

DEVELOPMENT OF A SAFETY CULTURE MEASUREMENT AND IMPROVEMENT TOOL FOR THE CANADIAN RAILWAY INDUSTRY

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SUMMARY

The 2007 review of the Canadian Railway Safety Act recommended that a project be initiated to investigate safety culture measurement and improvement tools. An effective safety culture is found when safety values are firmly entrenched in the minds of managers and employees at all operational levels, and respected on a daily basis in the performance of their duties. The purpose of this study was to provide and validate a safety culture measurement tool to measure and improve the safety culture of a railway organization within the context of the Canadian safety management systems approach to railway safety. An enhanced safety culture perception survey, implementation guide and scoring tabulation workbook were developed through a review of existing safety culture measurement and improvement research and tools, and with input from Canadian railways industry stakeholders. A pilot validation field test of the enhanced survey was undertaken to identify its strengths and weaknesses. Recommendations for improving the administration of the enhanced survey, for improving data collection techniques, and ultimately for improving safety culture were made.

INTRODUCTION

The Canadian Department of Transport (Transport Canada) is responsible for national transportation policies and programs. It ensures that air, marine, road, and rail transportation are safe, secure, efficient and environmentally responsible.

In 2007 a review of the Canadian Railway Safety Act, the legislation that ensures the safe operation of railways in Canada, called for Transport Canada and the railway industry to take specific measure to attain an effective safety culture. A collaborative working group consisting of government, industry and labour representatives developed a safety culture definition and a framework made up of practices and elements for the Canadian railway industry (referred to in this document as the Canadian railway definition of safety culture). Along with the definition and framework, the working group made a recommendation to develop a safety culture measurement and improvement tool for the Canadian railway industry. The current paper describes the effort to develop that measurement and improvement tool, the findings, results and lessons learned.

The project to develop a safety culture measurement and improvement tool consisted of the following elements:

- a review of research on safety culture and existing safety culture measurement tools;
- an evaluation of existing tools to identify the one most suitable for the Canadian railway industry;
- the development of an enhanced safety culture perception survey, implementation guide and scoring tabulation workbook; and,
- the implementation of a validation pilot test plan for the enhanced safety culture perception survey.

These elements will be described in this paper along with a discussion on the lessons learned to further improve the process of safety culture measurement and improvement.

BACKGROUND ON SAFETY CULTURE WITHIN THE CANADIAN RAILWAY CONTEXT

Following a review of Canada's Railway Safety Act in 2007, a definition of safety culture for the Canadian railway industry was agreed upon by a collaborative working group consisting of government, industry and labour representatives (referred to in this document as the Canadian railway definition of safety culture). The definition states the following:

The safety culture of an organization is the result of individual and group values, attitudes, perceptions, competencies and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization's health and safety management system. Organizations with a positive safety culture are characterized by communications from various stakeholders founded on mutual trust, by shared perceptions of the importance of safety and by confidence in the efficacy of preventive measures.

Along with this definition, a framework consisting of practices and elements was established:

Practice - Leadership and Commitment to Safety Culture:

Elements:

1. Clear leadership and commitment to safety at the executive or senior levels, as well as line management
2. Safety is a core value at all levels of the company
3. Safety is integrated into all levels of the company through policies, processes, procedures, objectives and initiatives
4. Executive participation in safety activities such as health and safety committee meetings, safety walkabouts, audits
5. Self evaluation, including benchmarking and lessons learned, for purposes of continuous improvement at all levels

Practice - Two-Way Communications:

Elements:

1. Multiple processes to promote management – employee communications (e.g., safety meetings, town hall meetings, safety forums, briefings, mentoring, performance reviews, etc.)
2. Multiple processes to increase employee awareness and knowledge of safety (e.g., newsletters, communiqués, brochures, safety flashes, training, etc.)
3. Confidential phone line, or other processes, for employees to report incidents and safety issues without fear of reprisal
4. Safety surveys directed towards employees and health and safety committees

Practice - Stakeholder or Employee or Employee Representative Involvement:

Elements:

