In January 2013 CN made a very generous donation to Saint Mary’s University to support the creation of the CN professorship of safety culture. Dr. Mark Fleming was appointed to the position until January 2018. The aim of the professorship was to promote the importance of safety culture and to develop practical improvement strategies. Too many activities were undertaken during the five years of the professorship to describe in one document, so ten projects have been selected.

Conducting research of this nature is complex and therefore requires a team of dedicated researchers. Over the past five years many SMU graduate students have been involved in applied safety culture projects. In addition, there was ongoing collaboration between CN and SMU in designing, testing and evaluating safety culture improvement interventions.

Areas of research collaboration included: understanding safety culture through the creation of a confidential near miss reporting hotline, investigating human factor causes of safety events, exploring methods to select employees who are engaged in safety and lastly, evaluating interventions with a focus on promoting a positive safety culture.

In addition to the following research highlights, ongoing projects requiring additional collaborators are listed on the last page of this document (page 12).

### Research Highlights:

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A near miss or close call is a free lesson, as a safety failure has occurred but no one was harmed. Currently, many organizations are underutilizing this learning opportunity, as near misses are underreported. To better understand this issue, the PREVENT confidential reporting hotline was created to understand how employees can be encouraged to report close calls. The hotline initiative is a tripartite collaboration between SMU, CN and CN unions. The purpose of the initiative is to enable employees to report near misses, and to understand the motivators and barriers to utilizing a near miss reporting system. An effective near miss reporting system can provide management with important insight into the functioning of their safety systems.

The PREVENT hotline is a confidential, toll-free telephone line that employees can call to report workplace near misses they may have witnessed or been directly involved in. An employee can call during set hours and reach a PREVENT employee immediately, or they can also call at any time and leave a call back number. Once an employee places a call, a staff member from the PREVENT hotline interviews the employee to further understand the human factors involved in the near miss. PREVENT staff members then review and code the interview data to identify human and organizational failures before sharing anonymized reports to PREVENT hotline steering group (CN management and Union representatives). A sample of reports are discussed in detail with the steering group to identify potential improvement strategies. The information collected from the hotline is used to build a quarterly newsletter that is shared with employees.

As part of the hotline initiative, multiple rounds of interviews and focus groups were conducted to address questions about the functionality of the PREVENT hotline with managers, supervisors and employees. The intent was to understand employee perceptions of near miss hotlines. Each time the hotline was rolled out in a new region, more focus groups were conducted in order to understand the unique nature of each location.

One of the barriers encountered while implementing the hotline was understanding the existing organizational culture and how to engage employees in the initiative. It is imperative for employees to have a shared understanding of the benefits of reporting near misses. In other words, employees need to know their engagement is worthwhile. If employees attribute near misses solely to personal failures without considering other contributory human and organizational factors, they are unlikely to engage in a near miss reporting system. Near miss reporting hotlines ideally need to be coupled with an educational component about the human factors involved within safety failures.
Learning from safety events is imperative, particularly in safety critical industries. The Learning Tree is a non-proprietary, evidence-based investigation technique that can be applied to a wide range of incidents or events. The Learning Tree was initially developed to analyze PREVENT hotline reports (see PREVENT: A Near Miss Hotline for Employees). From analyzing events reported on the hotline, it became necessary to develop a new tool to analyze reports. While traditional investigation methods are effective at identifying and categorizing immediate causes, the publicly available methods were either too generic or overly focused on categorization. The Learning Tree was developed to focus on learning from the incident rather than on causation. One of the unique features of the Learning Tree is the ability to capture system success, as well as failure. The Learning Tree promotes looking at a close call or safety event as a learning opportunity.

The Learning Tree is structured process that facilitates collaboration between employees and management. It is a flexible tool, as it can be utilized in a group setting or on an individual basis.

This approach includes some of the aspects of existing investigation strategies (e.g. determining the sequence of events) but also includes unique elements that focus on learning and improvement.

The scope of the tool lends itself to looking at the question of why the event happened, what led up to the event, and how the event occurred. The Learning Tree process involves six phases of analysis (see figure to the right):

1. Creation of a Storyboard
2. Barrier Analysis (identifying barrier failures & successes)
3. Cultural Analysis (identifying cultural threats & defenses)
4. Identifying Contributory Factors to Barrier Failures
5. Questions/Answers/Insight
6. Identifying Improvement Opportunities

The logic is to focus on what the event tells us about our safety systems rather than focusing on cause. It is important to note that as the analysis is being conducted, it is okay to move between phases if something is forgotten or another piece of information needs to be added. One of the main advantages of the learning tree is the ability to link successes and failures to different activities. The results from different events can be aggregated to assess common failures, successes, and opportunities for improvement.

