Developing safety culture measurement tools and techniques based on site audits rather than questionnaires

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Final Project report

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Summary

The importance of creating a positive safety culture for petrochemical companies was highlighted recently by James Baker III and colleagues in their independent report into fire at BP's refinery in Texas City (Baker et al, 2006). They concluded that BP needed to create a positive process safety culture, to prevent future disasters of this nature. This conclusion echoes those of reports into previous offshore disasters (e.g. Piper Alpha). It is some what surprising that although the importance of safety culture has been recognized for nearly 20 years, companies still struggle to create positive safety cultures. One of the barriers to improvement is the absence of objective safety culture indicators. A validated set of objective indicators would enable organizations to easily assess their safety culture and also specify practical interventions to improve.

The purpose of the current research project was to develop a set of objective safety culture indicators to enable Atlantic Canadian petrochemical organizations to assess their safety culture without conducting an employee perception survey. The project consisted of three phases, namely the development of a pilot safety culture audit instrument, pilot testing the instrument and testing the reliability and validity of the instrument. Phase one involved a comprehensive literature review and consultation with domain experts, which produced a pilot safety culture audit that consisted of 28 indicators. In phase two the pilot instrument was tested in a contracting organization with 14 branches. Eleven branches completed the pilot safety culture audit. The branches were then ranked on the basis of their scores on a standard safety culture perception measure that had previously been completed by branch employees. The pilot audit did not discriminate between branches with high and low perceptual safety culture scores. The pilot safety culture audit was significantly revised in light of its poor performance in the

pilot study. The revision involved further consultation with domain experts (e.g. oil industry safety managers) to produce a finer grained instrument. The revised audit tool contained twelve safety culture elements (e.g. commitment to safety), each of which contained five safety culture indicators.

Phase three of the project involved testing the reliability and validity of the safety culture audit tool. Interrater reliability was tested by comparing the results two managers from the same organization received when conducting the audit. The results indicated that the audit is reliable. The validity of the audit was tested by comparing the results obtained from the audit with the results from an employee safety culture perception survey. The significant correlation between the audit and perception survey provide strong evidence for the validity of the audit.

This research project has produced the first validated safety culture audit based on objective indicators. This safety culture audit will enable Atlantic Canadian offshore oil and gas companies to efficiently assess their safety culture and identify improvement opportunities as they can consider implementing the indicators that are not currently in place. This research should make a significant contribution to the health and safety of offshore workers working off the East Coast of Canada.

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Introduction

The Atlantic Canadian offshore oil and gas industry increasingly recognizes the importance of the cultural aspects of safety management. This is due in part to the findings from investigations into major disasters in process industries (e.g., Texas City fire, and Piper Alpha) and other industries such as nuclear power (e.g., Chernobyl), marine transportation (e.g., Exxon Valdese) and passenger rail transportation (e.g., Ladbrook Grove). The investigations into the causes of these disasters concluded that systems broke down catastrophically, despite the use of complex engineering and technical safeguards. These disasters were not primarily caused by engineering failures, but by the action or inaction of the people running the system. Some safety experts estimate that 80-90% of all industrial accidents are attributable to "human factors" causes (see Hoyos, 1995). It is now widely accepted that an effective way to further reduce accident rates is to address the social and organizational factors that influence safety performance. In parallel with the wider recognition of the importance of psychological aspects of safety, the concept of organizational culture came to the forefront. The recognition of the importance of organizational culture for safety reflects the increasing emphasis on cultural factors that are associated with success, for example the term ‘Google-ish’ has been coined the describe successful innovation cultures.

Organizational culture is central to how employees make sense of, and experience, their organization. Culture is the shared understanding of the organizational environment, which is held by an entire group of employees in an organization (Ostroff, Kinicki, & Tamkins, 2003). Organizational culture is defined as:

> a pattern of basic assumptions – invented, discovered, or developed by a given group as it learns to cope with its problems of external adaptation and internal integration- that has

> worked well enough to be considered valid and therefore, to be taught to new members as the correct way to perceive, think and feel in relation to those problems. (Schein, 1990, p. 9).

Culture consists of three fundamental layers: observable artefacts, espoused values, and basic underlying assumptions. Observable artefacts are visible products or behaviours of underlying values that represent deep-rooted ideologies or assumptions of the organization. These artefacts include symbols (e.g., natural and manufactured objects), organizational language (e.g., jargon, gossip, and gestures), narratives (e.g., stories, legends, and myths), and practices (rituals and ceremonies). Espoused values are values that are supported by management or the organization in general (Ostroff et al., 2003). Gaps between management's espoused and enacted (i.e., carried out) values can affect employees' perceptions of such things as corporate safety programs (Clarke, 1999). Basic assumptions exist in the core of organizational culture and are rarely confronted or debated by employees. These assumptions are unobservable and very difficult to change. Employees will view any behaviour that goes against organizational assumptions as implausible (Ostroff et al., 2003).

Safety Culture

Safety culture has been described as the most important theoretical development in health and safety research in recent years (Pidgeon, 1991). The term *'safety culture'* was introduced by International Atomic Energy Agency in their report on the Chernobyl nuclear power plant disaster in 1986. The errors and violations of the operating procedures that contributed to the disaster at the Chernobyl plant were seen by some as being evidence of a poor safety culture (Lee, 1998).

An organization's safety culture is stable over time. It influences workers' (or group of workers') view of the world (i.e., what is important and how they interpret new information). It can be likened to the personality of the organization. Safety culture determines the accepted norms and behaviour (Vincent, 2005), such as adherence to safety rules and procedures (Fleming, Smith, Slaunwhite, & Sullivan, 2006). Safety culture transcends the organizational members that share the culture, as it is the things that are passed on and endures. In essence, safety culture is independent of people who are currently part of the organization; the culture will exist after all of these people have left. New members of the organization informally 'learn' the safety culture, through observation, social feedback and trail and error.

The importance of safety culture is illustrated by the fact that although airlines across the world fly similar types of aircraft, with crews who are trained to similar standards, the risk to passengers varies by a factor of 42 across the world's air carriers. Since these organizations have very similar technology, systems and structures some argue that the difference in performance is largely due to systematic differences in the behaviour of their employees, in other words: their safety culture (Reason, 1998).

Safety Culture Maturity Model

Although the importance of safety culture is widely accepted, few organisations have successfully implemented effective safety culture improvement initiatives. One reason for this is the absence of clear guidance on what a good culture looks like and how to create such a culture. In an attempt to address these limitations Fleming (2000) developed a Safety Culture Maturity Model that described the stages of safety culture development. This model was based on previous work in the software industry. The capability maturity model enables organisations to assess their capability to reliably produce software products. The model uses an ordinal scale to

outline evolutionary steps that organizations can use to measure and evaluate a number of elements involved in software production. This model is useful for organizations as it allows them to determine their current level of maturity, or the evolutionary step they are on (Paulk, Curtis, Chrissis, & Weber, 1993). Maturity models also aid in identifying an organization's areas of particular strengths or weaknesses (National Patient Safety Agency, 2006), and what actions need to be taken to reach the next level (Paulk, et al., 1993).

The maturity model framework places safety culture on a continuum from poor to good and therefore facilitates the identification of indicators for each level of maturity. Current safety culture maturity models use pre-existing organizational typologies created by Westrum (1984), Reason (1993) and Fleming (2000) as the basis for their maturity levels.