1. Empowered and proactive health and safety committees (e.g., annual action plans for top causes)
2. Process to support and increase the effectiveness of Health and Safety committees
3. Involvement in risk assessments
4. Participation in safety site visits, walkabouts, audits, etc.
5. Participation in investigations and corrective actions
6. Involvement in developing and implementing safety programs at all levels

Practice - Learning Culture:

Elements:

1. Continuous improvement through internal and external reviews
2. Processes for monitoring safety trends (e.g., trend analysis)
3. Use of Leading Indicators (e.g., near misses, audit results, rule violations, health and safety effectiveness, etc.)
4. Systematic Risk Assessments
5. Systematic Corrective Actions following accident or incident investigations
6. SMS internal audits
7. Audit and quality assurance of accident or incident investigations, corrective actions, etc.
8. Internal processes for sharing safety knowledge and best practices (e.g., website for Health and Safety committee minutes and action plans)

Practice - Establishment of a 'Just' Culture:

Elements:

1. Company policies will encourage and/or recognize, and be fair
2. Complete and objective investigations
3. Internal escalation process for unresolved health and safety issues
4. Internal recourse for employees to deal with safety issues (e.g., safety ombudsman)
5. Going beyond rule violations when identifying accident or incident causes (e.g., human factors include a review of training, rest, knowledge, familiarity, supervision, clarity of work process, etc.)
6. Non-punitive reporting processes for employees to report incidents, accidents, near misses, and other safety concerns
7. Straight forward and transparent means to determine whether or not disciplinary action is warranted

The practices are based upon the James Reason model, which is a recognized model for safety culture in the transport and energy sectors [1]. Establishing this type of framework for safety culture, agreed upon definitions and other identifiers are essential to establishing an overall strategy for measurement and improvement. One commonly cited framework developed by Cooper distinguishes between three interrelated aspects of safety culture:

- Psychological aspects – how staff feel about the culture (beliefs, attitudes, values and perceptions).
- Behavioural or Organisational aspects – what staff do (safety related activities, actions and behaviour).
- Situational or Corporate aspects – what the organisation has (policies, procedures, management systems) [2].

One of the key points in this approach is that it clearly delineates culture (behavioural and situational aspects) from climate (psychological aspects). It suggests that organisations should consider all three aspects in order gain a fully comprehensive understanding of their safety culture. To do this, organizations require techniques that provide collect information to provide sufficient coverage of all three aspects [3].

The Canadian railway definition of safety culture and the associated practices and elements form the foundation for the development of a safety culture and measurement tool for the Canadian railway industry. Using this framework, the development of the tool can be aligned to specifically measure aspects of the practices and elements. Transport Canada had developed a Safety Culture Checklist and a safety culture perception survey based on these practices and elements to allow the railway industry to identify areas for safety culture improvement. The next section of the paper provides an overview of information gained from existing research on safety culture measurement and existing tools.

LITERATURE REVIEW

A literature review was performed to identify research on safety culture and existing tools for measurement and improvement in the transportation sector. Highlights of the review of research and of the review of existing tools are summarized in the sections below.

Review of safety culture research

Numerous research reports, papers and articles on the topic of evaluating safety culture measurement and improvement were reviewed. Some key findings obtained from this review are presented in the following paragraphs.

Interpretations and approaches to measure vary

Interpretations of 'safety culture' vary significantly and are interwoven within organizational culture. It is widely recognized there are a number of interpretations, definitions and approaches to Safety Culture within the literature and are made up of different models from psychological, anthropological and sociological viewpoints [4]. Each organization's culture shares some common characteristics but is also unique to that organization and there is no single, universally-accepted standard by which to evaluate safety culture [5].

Approaches on how to measure safety culture vary significantly. Literature has shown that there is a lack of comprehensive tools for safety culture measurement and improvement. Within the tools that exist in the transportation and energy sectors most are limited to questionnaires [6]. Research indicates that questionnaires do not provide the reliability and comprehensiveness needed and are limited in value, reliability and consistency of application [7]. Not one single approach or technique is suitable for understanding and exploring safety culture, rather, a holistic and multi-method approach should be taken towards measurement [8]. Further, the majority of the measurement tools do not guide the user towards the development of practical improvement actions [9]. The research review performed found no comprehensive validated research papers on specific safety culture improvement actions based on measurement results.