To conclude, the learning tree tool is a new method of analyzing significant safety events and close calls. It consists of six phases that involve identifying barriers and cultural indicators and piecing the information into a storyboard. Often, during an incident investigation, as questions arise, the Learning Tree facilitates capturing that information through the questions/answers and insights phase. It is a tool that can be used by managers, supervisors and employees together as a group or individually.
As regulators are tasked with overseeing the operation of licensees, it is important to understand how regulator safety culture influences their oversight approach, and effectiveness. Safety culture of the regulator is imperative, as it influences how they perform oversight activities, and how they interact with licensees. A poor regulator safety culture has been identified into investigations into major disasters, including most recently, Fukushima. Highlighted by the director general of the IAEA in the Fukushima report, it is imperative that regulators have “…legal authority, technical competence, and a strong safety culture in order to effectively oversee the safety of licensees”. Regulator safety culture is defined as “…that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, protection and safety issues receive the attention warranted by their significance”. Therefore, the regulator’s safety culture influences how they see their responsibilities and how they fulfil their duties. To date very little research has been conducted exploring the nature of regulator safety culture and there is no systematic testing of assessment methodologies. This research project had two objectives: the development of a regulator safety culture framework and development of an assessment tool based on the framework.

The framework development involved semi-structured interviews with safety culture experts from a range of industries. Based on the participant descriptions, interview responses were aggregated into five different themes to represent regulator safety culture. The five themes are: (1) leadership commitment to creating a positive safety culture, (2) proactive, risk informed and flexible approach, (3) continuous learning and self-improvement, (4) unwavering ethical standards and (5) transparency through communication.

Subsequent to the development of the framework for regulator safety culture, a survey assessment tool was created through a second research study. A working group from the International Atomic Energy Agency (IAEA) participated in developing the survey. Many safety culture documents were reviewed by the working group including: the framework developed by the safety culture experts within the first study, the Nuclear Energy Agency (NEA) document on regulator safety culture and the IAEA model on safety culture. After the workgroup reviewed this information, they expanded the framework to 11 factors of safety culture.

The IAEA workgroup then developed a total of 144 survey items. Following the generation of survey items, the items were sent to 14 subject matter experts (SMEs). The SMEs consisted of individuals with expertise in regulatory safety culture. SMEs had to evaluate 1) how closely each item represented its respective theme, 2) the clarity of each item and 3) the importance of each item for safety culture. The results were used to reduce the number of items to a total of 71. The regulator safety culture perception survey is currently being tested and evaluated. It is hoped that the findings from this research provides a first step in facilitating assessment of regulator safety culture to advance a regulator’s ability to oversee industry safety and prompt additional research on representative frameworks and assessment methods.

Understanding How Employees Perceive Senior Management Commitment to Safety

Employee’s perceptions of senior management commitment to safety is known to influence employee safety behavior. While previous research has attempted to understand management behaviors associated with perceptions of safety commitment, the issue of how employee perceptions are formed has not been explored. Kate Bower’s master’s thesis focused on understanding senior management commitment to safety from an employee’s perspective. A number of front-line employees participated in semi-structured, one-on-one interviews in order to further understand the processes in which senior leaders influence employee perceptions of safety commitment.

Four themes arose from the employee perceptions of leader’s commitment to safety. The first theme was (1) Engaged Safety Leadership. Perceptions of engagement involved senior leaders being active in their commitment to safety, for example they were visible in the field, addressed concerns in a timely manner, applauded safety compliance and used a coaching versus punitive leadership style. Being an active leader also contributed to employee’s perceptions that their leaders had an understanding of operational-level work conditions. Employees formed negative perceptions of senior managers if they were disengaged, if they did not speak up or ask questions about safety, or do not ensure that lower-level management engage in safety leadership. Disengaged senior leaders were described as being passive towards safety, for example, not visiting the worksites or directly talking to employees about safety matters.