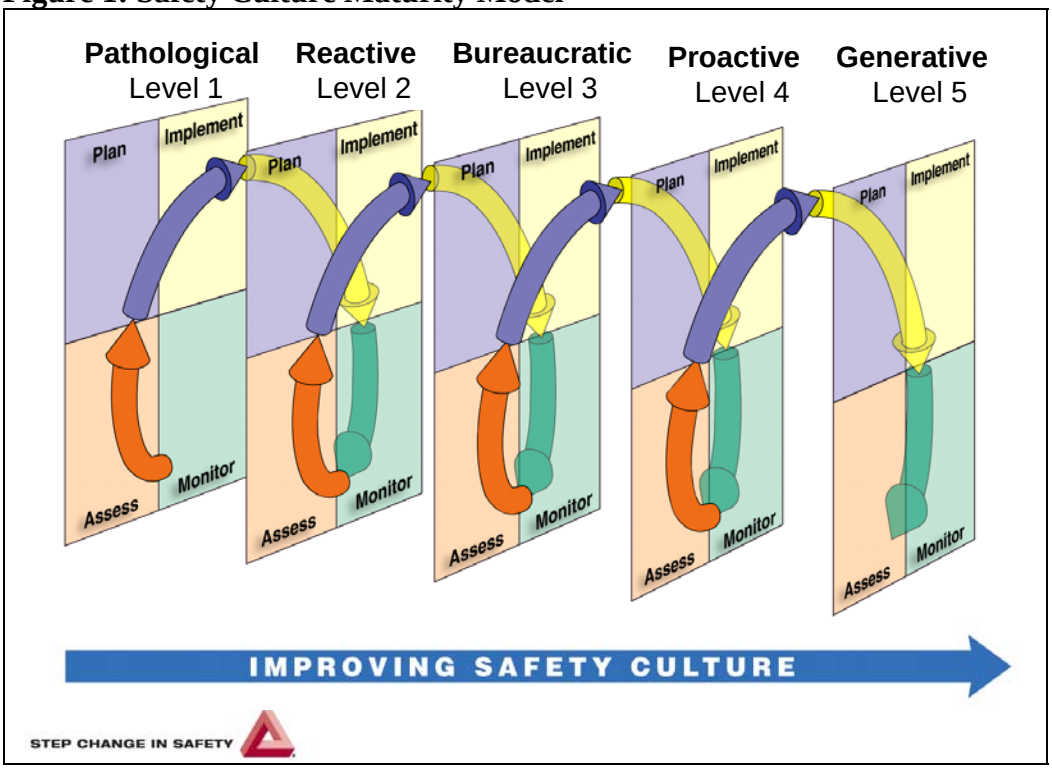
Westrum (1984) developed a typology of organizations culture. The typology identifies three basic styles of organizations: pathological, bureaucratic, and generative. Pathological environments develop when there is a focus on personal needs, power, and glory. Bureaucratic environments arise when there is a fixation with rules, positions, and departmental territory. Generative environments, conversely, arise when there is focus on the mission, not on persons or positions (Westrum, 2004).

Westrum (1996; 2004) proposes that this typology can be used to categorize the range of organizational culture. In pathological cultures information is only important if it will affect their personal interests. In bureaucratic cultures information is only used to advance the goals of the department. In generative culture emphasis is placed on using information to aid in accomplishing the mission (Westrum, 2004). Westrum (1996; 2004) also proposes that this typology could be used to characterize organizations on how they respond to failure. In pathological organizations, information is hidden and failures are dealt with by blaming a

scapegoat. In bureaucratic organizations, information may be ignored and failures are explained away or resolved, with no deeper inquiry into them. Generative organizations actively seek information and inquiries occur after failures are discovered. These inquiries serve to attack the underlying conditions, not just the immediate causes of the failures. The characteristics of a high reliability organization can be likened to the characteristics of the generative organization style.

Reason (1993) adapted and expanded Westrum's tripartite typology, by including the characteristics of reactivity and proactivity into his typology. Reactive organizations state that safety is important to them, but respond only after accidents have occurred. Proactive organizations try to anticipate safety issues before they happen (Reason, 1998).

Figure 1: Safety Culture Maturity Model



Parker, Lawrie, and Hudson (2006) created a framework for the development and maturation of organizational safety culture based on Westrum's and Reason's typologies of organizational cultures. Their model consists of five safety culture levels from Westrum's and Reason's organizational typologies: *pathological, reactive, calculative, proactive,* and *generative* (see figure 1). The framework is a theory-based tool that the researchers suggest could be used by companies in the oil industry to self-assess their current level of safety culture. They also suggest that the framework could be used for comparing organizational cultures, and subcultures.

In creating the safety culture framework, Parker and colleagues (2006) conducted interviews with oil and gas company executives and investigated both concrete and abstract aspects of safety culture. Examples of the concrete aspects investigated are audits and reviews, and incident/accident reporting. Examples of the abstract aspects investigated are the management's view of who causes accidents, and the balance between health and safety and profitability. The researchers found some support for their five level safety culture framework. When oil industry workers reviewed the framework, they did not perceive the characteristics of the more mature levels of safety culture (i.e., proactive and generative) as being associated with the less mature levels (i.e., pathological and reactive) (Lawrie, Parker, & Hudson, 2006).

Characteristic of a Positive Safety Culture

The above provides a useful framework for safety culture improvement, and provides general guidance on the nature of a positive culture, but the model does not specify organisational practices associated with a positive culture. It is clear that organisations would like to have a generative culture so that they can gain a deep understanding of the safety threats

within their organisation, but how does one create such a culture. There is a need to identify the organisational practices associated with a positive safety culture.

Commitment, competence and cognizance

Reason (1993; 1998) discusses three cultural factors that play a role in an organization's progress towards greater safety. The three factors, commitment, competence, and cognizance, have been recognized as being central to the development of successful safety practices (International Nuclear Safety Advisory Group, 1991). These cultural factors are necessary components for successful safety practices in an organization, as simply mechanically applying good safety practices is not enough to ensure success. Organizations must make certain that "all duties important to safety are carried out correctly, with alertness, due thought and full knowledge, sound judgment, and a proper sense of accountability" (INSAG, 1991, p.4). Commitment, competence, and cognizance are shaped by the quality of the decision-making made at the top level of an organization (Reason, 1993).

Commitment has two elements: motivation and resources. Motivation is related to whether the organization attempts to be a safety leader in their industry or only tries to stay a step ahead of safety officials. The commitment of resources relates to the organization's allocation of money, as well as human resources, in the pursuit of safety goals. The quality of the resources allocated is just as important as the quantity of resources. Being committed to achieving safety goals is futile if an organization does not have the competence to achieve the goals they have set. The competence of an organization is reflected by their safety information technology, and its ability to adequately collect safety information, distribute it, and respond to it. Being committed to achieving safety goals and competent in addressing safety issues necessitates the organization being cognizant of the dangers that it faces. Cognizant organizations recognize that safety is an

ongoing struggle, and seek to reform and strengthen their safety defences during lengthy periods without a bad accident rather than being complacent (Reason, 1998).

High Reliability Organizations

Pidgeon (1991) suggests that culture provides a useful heuristic for managing risk and safety in organizations and that it provides an overall characterization of the common features of high reliability organizations. High Reliability Organizations (HROs) are organizations that constantly operate under high-risk conditions but have few accidents. Examples of such organizations include air traffic control systems, nuclear power generating plants, and power grid dispatching centers (Weick & Sutcliffe, 2001). These organizations carry out a range of extraordinary steps in order to have incident free performance (Bellamy, Crawford, Marshall, & Coulter, 2005).

High Reliability Organizations are considered to be unusual outliers in mainstream organizational theory because they have unique potentials for disastrous consequences and interactively complex technology. HROs are not error-free, but they are able to contain the effects of errors so they do not turn into major failures. These organizations have strategies to respond to unexpected events (Bellamy et al., 2005). HROs are experts in making fast decisions based on imperfect data and knowing when to improvise instead of following routines (Waller & Roberts, 2003).

Weick et al. (2001) outline hallmarks of High Reliability Organizations. These organizations have a preoccupation with failure, treating any lapse as a symptom that something is wrong with the system. They encourage employees to report errors. HROs are reluctant to simplify, and attempt to see a complete picture of what is going on. Anomalies in the system are noticed while they are still able to be isolated, as HROs are attentive to the front line. These

organizations are committed to being resilient, developing the capabilities to detect, contain, and rebound from errors that inevitably occur. HROs allow decisions to be made on the front line, and allow authority to migrate to the employees with the most expertise, regardless of their level of seniority.