Safety culture measurement should be based on an organization's safety policy or safety culture framework

As stated previously, the importance of a well-defined framework is critical to align the measurement tool with the definition and other attributes that make up the description of safety culture. This includes various components such as practices, elements, characteristics and traits. Without a through and clear definition, framework and description of safety culture, measurement tools will provide the definition inherent in their structure and may not be aligned with the specific organization's desired safety culture attributes.

Measurement tools need to be practical

Safety culture tools should be practical and easy to use and should include guidance to ensure reliable application. Lardner [7] identifies the following key success factors in implementing a safety culture measurement tool using a perception survey instrument:

- It is critical that senior management understand the assessment process and that they are committed to making it work.
- Frontline workers should be involved in assessment, interpretation and identifying interventions
- A high response rate to surveys should be obtained by making participation easy.
- It is important that the sample is representative of all occupational groups, levels of seniority, departments, locations and contractor staff.
- If a self-completion questionnaire is being distributed to the entire workforce then a high response rate (over 70%) is desirable. If only 40% of the workforce respond then it is likely that those who made the effort to complete the survey have different attitudes than those who did not complete the survey.

- Involving participants in the interpretation of the results and assessing safety attitudes and perceptions is unlikely to be of much benefit if the responses are not interpreted by the same group who were involved from the beginning in creating the survey instrument.

Leadership is essential

Research has demonstrated the importance that leadership has on ensuring an effective safety culture. Just as senior level managers are thought to influence the attitudes, behaviours and priorities of middle level managers, similarly, middle level managers' styles and attitudes influence the kinds of relationships which develop between supervisors and employees further down the hierarchy [10]. Demonstrated senior management commitment and involvement are vital for successful health and safety performance [11]. Safety culture evolves gradually based on the character of the leadership [12]. One of the key challenges in improvement is "how to develop managers and supervisors to lead their subordinates in safety matters" [13].

Organization wide measurement is required

Measurement of safety culture needs to occur at several layers within the organizational structure and needs to include a representative sample across the organization. Safety culture can vary within the same company, from one site to another and from department to department. Critical behaviours of managers are different from the critical behaviours of maintenance staff [14]. Within the organizational structure there needs to be a representative sample of identified critical behaviours across the organization.

Safety culture maturity models and frameworks are effective for improvement

Safety culture maturity models that are made up of iterative stages of safety compliance are a well used framework for continual improvement (Figure 1). Organizations progress sequentially through the five levels, by building on their strengths and removing the weaknesses of the previous level. It is unlikely that these elements will map exactly onto the factors that companies have previously measured in safety culture or climate surveys, because there is considerable variation in the proposed elements of an organisation's safety culture [15].

