) between perception survey scores and injury frequency rates. This correlation is typically cited to support suggestions that safety perceptions influence safety behaviours, which lead to injury rates. A correlation, however, is not evidence of causal relationship. There are a number of other interpretations which are equally possible. It is possible that safety behaviour leads to injury rates, which influence safety perceptions. It is possible that there is a multidirectional interaction between behaviours, perceptions, and injuries. It is also possible that an unknown variable is exerting an influence on both perceptions and injury rates (e.g. the correlation between polio infections and ice cream consumption in the 1950's, where the causal factor was the weather), or even that the correlation is entirely spurious and there is no relationship between the two variables (e.g. a correlation between eye colour and injury rate is spurious).

Assumptions about the nature of the relationship between perception survey scores and injury frequency rates should not be made based on correlation data. Further, the use of surveys which aim or claim to predict injury frequency rates is inappropriate for organisations seeking to prevent major accident events (MAEs). It is unlikely that a survey focused on the factors associated with injury causation will intelligently identify the factors associated with MAE causation. Indeed, there are many instances where facilities have recorded very low injury frequency rates and yet experienced disastrous incidents (e.g. Longford, Texas City, Macondo).

A correlation between perception survey scores and injury frequency rates provides no assurances that a survey will be able to identify those factors that lead to major accident events. Notably, some recent research has developed perception surveys focused on process safety. However, such research is currently limited to the calculation of correlations between survey scores and process safety indicators. At this point in time, there is no compelling evidence of a predictive or causal relationship between perception survey scores and safety outcomes.

Case study – Snorre Alpha blowout

In 2004, the Snorre Alpha facility in the North Sea experienced an uncontrolled gas blowout on the seabed. While no-one was injured, the serious potential of the incident led the Norwegian Petroleum Safety Authority to characterise the incident as one of the most serious to ever occur on the Norwegian shelf.

Twelve months prior to the event, a perception survey was administered. The survey generated positive results, with no indication that a serious event was likely. Significantly, the perception survey delivered findings that were directly contradicted by the later incident investigation findings – causal factors identified during the investigation had been highlighted as organisational strengths by the perception survey.

In particular, perception survey results claimed that risk assessments were rigorous, rules were complied with, safety communication was strong, safety was prioritised, and incidents were reported and used to drive change. Conversely the incident investigation found that risk assessments were not done and poorly understood, non-compliance was normal, there was a poor communication climate, production targets were prioritised, many incidents were not reported, and the organisation made limited use of their own and others' incident information.

While this is only one case study, it highlights the limitations of perception survey data as a means of predicting safety outcomes.

(Adapted from Antonsen, 2009)

3.4. When are perception surveys useful?

Perception survey data can provide meaningful information when the focus of analysis is a subjective individual-level construct (e.g. satisfaction, turnover intention, attitude about an object, etc.). These types of data are still susceptible to the potential confounding factors associated with the use of self-report measures discussed in section 3.1. However a cautious and well-planned approach to survey design and data collection can minimise the influence that such factors will have on people's responses.

In the case of safety culture, perception survey data may be appropriate for use as one component of a broader triangulated cultural analysis. Triangulation includes multiple sources and methods of data collection to avoid methodological error and improve the representativeness of the findings. Triangulation in safety culture analysis should include artefact observation and the use of focus groups and interviews to uncover the relevant basic assumptions influencing problematic safety outcomes. The use of multiple sources and methods of data collection allows for greater understanding of a problem and the development of more meaningful conclusions and recommendations. For example, perception data may be compared to artefact observation data to identify specific examples of misalignment between espoused values and artefacts, which could then be explored in greater detail to uncover the influencing basic assumptions.

Hypothetical Example – Failure to stop production during loss of containment

A company runs a perception survey, with resulting analysis suggesting that personal responsibility for safety is an organisational strength. In particular, responses to the statement "I have the right to stop the job if I believe it is unsafe" were overwhelmingly positive, with all personnel selecting the "agree" or "strongly agree" response option. However, a corresponding analysis of artefacts contradicts the perception survey results. A review of incident investigation reports reveals a number of occasions where personnel failed to stop production during loss of containment events. This is evidence of a significant misalignment between the espoused value of having the right to stop the job, and observed artefacts where personnel have failed to stop production.

The identified misalignment triggers further investigation through interviews and focus groups with key personnel involved in the loss of containment events, and with personnel in similar positions who were not involved in those events. This in-depth exploration identified a number of issues driving the evident reluctance to stop production:

- Once shut down, the facility is notoriously difficult to re-start.
- Every unplanned shutdown adversely affects the company's key performance indicators and associated annual bonuses for all employees.
- During an unplanned shutdown, facility personnel experience significant ongoing pressure from the onshore executive to reinstate production.
- A number of years ago, a production technician was fired after stopping production during a loss of containment event.

Through the interviews and focus groups, the existence of a basic assumption is identified whereby loss of containment rectification is initially attempted without stopping production, because of the number of expected adverse outcomes associated with an unplanned shutdown.

This information facilitates the development of targeted actions to remove these adverse outcomes and replace them with positive ones, which aim to change the basic assumption about loss of containment event response.

4. Concluding comments

Safety resources are not unlimited. When deciding on how to allocate budgets targeting safety performance improvement, organisations should seek to identify those strategies which target the most meaningful change and which have the greatest likelihood of success in safety performance improvement. Perception surveys may seem like an attractive choice because they are relatively inexpensive to administer, involve minimal time 'off-tools', and deliver a simple set of quantitative data that is easy to analyse and trend, leaving more budget to be spent on other things. While these characteristics of

perception surveys are positive, they do not speak to the effectiveness of perception survey data in driving safety performance improvement. Organisations already measure, track and trend a range of indicators that provide reasonably reliable information about control measure performance. Given the existing range of indicators already in use, organisations should question whether perception surveys are likely to provide additional reliable information beyond that which is already measured; indeed whether they deliver an acceptable return on investment.

Perception surveys do not provide objective information about the strengths and weaknesses of safety control measures, they do not provide meaningful insights into safety culture, and they do not reliably predict safety outcomes, particularly in relation to major accident events. Ultimately, perception surveys may not represent the best use of limited safety resources for organisations seeking to prevent major accident events.

5. References, acknowledgments & notes

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