A key feature of high reliability organizations is said to be a culture of safety or "a culture of reliability" that pervades the organizations (Gaba, Singer, Sinaiko, Bowen, & Ciaverelli, 2003; Weick, 1987). Culture is an important element in high reliability organizations as it is a way to establish meaning in an organization. Meaning provides guidance in times when the environment is unstable, and allows people to assess what, if any, decision needs to be made. Standard Operating Procedures are a method of providing order instead of culture, but culture allows room for interpretation, improvisation, and unique action (Weick, 1987).

Culture in high reliability organizations allows for a system where there is centralization and decentralization simultaneously. Centralization allows for a clear chain of command when a situation needs to be dealt with, and decentralization allows for employees to operate their own units and make decisions locally. Centralization needs to occur before decentralization so that when employees are carrying out their operations, the operations will be equivalent and coordinated. This is when culture becomes very important – it can preserve coordination and centralization because the homogeneous set of assumptions and decision premises that occur with culture are applied in the local (decentralized) units. When these assumptions and premises from the culture are applied, compliance can occur without surveillance (Weick, 1987).

High Performance Work Systems

A High Performance Work System (HPWS) is defined as a system of integrated human resources practices, which are internally and externally consistent, that influence the internal

social structure of the organization, and ultimately, organizational performance (Evans & Davis, 2005). These human resources practices serve to select, develop, retain, and motivate the organization's workforce (Way, 2002). These practices include selective staffing, flexible job assignments, extensive training, decentralized decision-making, self-managed teams, open communication, and performance contingent compensation (Evans et al., 2005). High performance work systems are also characterized by transformational leadership practices, employment security and high-quality work for their employees (Zacharatos, Barling, & Iverson, 2005).

Pfeffer (1998; 1999) outlines the practices of successful organizations that parallel the practices of high performance work systems. Pfeffer (1998) defines a successful organization as one that is making profits through people. Through research studies, reviewing literature, and personal observation, Pfeffer (1998; 1999) cites the following seven dimensions as being central to successful performance in organizations:

- Employment security
- Selective hiring of new personnel
- Self-managed teams; decentralized decision making
- Comparatively high compensation contingent on organizational performance
- Extensive training - learning new knowledge and skills for front line problem solving
- Reduced status distinctions (e.g., dress, language, wages)
- Extensive sharing of information (e.g., financial performance, strategy) throughout the organization

Power in a HPWS is delegated downward: Teams of employees are given authority and responsibility through outlets such as employee participation programs. Employees in a HPWS are also given greater access to resources. Employees are able to provide suggestions and express their viewpoints through open lines of communication with each other and management (Evans et al., 2005).

Research on high performance work systems (HPWS) has found a link between their practices and safety performance at the organizational level and at the employee level (Zacharatos et al., 2005). Zachartaos and colleagues (2005) investigated the relationship between HPWS and organizational level safety performance with employees from manufacturing organizations in Ontario. It was found that the practices of HPWS were related to less lost-time work injuries. In a second study with employees from organizations in the petroleum and telecommunications industries, Zachartaos and colleagues (2005) found that employees' perceived organizational safety climate mediated the relationships between high performance work systems and both personal safety orientation (i.e., compliance, initiative, knowledge, and motivation) and safety incidents (i.e., injuries requiring first aid, near misses, and lost-time injuries). Employee trust in management was also found to mediate the effects of the high-performance work system on the occurrence of safety incidents. These findings show that a high-performance work system is significantly associated with occupational safety in organizations in various industries, and that perceived safety climate plays a role in this association.

Low accident organisations

Comparisons between high and low accident companies highlight differences in safety practices. ACSNI (1993) conducted a comprehensive review of empirical research on high and low accident organizations and found that low accident organizations, unlike high accident organizations, had the following characteristics:

- Frequent, less formal communication about safety at all levels
- Good organisational learning
- Strong focus on safety by all
- Strongly committed senior management
- Democratic and co-operative leadership style
- High quality training, including safety training
- Good working conditions and housekeeping
- High job satisfaction

- Good industrial relations
- Selection and retention of employees who work steadily and safely

Assessing Safety Culture

Assessments of an organization's safety culture can be performed using subjective or objective assessments. Most often, subjective assessments (in the form of self-completion questionnaires) are used when attempting to assess safety culture. Self-completion questionnaires are given to employees and management to determine the current safety culture of an organization. Questionnaires ask respondents to comment on various organizational characteristics (tangible and intangible), which overall, gives insight into what the organization's safety culture is like. These subjective assessments can include questions about behavioural safety norms, error reporting in the organization, allocation of resources, and management's role in safety (e.g., Gaba et al., 2003). Some questionnaires that claim to assess safety culture have very similar dimensions and statements as those claiming to measure safety climate (Cox & Flin 1998). There has been an increasing recognition that self-completion questionnaires are unlikely to measure safety culture, but rather only assess an organization's safety climate (Cox & Flin, 1998; Guldenmund, 2000; Mearns, et al 1997).

Objective assessments of safety culture involve looking at various concrete indicators throughout an organization to reveal the status of the culture, as opposed to asking employees or management for their opinions and attempting to learn about intangible qualities of the organization. Tangible indicators of safety culture, which can be seen by those inside and outside the organization, can include audits and reviews, accident reports and investigations, and employee training procedures (e.g., Parker, Lawrie, & Hudson, 2006).

A review by Sorenson (2002) of empirical research on safety culture revealed a number of indicators of safety culture. The review encompassed research on safety culture in both chemical processing plants and nuclear power plants. A model that included 78 indicators of safety culture was produced for a Swedish nuclear power plant, with the following being identified as the five main objective indicators of safety culture in the plant:

- Annual rate of safety significant errors
- Annual rate of maintenance problems
- Ratio of corrective to preventive maintenance on safety equipment
- Annual rate of problems with repeated root cause
- Annual rate of plant changes that are not incorporated into design-basis documents prior to the next outage

Interestingly, four out of the five indicators are safety culture outcomes rather than indicators, for example annual rate of safety significant errors. The exception is the ratio of preventative to corrective maintenance. These indicators would provide information on the status of the safety management within the organisation but would provide little information on the current culture or how to improve the safety culture. There is a need to create a set of objective indicators that organisations can use to assess their current culture that provide them with information about what actions they can take to improve their safety culture.

Current Study

The objective of the proposed study is to develop an audit method to measure safety culture, to increase scientific understanding of the safety culture construct and the stability of the construct when different measurement methodologies are used.

The study aims to:

1. develop and validate a safety culture audit technique,
2. assess the stability of safety culture across measurement methodologies,
3. measure the safety culture maturity of a sample of Atlantic Canadian offshore companies and make recommendations about how participating companies can improve their culture.

Discussion Methodology and Materials

This project consisted of three stages: the development of a pilot safety culture audit instrument, pilot testing the instrument, and validating the instrument. The pilot instrument was created based on information gathered in a review of relevant literature and consultations with subject matter experts and industry experts. The pilot study tested the safety culture audit in one organization. The reliability and validity phase of the project involved conducting audits using the instrument in petrochemical operating and contracting organizations and comparing the results from multiple audit raters and comparing audit results with the results from an existing safety culture measure.

Developing and Pilot Testing the Safety Culture Audit Instrument

The safety culture maturity model was used as an initial framework for the safety culture audit technique. This model provides a general framework but it required the identification of safety culture indicators for each level of the model. A review of peer-reviewed publications and academic books was conducted to identify key safety culture indicators. This review involved examining papers on methodological issues in measuring safety culture and audit techniques used in other domains.