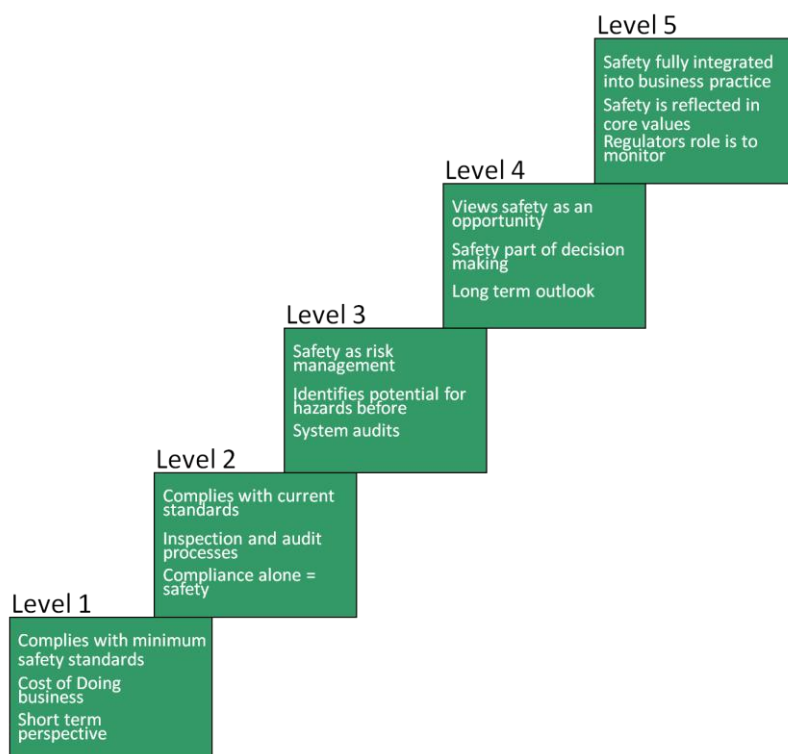


Figure 1: Safety culture maturity model

Review of safety culture measurement and improvement tools

Safety culture tools from government agencies and organizations recognized for promoting safety in operations were identified and reviewed. Commercial products with proprietary information were not included in the review process due to licensing fees. Table 1 below lists the tools that were included as part of this review. Tools were obtained from Canada, the United States, Europe, and Australia.

Title	Source	Industry
Loughborough Safety Climate Assessment Toolkit	Loughborough University, Health & Safety Executive (HSE), and a number of offshore organisations (Cox & Cheyne, 2000)	Offshore oil and gas
Transport Canada Culture Evaluation	Transport Canada	Railway, Aviation.
Transport Canada Railway SMS Audit	Transport Canada Railway	Railway
HRMI Safety Culture Inspection Toolkit	Her Majesty Railway Inspectorate	Railway
RSSB Safety Culture Improvement Toolkit	Railway UK	Railway
RISSB Safety Culture Improvement Toolkit	Railway Australia	Railway
Safety Culture Toolbox	EuroControl	Aviation – Air Traffic Management
HSL Safety Climate Tool	Health and Safety Laboratory	General
The Safety Culture Indicator Scale Measurement System (SCISMS)	Terry L. von Thaden and Alyssa M. Gibbons Technical Report HFD-08-03/FAA-08-2 July 2008 Prepared for Federal Aviation Administration, Atlantic City International Airport, NJ, DTFA 01-G-015	Aviation
Commercial Aviation Safety Survey (CASS)	Federal Aviation Administration (FAA), (Developed by University of Illinois) ,(Wiegmann, 2003, 2004)	Commercial aviation, aviation maintenance
CANSO	Civil Aviation Navigation Services Organization	Aviation, Navigation
Safety Health Aviation Maintenance Engineering Tool (ShoMe)	Civil Aviation authority, Safety regulation Group UK	Aviation maintenance
Safety Culture Toolbox	EuroControl	Aviation
Hearts & Minds Programme / Toolkit	Energy Institute, UK	Offshore oil and gas
Safety Culture Maturity Model (SCMM)	The Keil Centre (Lardner, 2004; Lardner et al., 2001; Fleming, 2000)	Offshore oil and gas

Table 1: Safety culture measurement tools reviewed

Results of the review of tools indicated only one was created specifically for the railway industry, the RSSB Safety Culture Assessment Tool Kit. Other industries such as aviation and energy have developed similar tools. All tools reviewed, except for Loughborough University, have a fee, license or membership required to obtain and use.

In addition to the above mentioned tools, the Railway Association of Canada was canvassed to provide current Canadian railway industry tools and processes for measuring and improving safety culture.

Overall, there are few validated tools in the railway sector and only a limited number of tools in the transportation sector. Other tools from the energy sector may provide additional insight into more comprehensive measurement and improvement concepts and approaches.

In order to provide a tool well suited for the Canadian railway industry context, an evaluation of the tools identified during this review was undertaken. This evaluation will be described in the next section.