The literature review identified a wide range of cultural elements or characteristics associated with important safety outcomes. Common elements identified are summarised in table 1 below:

Table 1: Common cultural elements identified

HRO's	HPWS	Low accident organisations	Common elements
Preoccupation with failure (investigate all lapses) Encourage employees to report error Seek to develop deep understanding of issues	Extensive sharing of information throughout the organization	Good organisational learning	• Good organisational learning
Decentralised decision making to those with most expertise	Self-managed teams; decentralized decision making Reduced status distinctions	Democratic and co-operative leadership style	• Workforce involvement
	Extensive training - learning new knowledge and skills for front line problem solving	High quality training, including safety training	• Training
	Selective hiring of new personnel Compensation contingent on performance	Selection and retention of employees who work steadily and safely	• Safety performance evaluation
Attentive to frontline employee concerns		Frequent, less formal communication about safety at all levels	• Communication
	Employment security High quality work	Good working conditions and housekeeping High job satisfaction Good industrial relations	• Job conditions and satisfaction
		Strong focus on safety by all Strongly committed senior management	• Commitment to safety

Expert opinion was gathered through consultations with subject matter experts (experts in the area of organizational safety culture) and industry experts (Health and Safety representatives from operating and contracting organizations). Information gained through these consultations was combined with the information gathered in the literature review and used to develop the pilot safety culture audit instrument (See appendix A).

The pilot safety culture audit instrument consisted of a structured interview schedule, which contained 28 questions (each with additional probe items). Audit information was obtained by interviewing senior managers to illicit information about the safety culture indicators. This information was then used to establish their safety culture maturity level (i.e. Pathological, Reactive, Calculative, Proactive, and Generative) for each of the eight elements or dimensions of safety culture (see table 1).

The pilot safety culture audit instrument was tested in a large contracting company with 14 branches. The pilot study involved surveying employees' safety culture perceptions using a card sorting exercise and a self completion questionnaire. Once the employee perception survey was completed, the managers of each branch were invited to participate in a safety culture audit interview. Eleven managers participated in the pilot safety culture audit. The managers provided the information required for the audit during interviews that were between 30-45 minutes in length. (Interview results are presented in Appendix B).

Results from the pilot test indicated that the safety culture audit instrument was not precise enough to discriminate between the branch with best safety culture results from the branch with the poorest safety culture (see table 2). The inability of the pilot audit to discriminate between branches may have been due to range restriction, since the pilot study was conducted within one organisation. In fact many of the branches listed the same practices as they were company wide

policies. It is also possible that the pilot audit was not fine grained enough to pick up differences between branches.

Table 2: Sample results from the pilot study for commitment to safety element

Commitment to Safety	Branch with best questionnaire results	Branch with poorest questionnaire results
Visit worksite	1/week	3/month
Manager safety evaluation	Not evaluated	Evaluated but not sure how
Safety bonus for employees	Monthly draw for near miss reports	No safety bonus
Safety on management meeting agenda	Regular item	First item on agenda
Safety leadership training	DNV loss control management	Training provided by safety manager from main office
Supervisor safety evaluation	Yes, by managers via field observation	Incident reviews and performance reviews
Safety inspections	No	Review 1/3 risk assessment

In order to improve the safety culture audit, a panel of offshore industry safety experts reviewed the pilot instrument and gave their opinions on how the instrument could be refined. Specific workshops were held in St. John's, Newfoundland (CAPP office) and Halifax, Nova Scotia (Saint Mary's University) with health and safety professionals from four offshore operating companies. The workshops lasted 3.5 hours and involved a presentation about safety culture and the background to the instrument. In total seven health and safety specialists reviewed the instrument.

The results from the pilot testing and consultations with industry experts led to revisions to the pilot audit instrument. This included changing the method of response for the audit's

questions. The revised audit instrument required respondents to choose the extent to which a number of safety culture indicators have been implemented in their organization by indicating which maturity level their organization has achieved for each element. The change in response format was designed to improve the efficiency of the audit and to produce a finer grained categorisation of the safety culture. The industry experts also questioned the utility of the job conditions and satisfaction element as it was not as clearly linked to safety as other elements and it was also difficult to identify specific indicators for this element. In addition, participants in the pilot study also raised concerns about this element. This element was dropped in the revised audit, given concerns about its face validity. The revised instrument consisted of six elements, which were subdivided into twelve indicators (See Appendix C).

- Organisational learning
  - **Incident Investigation Team**
- Workforce involvement
  - **Workforce Involvement**
- Training
  - **Frontline Worker Safety Training**
  - **Supervisor Safety Training**
  - **Manager Safety Training**
- Safety performance evaluation
  - **Manager Safety Performance Evaluation**
  - **Supervisor Safety Performance Evaluation**
- Communication
  - **Safety Communication**
- Commitment to safety
  - **Planned Maintenance**
  - **Rules and Procedures**
  - **Managers Visiting the Worksite**
  - **Supervisors Visiting the Worksite**

Establishing the Reliability and Validity of the Safety Culture Audit Instrument

The reliability and validity tests were conducted with a convenient sample of petrochemical contracting and operating organizations.

As proposed the reliability of the audit was tested by examining interrater reliability and internal consistency of the audit. Interrater reliability determines the extent to which two people will produce the same results when using the audit at the same site. To establish the interrater reliability of the safety culture audit, two managers from the same organization independently conducted the safety culture audit. Three operating companies participated in the reliability testing of the audit process (i.e. six managers in total). Prior to conducting the safety culture audit the participating managers were provided with the necessary information to successfully complete the audit. The principle researcher guided the manager through the self assessment process. Interrater reliability was calculated using Interclass Correlation Coefficient (ICC), which tests the degree of agreement among raters. The degree of agreement could vary from -1 to +1, the closer to +1 the higher the degree of agreement. The managers were consistent in their assessments of the safety culture using the audit, as the ICC was statistically significant at the .01 level ($r = .43$, $F = 2.51$, $p < .01$). This provides evidence for the reliability of the safety culture audit.

The internal consistency of the audit instrument was also tested, using Cronback's Alpha. Internal consistency tests the reliability of several questions/items in measuring the same characteristic or construct (i.e., safety culture). The internal consistency of the 12 questions (assessing six dimensions) in the safety culture audit instrument is .89, which indicates good reliability.

As proposed the validity of the safety culture audit was tested by examining the criterion (the extent to which the audit measures safety culture) and discriminant validity (extent to which it is measuring a discrete construct). The audit's level of criterion validity was established through concurrent validation. This involves testing the extent to which the results of the safety

culture audit produces similar results as existing safety culture measure. The criterion validity was tested by comparing the results obtained by the audit with the results of a validated perceptual measure of safety culture (safety culture card sorting exercise). Managers from twelve participating organisations completed the self assessment safety culture audit (see Appendix C) and employees (3-17) completed a safety culture card sorting exercise. Descriptive statistics are provided in Appendix D.

The validity of the safety culture audit was established by correlating the results from the audit with the results from the safety culture card sorting exercise. The correlation between the two measures is significant ($r = .491$, $n = 12$, $p < .01$), which provides support for the validity of the safety culture audit.

The discriminant validity of the audit was examined by comparing the safety culture audit to a standard safety management system audit. If the safety culture audit is measuring a discrete construct then there should be limited overlap between the two instruments. The comparison (see Appendix E) provides support that the audit is measuring a discrete construct as there is very little overlap in the content of the two audits.

Limitations and future research

The methodology closely followed that of the original proposal, with three notable exceptions. Firstly, the pilot study was conducted with a much larger organisation which facilitated the comparison between branches to establish the extent to which the audit could discriminate between those branches with high and low safety culture perception scores. This provided important information about the limitations of the pilot safety culture audit. In the

proposal the pilot was designed to test the inter-rater reliability, which was not possible given the nature of the pilot instrument.

Secondly the proposal stated the test –retest reliability would be conducted. This was not possible due to personnel changes within the collaborating organisations, as three of the six who participated in the reliability test left shortly after completing the first reliability test. This was substituted for by assessing the internal consistency of the audit tool, which is a more conventional measure of instrument reliability. Thirdly, the proposal stated that five organisations would be included in the validity and reliability testing. This sample was increased to twelve as five did not provide enough power to test the validity of the audit. In order the increase the number of participating organisations the demands on the organisations were reduced by requesting a smaller sample of employees to complete the safety culture perception survey.

Future research should focus on developing a similar tool to measure asset integrity cultural maturity. Incidents such as the Texas Fire and process upsets in Atlantic Canada have highlighted the need to produce more effective leading indicators for asset integrity. In addition, longitudinal research is required to test the extent to which interventions based on this audit result in improvements in safety outcomes.

Technology Transfer

The safety culture audit was developed in response to operating company desire to be able to assess safety culture without conducting employee perception surveys. The desire for an alternative to perception surveys is due to the short term contracting arrangements common in Atlantic Canada. These short term contracts mean that it is not practical to undertake an employee perception survey. For example if an operating company is using a drilling rig to drill one well, it is likely that they would only receive the results of a survey when the rig was going off contract. Therefore the success of the project necessitated working closely with operating companies. This project received a high level of support with four of the five operating companies with assets in Atlantic Canada participating, namely Encana, ExxonMobil, Hibernia and PetroCanada. Safety managers from these companies have been directly involved in the development of the instrument through attendance at workshops in St Johns, Newfoundland and Halifax, Nova Scotia, individual input on safety culture indicators and feedback on the draft instrument. In addition, these companies have been involved in the reliability and validity testing of the instrument. They are therefore aware of the results of the research as they have been directly involved. As a part of the reliability and validity phases the safety culture audit instrument was used to assess their culture and to identify opportunities for improvement. All the participating companies have an electronic copy of the audit that they can use within their organization or with contracting companies. A further indication of successful technology transfer is the decision by one operating company to use the audit as part of a national improvement strategy.

In addition to working closely with operating companies the safety culture audit instrument has been presented to Atlantic Canadian offshore contracting companies. This

involved giving presentations in St John's, Newfoundland and Halifax, Nova Scotia to ExxonMobil's contractor managers. These presentations were organized and funded by ExxonMobil.

Initial results of this research were presented at the PRAC annual meeting in May 2006 and a poster presentation has been accepted at the First PRAC R&D forum in St John's, Newfoundland in May 2007. Organizations involved in the research will continue to be supported in using the assessment tool. A final safety culture audit training workshop has been planned, to promote the use of the audit and share the results of this research. This event has been delayed due to changes in personnel within the partner operating companies.

Conclusions

This project consisted of three main phases, namely the development of a draft safety culture audit, pilot testing the audit and evaluating the reliability and validity of the audit. The grant application was submitted in February 2003, but due to delays in the application process, the project was not approved until the Fall of 2004. In the intervening period two of the three support organisations suspended operations in Atlantic Canada. This caused the project to be significantly delayed, as access with alternate organisations was sought. With the approval of PRAC the project was extended by 12 months.

A draft safety culture audit was developed by conducting a comprehensive review of the literature and consultation with domain experts. The pilot study involved interviewing eleven branch managers from one contracting organisation and correlating the results with safety culture scores for each branch. It was anticipated that the audit would be refined following the pilot by removing indicators that were not associated with the branch culture scores. In practice none of the safety indicators in the pilot audit discriminated between branches with high and low safety culture perception scores. Closer inspection of the results showed that many of the indicators were too broad and therefore did not discriminate. The results of the pilot were used to significantly modify the audit tool to ensure that it provided a more fine grained analysis.

The safety culture workshops held in St John's and Halifax provided important guidance on how to improve the audit. The seven managers that participated in these workshops suggested indicators and improvements in the design of the audit. The results of the reliability and validity testing provide support for the reliability and validity of the safety culture audit. This is significant from a scientific perspective as it is the first objective measure of safety culture that has been validated. This demonstrates that employee safety culture perceptions are

based on their objective experience of their working environment. The results have important practical implications for the Atlantic Canadian petroleum industry as they now have an audit process that they can use to assess the maturity of their safety culture which does not require employee perception surveys. This audit instrument provides significant improvements in efficiency as it enables the industry members to assess their culture and identify improvements.

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Appendix A: Pilot safety culture audit

1) Do managers visit the worksite to discuss safety?

□ No	□ Yes		
	• Is there a formal system in place to monitor and track how often they visit?		
	□ No	□ Yes	
		• Do managers have site visit targets to meet?	
		□ No	□ Yes

2) Do managers receive safety leadership training?

□ No	□ Yes
	• Please describe the training

3) Are managers evaluated on health and safety performance?

□ No	□ Yes	
	• How is it evaluated	
	• Are managers rewarded for health and safety performance?	
	□ No	□ Yes
		• How are they rewarded?

4) Is branch safety performance tracked/measured?

□ No	□ Yes
	• If so how is it measures?

5) Do you monitor the financial cost of related to safety incidents?

□ No	□ Yes

6) Do you have a safety bonus system or scheme developed and in place?

□ No	□ Yes
	• Could you please describe it

7) Do you assess health and safety records of potential contractors?

□ No	□ Yes
	• How is this assessment done?

8) Do you have a process where employees are able to report safety suggestions and concerns?

□ No	□ Yes
	• Could you please describe this process?

9) Is safety a regular item on the agenda of management meetings?

□ No	□ Yes

10) Do you have a specific person in a management position assigned to dealing with safety issues?

□ No	□ Yes	
	• Are they on a health and safety committee?	
	□ No	□ Yes
	• What level of management are they in? (who are they)	

11) How do managers communicate with employees about safety? *(Props: flyers, meetings, bulletin broads)*

12) How do workers communicate with management about safety?

13) How does management communicate with other organizations about safety?

14) Do supervisors receive safety training?

□ No	□ Yes	
	• Is safety leadership part of the training?	
	□ No	□ Yes

15) Are supervisors evaluated on Health and Safety?

□ No	□ Yes
	• How? (eg: accident rates)

16) Do supervisors visit the worksite to talk about safety?

□ No	□ Yes	
	• Is there a formal tracking system in place?	
	□ No	□ Yes
	• How often do these visits occur?	

17) Do supervisors perform workplace inspections?

□ No	□ Yes	
	• Is there a formal system to monitor it?	
	□ No	□ Yes
	• What is the frequency of visits?	

18) Are workers involved in workplace inspections?

□ No	□ Yes
	• How?

19) Is there an all hands safety meeting?

□ No	□ Yes
	• Do they get paid to attend?

20) Are frontline workers involved in incident investigations?

<table>
<tr><td>□ No</td><td colspan="2">□ Yes</td></tr>
<tr><td></td><td colspan="2">• How are they involved?</td></tr>
<tr><td></td><td colspan="2">Are employees formally trained in incident investigations?</td></tr>
<tr><td></td><td>□ No</td><td>□ Yes</td></tr>
<tr><td></td><td></td><td>• How are they trained?</td></tr>
</table>

21) Who else is involved in accident/incident investigation?

22) Do you involve frontline workers when designing or updating the rules and procedures?

<table>
<tr><td>□ No</td><td>□ Yes</td></tr>
<tr><td></td><td>• If so how?</td></tr>
</table>

23) Is it encouraged that employees stop work because of potential hazards?

□ No	□ Yes
	• What is the process for stopping work?

24) Do workers stop jobs for safety concerns?

□ No	□ Yes
	• What is the frequency of occurrence? (per month/day/year??)

25) Has a manager ever stopped a job because of safety issues?

□ No	□ Yes
	• Could you please describe the last incident?

26) What is the process for refusal of work?

27) Do you monitor the hours employees work during a week?

□ No	□ Yes
	• On average how many workers go into overtime in a week?