EVALUATION OF SAFETY CULTURE MEASUREMENT TOOLS

In order to develop recommendations for a safety culture measurement and improvement tool for the Canadian railway industry, an assessment of the tools identified in the literature review was performed. The assessment was carried out using a comprehensive set of evaluation criteria that addressed ten principals as follows:

- Approaches to obtain data
- Skills/special knowledge required
- Infrastructure for implementation
- Practicality
- Repeatability
- Availability
- Comprehensiveness of content
- Guiding principles/philosophies
- Use of a maturity model
- Improvement tools

A qualitative evaluation and a quantitative scoring of each of the measurement and improvement tools was performed. The qualitative evaluation involved the identification of the strengths, weakness and opportunities of each tool for each criterion. The quantitative scoring was utilized to score each tool and then a weighting factor was applied to determine an individual score per measurement tool.

The results of the qualitative evaluation provided important information on the attributes of each measurement tool. All tools evaluated had significant deficiencies against the criteria and the key results of the evaluation are summarized as follows:

- The alignment of the content of the measurement tool against the Canadian railway definition of safety culture and the associated practices and elements was poor;
- Most tools evaluated have restrictions on their use related (e.g.: fees, membership, licenses, terms and conditions);
- None of the tools had a comprehensive approach (e.g.: a process combining surveys, interviews, and workshops);
- No tools provided guidance on analysis or triangulation (i.e.: use of two or more methods), such as survey, interviews and workshops, to verify results;
- Some tools required information to be analyzed exclusively by the creator of the tool.

The evaluation indicated that the UK Railway Standards and Safety Board (RSSB) measurement tool scored the highest among the tools although numerous deficiencies were identified. Overall, the results of the evaluation indicated that no single tool would provide the necessary comprehensiveness, reliability and usefulness for the Canadian Railway industry. The scoring of the five highest rated tools evaluated is as follows: RSSB/RISSB (19%), Loughborough (14%), HSE UK Laboratory (10%), Keil Centre (3%) and EuroControl Safety Culture Toolbox (3%).

The evaluation indicated that the existing Transport Canada safety culture perception survey scored generally in the middle of all tools. While this perception survey was designed based on the Canadian railway definition of safety culture and the associated practices and elements, deficiencies related to the comprehensiveness and reliability of the survey were found.

Based on these results the project team concluded that further analysis, refinement and enhancement of the Transport Canada safety culture perception survey vis-à-vis the highest scoring tools and findings from the

research review, along with a comprehensive implementation guide, would be the best course of action to provide an effective safety culture measurement tool for the Canadian railway industry.

During the time that the current project was underway, a research initiative, entitled Keeping Rail on Track, from Australia with the objective of testing and improving the UK RSSB Safety Culture Toolkit's ability to measure and improve safety culture in the Australian railroad context was coming to a conclusion. Thanks to a collaborative research agreement between Canada and Australia and with consideration of the similarities between the two railway industries, results from the Australian study could be leveraged to help enhance the Transport Canada safety culture perception survey.

In order to enhance the current Transport Canada safety culture perception survey, the following tasks were undertaken:

- a) Analyze the existing Transport Canada perception vis-à-vis research and tools reviewed and leveraging insights gained from a parallel Australian research project;
- b) Prepare separate surveys for 'management', 'supervision' and 'tradespersons' with differentiated questions allowing for cross analysis of the results;
- c) Prepare an implementation guide and scoring tabulation workbook to assist in survey implementation and results analysis; and
- d) Design a pilot test to validate the survey in the field.

The next section of this paper will describe the tasks undertaken to develop an enhanced Transport Canada Safety Culture Perception Survey.

DEVELOPMENT OF ENHANCED SAFETY CULTURE PERCEPTION SURVEY

The development of the enhanced safety culture perception survey involved a detailed review and integration of the current Transport Canada safety culture perception survey with the results of the research and tool review and the information obtained from Australia's Keeping Rail on Track study. The objective was to map and upgrade the Transport Canada Safety Culture perception survey vis-à-vis the collected information.