28) Do you share lessons learned with all employees in the company?

□ No	□ Yes
	• How do you share this information?

Appendix B: Results of the pilot study

	Branch 1	Branch 2
Commitment to Safety	Managers visit sites; MVP; site visit targets Post incidents in system; monthly incident report Estimate incidents' financial costs No bonus system Assess H&S records of potential contractors Employees report concerns at meetings, to H&S reps Safety regular agenda item at management meetings H&S rep (below manager) on H&S committee Supervisors attend "toolbox" meetings (daily or weekly) Supervisors conduct workplace inspections ~ once/week	Managers visit sites; Site visit targets (minimum 4/month) Branch safety performance tracked through incident ratios, audits Estimate incidents' financial costs at company level No bonus system Assess H&S records of potential contractors Safety suggestion box, "open door" policy, safety meetings Safety regular agenda item at management meetings Director of Safety Development (above branch manager) on H&S committee Supervisors participate in Branch safety audits
Training	Manager training for new policies/programs Supervisors receive safety leadership training	Manager training includes recognition of safety, promotion of safety, and "lead-by-example" Supervisors receive safety leadership training
Communication	Monthly safety meetings; H&S rep; personal communication H&S reps have bulletin boards Daily safety email Safety partnership committee	Verbal comm..; near-miss reports posted; pre-job assessments Employees encouraged to participate in Near-Miss program and attend safety meetings to voice concerns Verbal communication with clients about safety
Safety Performance Evaluation	Manager safety performance evaluated by clients Supervisors not evaluated on H&S	Managers evaluated on safety (incident ratios, Near-Miss Program) Supervisors evaluated on H&S (performance reviews)
Workforce involvement	Workers do inspections on fellow operators Monthly All hands safety meetings (employees paid) Frontline workers not involved in investigations Incident Prevention Committee (IPC)	A worker helps with workplace inspections Monthly All hands safety meetings (employees paid to attend) Workers involved in incident help with investigation Investigation procedures reviewed with employees regularly Frontline workers comment on design/update of rules/procedures

	Branch 1	Branch 2
Job Conditions	Stop Work Policy Jobs stopped a few times/year Manager has stopped work for safety concern Monitor employee hours/week 50% work overtime/week	Workers encouraged to stop work for safety concerns (hazard assessment pre-job, no description of during job stop system) Unsure of frequency of jobs stopped Manager has stopped work for safety concern Monitor employee hours/week Overtime is a regular situation
Organizational learning	Share lessons learned with employees by bulletins, safety meetings, and IPC meetings	All investigations and outcome/follow-up are circulated to all branches

	Branch 3	Branch 4
Commitment to Safety	MVP audits; no site visit targets Head office monitors branch safety performance Head office (not branch) monitors financial costs of incidents No bonus system No assessment of H&S records of potential contractors Employees report safety suggestions at safety meetings Safety regular agenda item at management meetings Safety officer (company-wide), Branch managers address branch safety concerns Supervisors visit worksites to talk about safety/audits (~ once/week) Supervisors complete worksheets for workplace inspections	Risk assessment audits; site target visits Not rewarded for safety performance; no bonus system Head office monitors branch safety performance (audits) Monitors the financial costs of incidents Head office assess H&S records of potential contractors Near-miss program, safety meetings, "tool box" meetings Safety regular agenda item at management meetings Safety officer at larger branches, branch managers address safety concerns at smaller branches, attend IPC meetings Supervisors visit worksites to talk about safety regularly (no track system) Supervisors involved in quarterly audits at branch, monthly inspections
Training	Supervisors receive safety leadership training No safety leadership training for managers	"Most" managers have safety leadership training Supervisors receive safety leadership training
Communication	Communicate at safety meetings, audits; "daily" Branches pass on safety policies to customers	Safety meetings, safety bulletins posted, "one on one" communication with operators Clients request safety records & information
Safety Performance Evaluation	Managers not evaluated on H&S Supervisors evaluated on H&S (annual perform. evaluations)	Managers evaluated on H&S by head office audit Managers evaluate supervisors on safety performance
Workforce involvement	A worker helps with quarterly workplace inspections All hands safety meetings (employees paid to attend) Frontline workers not involved in incident investigations Branch manager, Safety manager investigate (depending on incident severity) Employees voice views of new rules at safety meetings	Workers help with workplace inspections Monthly All hands safety meetings (employees paid to attend) Frontline workers involved in incident investigations (trained) Workers involved in incident, managers, supervisors investigate incidents Employees voice views of new rules at IPC meetings

	Branch 3	Branch 4
Job Conditions	Workers encouraged to stop work for safety concerns (stop & call manager immediately) Jobs not often stopped for safety concerned Manager has stopped work for safety concern Monitor employee hours/week Overtime depends on time of year	Workers encouraged to stop work for safety concerns (tell client, then supervisor & branch manager if not resolved) Jobs stopped ~ once/year Manager has stopped work for safety concern Monitor employee hours/week Max. 12 hours worked/day; typically a 40 hour work week
Organizational learning	Publish incident reports daily (follow up or changes come out in same daily format)	Post lessons learned on safety bulletins, which are shared with all employees.

	Branch 5	Branch 6
Commitment to Safety	BBS audit system; site visit targets (4/month) Not rewarded for safety performance Hours worked, lost time,& incident reports track performance Do not monitor financial costs of incidents (head office?) No bonus system Review H&S program of potential contractors Near-miss program, "open door" policy, safety meetings Safety is regular agenda item at management meetings Safety Officer at head office on H&S committee BBS audit system; site visit targets (4/month) Supervisors perform inspections (risk assessments, ~4/month)	Formal site visit system (no info provided); site visit targets Not rewarded for safety performance Branch performance statistics tracked Financial costs of incidents tracked at head office Near-Miss program incentives (somewhat of a bonus system) Do not assess H&S records of potential contractors Employees can voice safety concerns at safety meetings Safety is regular agenda item at management meetings Director of Safety (upper management?) on H&S committee MVP; supervisor site visit targets (4/month) Pre-job risk analyses; no formal inspection system; ~2-6/week
Training	Managers receive safety leadership training Supervisors receive safety training (no safety leadership training)	Managers receive safety leadership training Supervisors receive safety leadership training
Communication	Post incident reports, "tool box" meetings, safety meetings "Open door" policy (to voice safety concerns) Submit safety policy manual for other orgs. to review/audit	Safety meetings, daily communication "Open door" policy, "tool box" meetings Give advice, presentations to other organizations
Safety Performance Evaluation	Unsure if managers are evaluated on safety Supervisors evaluated on H&S (informally evaluated; BBS audit)	Unsure if managers are evaluated on H&S Supervisors not evaluated on H&S
Workforce involvement	Workers complete field level risk assessment forms Monthly All hands safety meetings (employees paid) Workers involved in incident help with investigation Managers, supervisors, safety manager investigate incidents Ask for employee input on new rules, procedures	Workers involved in inspections at some sites (in MVP audits) Monthly All hands safety meetings (employees paid) Workers involved in incident help with investigation Director of Safety in Edmonton in charge of investigation Employees voice views of new rules at IPC meetings

	Branch 5	Branch 6
Job Conditions	Workers encouraged to stop jobs for safety concerns Jobs stopped ~once/2 months Managers stop jobs for safety concerns ("~ couple of times") Monitor employee hours/week 80% 10hrs/day, 40% 12hrs/day; hourly checks after 12 hrs	Stop Work Policy Jobs stopped ~2/year Managers stop jobs for safety concerns Monitor employee hours/week 80% work overtime
Organizational learning	Safety meetings, informal discussions	Safety meetings, bulletins distributed throughout company

	Branch 7	Branch 8
Commitment to Safety	Supervisors visit worksite to discuss safety (no formal tracking system) Supervisors complete site risk assessments, branch safety inspections	MVP system; manager site visit targets (4/month) Not rewarded for safety performance Branch safety performance tracked by central office Monitors financial costs of incidents No bonus system Assess H&S records of potential contractors (no formal system) Safety meetings, near-miss program, "open door" policy Safety regular agenda item at management meetings Director of Safety ("high-level management") on H&S committee Supervisors visit worksite to discuss safety; target visits 4/month
Training	Supervisors receive safety leadership training	Managers receive safety leadership training ("practical leadership skills") Supervisors receive safety leadership training
Communication	Director of Safety liaises with other companies' Directors and Managers of Safety, etc.	Safety meetings, bulletins, "tool box" meetings, "open door" policy Safety meetings, "open door" policy (two way communication) Give clients quarterly reports to review; Willing to stop jobs
Safety Performance Evaluation	Supervisors not evaluated on H&S	Managers evaluated on H&S (annual review; after every incident) Supervisors evaluated on H&S (incident reviews, conduct at safety meetings & with workers on-site)
Workforce involvement	Workers conduct field level risk assessments All Hands Safety meetings (employees paid) Workers involved in incident help with investigation Supervisor and/or Branch Manager investigate incidents Employees voice views of new rules at IPC, safety meetings	Workers conduct field level risk assessments All Hands Safety meetings (employees paid) Workers help with incident investigations (receive practical leadership skills incident investigation training) Safety Director, Branch Manager investigate incidents Employees voice views of new rules at IPC, safety meetings

	Branch 7	Branch 8
Job Conditions	Workers encouraged to stop jobs for safety concerns Jobs stopped ~2/year Managers stop jobs for safety concerns Monitor employee hours/week 50-60% work overtime	Workers encouraged to stop jobs for safety concerns (shut down job, call supervisor or manager) Unsure of # of jobs stopped Managers stop jobs for safety concerns Monitor employee hours/week Unsure of overtime %
Organizational learning	Bulletin boards, safety meetings	Daily safety bulletins given to every employee

	Branch 9	Branch 10
Commitment to Safety	BBS audit system; site visit targets (3/month) Rewarded for safety performance (unsure on how) Branch safety performance tracked (quarterly incident reports) Monitors financial costs of incidents No bonus system Assess H&S records of potential contractors Safety meetings, near-miss program, "tool box" meetings Safety is foremost agenda item at management meetings Safety Manager (upper management) on IPC Supervisors conduct risk assessments (~1/3 jobs) BBS observation forms (complete at least 3/month)	Visit worksite to discuss safety (no formal system) Not rewarded for safety performance Branch safety performance tracked (lost time accidents) Do not monitor financial costs of incidents No bonus system Don't assess H&S records of potential contractors Ask employee safety rep. if employees have safety concerns Safety is regular agenda item at management meetings Safety Manager - unsure if on H&S committee Supervisors visit worksite to discuss safety (no formal tracking system) Quarterly checklist; system to track crane inspections, certifications
Training	Managers receive safety leadership training Supervisors receive safety leadership training (STARCORP program)	Managers receive safety leadership training Supervisors receive safety leadership training
Communication	Flyers, safety topics, bulletins from corporate Safety Manager Safety meetings, near-miss program, "tool box" meetings, personal communication Talk with other orgs. about their safety programs	Daily safety email given to all employees, personal communication Safety reps asked about employee concerns, safety meetings Safety Dept. sends out info on incidents that happen at other orgs.
Safety Performance Evaluation	Managers evaluated on H&S (unsure on how) Supervisors evaluated on H&S (incident reviews, performance reviews)	Managers evaluated on H&S (head office conducts audits) Supervisors evaluated on H&S (informally)
Workforce involvement	Workers conduct hazard assessments Monthly All Hands Safety meetings (employees paid) Workers involved in incident help with investigation Managers, supervisors, safety personnel investigate incidents Ask for employee input on new rules, procedures	Workers involved in onsite inspections with manager Weekly All Hands Safety meetings (employees paid) Workers involved in incident help with investigation (not trained) Managers, supervisors, safety manager investigate incidents

	Branch 9	Branch 10
		Involve employees in design of new rules ("somewhat")
Job Conditions	Workers encouraged to stop jobs for safety concerns (talk to client first, then call manager) Jobs stopped ~once/month Managers stop jobs for safety concerns Monitor employee hours/week; Overtime varies (time of yr)	Workers encouraged to stop jobs for safety concerns (stop job, talk to supervisor) Jobs not frequently stopped (stopped more during busier times) Managers stop jobs for safety concerns Monitor employee hours/week; ~60% work overtime
Organizational learning	Presentations, daily safety updates, bulletins, memos	Weekly safety meetings, daily safety emails

	Branch 11
Commitment to Safety	MVP system; site visit targets (once/week) Not rewarded for safety performance Branch safety performance tracked (# man hours since last incident) Do not monitor financial costs of incidents at branch level Bonus system: employees who submit near-miss reports have name put in quarterly draw Open-door policy Safety is regular agenda item at management meetings Member of upper management assigned to safety issues (on H&S committee) Supervisors visit worksite to discuss safety ("on site everyday") Supervisors don't perform workplace inspections
Training	Managers receive safety leadership training (practical loss control, incident investigation and prevention training) Supervisors receive safety leadership training ("same training as managers")
Communication	Safety bulletins from head office posted daily if incident or near miss Face-to-face communication between employees & managers Company is member of the Canadian Crane Owner Association (discuss safety with others at these meetings)
Safety Performance Evaluation	Managers not evaluated on H&S Supervisors evaluated on H&S (by managers through field observations)
Workforce involvement	A worker is chosen to assist with inspections Monthly All Hands Safety meetings (employees paid) One worker (on IPC) receives incident prevention training Managers, supervisors, Director of H&S, and select employees investigate incidents Employees on IPC give input on new rules, procedures

	Branch 11
Job Conditions	Workers encouraged to stop jobs for safety concerns (talk to co-workers, then supervisor, then manager, then OH&S) Jobs stopped ~once/week Managers stop jobs for safety concerns Monitor employee hours/week; ~60% work overtime
Organizational learning	Bulletins posted on board daily

Appendix C: Safety Culture Maturity: Self assessment audit

Company Name:_____

Position with in company (e.g. supervisor)_____

Safety culture consists of shared perceptions and beliefs about safety. These perceptions are formed in part by management priorities and systems that promote the relative importance of safety. It is possible to assess safety culture maturity by audits current systems. The following self assessment audit is designed to measure the maturity of key safety culture elements.

Assess the maturity of your organisation's safety culture by circulating the maturity level corresponding to most accurate description of the systems that exist within your organisation. For example for "Manager safety training" you would select level 1 if your organisation provides basic training, which does not include how to be an effective safety leader. If you have no knowledge of a particular system then leave that element blank.