No new or additional survey content was included in the process of enhancing the Transport Canada safety culture perception survey. All content is sourced from the existing safety culture perception survey, the Australian survey and the UK's RSSB survey. Questions for the survey were identified based on expert judgement from members of the project team to align with the Canadian railway definition of safety culture and the associated practices and elements. The next steps included a complete comprehensive review of the survey, implementation guide and scoring tabulation workbook; establishing formal plan for performing a pilot; and performing the pilot according to the content of the guidance material to enable a true test of the enhanced survey.

VALIDATION FIELD TEST

A validation of the enhanced safety culture survey in the field was required before widespread industry use. A regional railway on Canada's east coast, New Brunswick Southern Railway (NBSR) volunteered to administer the survey throughout its organization in order to contribute to identifying strengths and areas of improvement. Overall, the survey appeared to provide an adequate approach for performing a measurement of safety culture perception, although no verification interviews or workshop were performed on the collected data due to operational and scheduling constraints. As no follow up workshops were held to discuss and further analyze results, interviews were held with four NBSR personnel to identify observations and areas of improvement in administering the perception survey. The following are the key findings from those discussions:

- The terminology in the survey needs to be clear and simple;
- Planning and executing the survey in a timely and transparent manner in the organization is required in order to understand the purpose and have an open discussion on the results;
- Ensuring the survey can be completed in 10-15 minutes; and

- Using interviews and workshops per department area to explore the results and contribute to qualitative analysis.

While this validation field test did not provide an opportunity for in-depth qualitative analysis through follow up interviews and workshops, it did provide some key lessons learned in ensuring the successful roll out of the enhance perception survey within an organization. These lessons will be presented in the next section.

DISCUSSION OF RESULTS

This project involved comprehensive research on safety culture surveys, tools, techniques and strategies across several industry sectors. The objective was to identify a tool that could be adapted for use in the context of the Canadian railway sector. Numerous approaches, formats and styles are employed for measurement and improvement, however, no single standard approach is recognized. Ongoing research and studies across several industries have identified key characteristics of effective processes for measuring safety culture.

Recommendations made during this project involved the use of a survey as one element of a comprehensive 'toolbox' approach to measure safety culture. However, the research and the pilot results are clear that surveys only provide a set of data based on perception and do not adequately provide a reliable combination of quantitative and qualitative measure of safety culture. Additional techniques to follow up on surveys, such as interviews and workshops are valuable to enable a clear analysis of survey data and enable a higher level of reliability through triangulation of results. It is critical that organizations do not rely solely on perception survey techniques to evaluate their safety culture as doing so can result in a false sense of reliability.

This project results provide key insights into the strengths and areas for improvement in administering a perception survey to measure safety culture to ensure that it can be measured and improved. Some of these include:

- Further elaboration of the Canadian railway definition of safety culture and the associated practices and elements with identification measurable of traits, characteristics and evidence to provide more effective measurement;
- Interview and workshop approaches, in addition to a survey, to ensure a robust measurement of safety culture and to allow for triangulation of results during analysis;
- Timely turnaround of survey results to hold follow up workshops and implement a safety culture improvement plan;
- Cross analysis tools and techniques for management, supervision and tradespersons to identify consistencies and conflicting data; and
- Improvement based on a continuous cycle and open discussion.

It is clear that current tools are not adequate to provide a reliable measurement and improvement of safety culture. Recent catastrophic incidents remind us of the importance of the human factors play in ensuring the safety of our rail operations and other similar high-hazard industries.

CONCLUSION

This project delivered an Enhanced Safety Culture Perception survey and represents a step forward in techniques used to measure safety culture. A review of research and tools indicated that there are a variety of interpretations of safety culture and various ways to measure it. The review also indicated that few tools were specifically designed for the railway industry. Most importantly, the review highlighted the need to align a measurement tool with an organizations safety policy, definition of culture and culture framework. An enhanced perception survey was developed, and a pilot test of the survey indicated some need for refinement of the questions and of the implementation strategy. The survey provided important information but was limited due to the need for additional qualitative data collection techniques such as workshops and interview. Much like improving safety culture, improving the techniques to measure it is an iterative and continual process towards an ultimate objective. While the tool developed during the course of this project has limitations, it provides a foundation for further refinement in terms of the type of data collected, and the implementation technique.

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