Manager Safety Training	**Select level**
Managers receive no safety training	0
Managers receive basic safety training (including responsibilities of managers under Safety program and legislation)	1
Managers receive safety training, which includes how to be a safety leader (course outline includes safety leadership section)	2
Managers receive skill based safety leadership training and development (course must include leadership practice e.g. role play or leadership demonstration based on real life scenario by senior leader).	3
Managers receive regular safety leadership training and development tailored to individual needs, as identified through 360 degree evaluation (safety specific). Ongoing coaching is provided. Training undertaken is linked to 360 results and is not a standard course offered to all managers.	4

Manager Safety Performance Evaluation	**Select level**
Safety performance is not monitored at the departmental level	0
Departmental safety performance is tracked and target incident rate set by department. Incident rate used as a part of bonus system for managers.	1
Mangers include safety system performance measures (e.g. audit results) and outcomes as a part of regular management reports, which are used as a part of the mangers ongoing evaluation.	2
Safety leadership is included in annual appraisal, which includes measurable targets (not outcomes) such as specific safety leadership activities, such as visiting the worksite and involvement in safety initiatives.	3
Managers' safety leadership is the central element of their performance evaluation. This involves the regular use of a formal upward appraisal system to assess **safety** leadership skills. Targets for improvement are set and monitored.	4

Safety Culture Maturity: Self assessment audit

Managers Visiting the Worksite	**Select level**
Managers do not visit worksite to specifically discuss safety	0
Managers visit worksite regularly to discuss safety as specified by a formal policy/ program (e.g. STOP)	1
There is a formal manager worksite visit program that specifies the number of visits to be conducted by each manager and tracks completion.	2
There is a comprehensive program that specifies how to perform a worksite visit, trains managers how to conduct a visit, evaluates managers to ensure they are competent and tracks frequency of visits and close out of actions.	3
There is a comprehensive program described above plus the quality of the managers' visits is evaluated by workers and anonymous feedback is provided.	4

Front line Supervisor Safety Training	**Select level**
Supervisors do not receive health and safety training	0
Supervisor safety training is limited to informing supervisors about their responsibilities as specified by legislation and safety program	1
Supervisors are offered fundamentals of safety course (which covers more than just system or legal responsibilities).	2
Supervisors are trained to be effective safety leaders, through skill based training and development (course must include leadership practice e.g. role play or leadership demonstration based on real life scenario by senior leader)	3
Supervisor safety leadership training and development tailored to individual needs, as identified through 360 degree evaluation. Ongoing coaching is provided Training varies between supervisors based on individually identified needs	4

Front line Supervisor Safety Performance Evaluation	**Select level**
Supervisors' safety performance is not evaluated	0
There is no formal system for evaluating supervisors' safety performance but failure in supervision identified a cause of accident	1
Safety performance is an element of a supervisor's annual appraisal. There are no formal criteria as the assessment is based on manager assessment of performance.	2
Safety leadership is included on supervisors' annual appraisal, which includes measurable targets (not outcomes) such as specific safety leadership activities, such as visiting the worksite and involvement in safety initiatives.	3
Supervisor safety leadership is the central element of their performance evaluation. This involves the regular use of a formal upward appraisal system to assess **safety** leadership skills. Targets for improvement are set and monitored.	4

Safety Culture Maturity: Self assessment audit

Front line Supervisors Visiting the Worksite	**Select level**
Supervisors do not visit worksite specifically to discuss safety	0
Supervisors are encouraged to visit the worksite to ensure subordinates are working safely	1
There is a formal program that sets targets for supervisors to conduct safety specific worksite visits	2
There is a formal program that trains supervisors to conduct worksite safety visits. The frequency and outcome of the visits is tracked.	3
In addition to the above the program assesses the quality of the worksite safety visits and subordinates provide anonymous feedback on quality of visit. Close out of action is tracked.	4

Safety Communication	**Select level**
Safety information is posted on a notice board.	0
Safety information is disseminated to all employees through hard copy (e.g. minutes from meetings) and electronically (group email)	1
Regular (12+ per year) safety news letter and website. Safety improvement suggestion system Town hall (all hands) safety meetings used to communicate major issues	2
Electronic safety action/ suggestion system that provides feedback on progress. Regular (12+/year) town meeting to facilitate open dialogue	3
Extensive use of interactive technology e.g. CEO safety blogs. Employees create and disseminate safety information through innovation and improvement groups. Employees are actively engaged in safety improvement and share their ideas at regular 'safety commons forums' both electronic and face to face	4

Workforce Involvement	**Select level**
There are no formal systems to involve workers in safety, (beyond joint occupational health and safety committee)	0
There is a safety suggestion scheme that enables workers to submit safety concerns, e.g. Hazard spotting	1
Involvement is encouraged through a safe and unsafe act observation and reporting programme. In addition the hazard spotting / safety suggestion system tracks completion and provides feedback to employee.	2
Workers are involved through a peer to peer safety observation and feedback system. There is a high level of worker involvement as evidenced by over 75% of workers participating.	3
Every worker is involved in at least one safety initiative. Safety improvement initiatives are managed by teams that are dominated by frontline workers. These teams have budgetary authority and responsibility.	4

Safety Culture Maturity: Self assessment audit

Incident Investigation Team	**Select level**
Incident report completed by victim/ witness	0
Incident investigation conducted by safety department with employee involvement for high consequence events	1
Injury incidents are investigated by a team led by safety department and include employees and managers	2
Multidisciplinary teams investigate safety failures. Teams include managers and employees trained in organisational analysis (e.g. root cause analysis).	3
Organisational learning teams include a cross section of employees and managers and are led by those with greatest expertise of task in question	4

Frontline Worker Safety Training	**Select level**
Front line workers are provided with task specific legally required safety training (e.g. fall arrest training)	0
Front line workers receive safety induction that includes legislation and company safety policy	1
Employees are trained in how to participate in safety, e.g. completing hazard report forms, conducting observations.	2
Front line workers are trained to conduct behavioural safety observations and provide (and receive) feedback.	3
Frontline workers receive safety leadership training and coaching.	4

Rules and Procedures	**Select level**
Minimal safety rules, only those legally required	0
Extensive safety rules written by engineering and management	1
Extensive safety rules written by engineers with extensive consultation with employees	2
Limited safety rules designed by employees with the support of experts (e.g. Engineering, Human Factors)	3
Context dependant safety rules that acknowledge changing demands to make it easy to comply with rules	4

Planned Maintenance	**Select level**
Maintenance only happens when equipment no longer usable	0
Maintenance occurs when minor breakdowns occur	1
There is regularly scheduled maintenance checks, but maintenance backlogs are common	2
Management actively monitor maintenance and ensure that maintenance backlogs are minimised	3
Frontline workers have control and responsibility for maintenance. They also have are able to obtain additional resources to prevent maintenance back logs occurring.	4

Appendix D: Descriptive statistics for the safety culture audit validation

Company	Organizational Learning	Workforce Involvement	Training[1]	Safety Perform. Evaluation[2]	Communication	Commitment to Safety[3]	**Total Audit Score**	**Card Sorting Mean**
1	3	3	8	6	2	10	**32**	**21**
2	3	2	6	5	2	7	**25**	**20**
3	2	2	5	4	3	7	**23**	**19**
4	2	2	7	4	2	8	**25**	**21**
5	3	3	6	4	2	6	**24**	**19**
6	2	2	5	3	2	5	**19**	**16**
7	2	1	5	4	2	7	**21**	**18**
8	2	2	8	7	1	10	**30**	**24**
9	2	2	6	2	1	9	**22**	**21**
10	3	3	9	6	4	10	**35**	**20**
11	2	2	8	3	2	8	**25**	**19**
12	2	1	5	5	2	7	**22**	**23**
Mean	2.33	2.08	6.5	4.42	2.08	7.83	**25.25**	**20.08**

[1] Sum of the three training indicators
[2] Sum of the two performance indicators
[3] Sum of the four commitment to safety indicators

Appendix E: Discriminate validity results

Safety Culture Audit / SMS. Audit	Organizational Learning	Workforce Involvement	Training	Safety Performance Evaluation	Communication	Commitment to Safety
Safety Policy						Both determine if rules exist; N.S. audit doesn't assess the nature of the rules
Hazard Assessment						
Safe Work Practices		Both determine if employees are involved in development of safety practices				
Job Procedures						
Company Rules						
Personal Protective Equipment						
Maintenance						Both determine if maintenance schedules exist; N.S. audit does not assess the frequency

Safety Culture Audit / SMS. Audit	Organizational Learning	Workforce Involvement	Training	Safety Performance Evaluation	Communication	Commitment to Safety
Training & Communication			Both assess if employee training occurs; N.S. audit training questions not safety specific			
Inspections						
Investigations	N.S. audit assesses aspects of incident investigation but does not determine who participates in investigations					
Emergency Preparedness						
Records & Statistics						
Legislation						
Physical Plant						
Supplementary Programs						N.S. audit determines if management is on a safety committee