The second theme was (2) Consistency in Safety Leadership. Employees discussed the importance of senior leaders practicing what they preach in order to demonstrate commitment to safety. Perceptions of consistency included being sincere and maintaining an unwavering position to work safely. Employees expressed that management (across any organizational level) who do not follow through with action in response to raised safety concerns reflect of a lack of safety commitment.

The third theme of (3) Allocating Money Towards Safety included demonstrating safety values by ensuring any equipment was purchased and that regular/timely maintenance was provided. Employees perceived senior managers as not being committed to safety when there was a lack of manpower needed for certain tasks and a neglect to provide necessary support (e.g., properly working tools or equipment).

Lastly, the fourth theme that emerged was (4) Policies and Procedures Reflect a Value for Safety. Part of senior leader’s demonstration of safety commitment was described as the criteria included in organizational policies and procedures. Policies and procedures defined to ensure safe work (e.g., a stop work policy) were said to be a reflection of senior management’s safety commitment. When policies or procedures were found to counteract safety prioritization (this included discrepancies in punitive procedures, hiring procedures, and inconsistent rules for certain work groups) it indicated a lack of value for safety.

This study helped to further understand the specific senior management behaviors that signal a commitment to safety to frontline workers. The qualitative interviews provided an in-depth understanding of employee perceptions in relation to leader’s safety decisions, behaviors and other organizational informants that contribute to perceptions of safety commitment.
It is widely accepted that safety values are important in the workplace context, yet little research has been done in this area. Safety values act as our guiding principles and inform our safety behaviors at work. It is important for organizations to be able to identify employees who share the same values towards safety. Therefore, understanding what an employee’s values could provide insight into how we can engage employees in safety-critical industries.

Our model of safety is based on a systems framework, meaning that employee safety values are only one of many important factors related to safety performance. Integrating individual differences into safety models has been a challenge because of the misuse of the construct “accident proneness”, the idea that some individuals are inherently more likely to be involved in a safety incident. The notion of a safe employee has grown past simply number of injuries or accidents experienced in the workplace. Other important safety performance constructs include safety compliance, participation, motivation, and knowledge. While research has shown that personality factors can be important when it comes to safety performance, we were specifically interested in measuring employee safety values.

To further understand the relationship between safety values and safety performance, a scale was developed to measure safety values in the workplace (Safety Values Scale; SVS). The first study focused on developing a framework for the SVS. Previous safety research was reviewed to create a relevant list of safety value factors. A number of subject matter experts (SMEs) assessed the importance the safety value factors by sorting and rating the items. Through multiple rounds of data analysis, six safety value factors were developed: (1) Security (being free from danger or harm), (2) Cautious (taking care to avoid risk or danger), (3) Vigilant (being aware of problems or signs of danger), (4) Protective (preventing others from being harmed or injured), (5) Informative (communicating safety concerns to others), and (6) Compliant (following rules and procedures).

In a second study, the survey was tested with a general sample of the working population. Employees from various North American industries filled out the SVS as well as other similar questionnaires to assess the survey’s psychometric properties. Participants also answered questions regarding relevant personality characteristics, including agreeableness, openness, neuroticism, extraversion, and conscientiousness. The results supported the properties of the scale, in that its factor structure is reliable and psychometrically sound.

To further validate the SVS, a third study was conducted with a sample of employees from a high hazard organization. The organization granted access to historical safety indicators (injuries and accidents) as an additional data source. Employees completed the SVS as well as other safety performance related scales (Safety Compliance, Participation, Motivation, and Knowledge). Results indicated that the SVS is a significant predictor of safety performance. Additionally, the SVS provided incremental validity above and beyond personality characteristics and organizational climate measures. There is the potential to use the SVS in selection. Selecting safety-minded employees is the first step building a safe organization from the ground up.
The term safety culture was coined 1986 by the International Atomic Energy Agency (IAEA) as a causal factor in the Chernobyl nuclear disaster. Since then, the IAEA has been at the forefront of safety culture assessment and improvement initiatives. In addition to providing guidance to member states, the IAEA conducts comprehensive independent safety culture assessments. As a safety culture perception survey is an important component of a comprehensive assessment, it is important to use valid survey. This can be a challenge for international organizations, as the majority of perceptions surveys are only available in English and many are proprietary. The IAEA conducts safety culture assessments across the globe and therefore requires a valid nonproprietary multilingual survey.

Over the past number of years Saint Mary’s University (SMU) has collaborated with the IAEA to develop and validate a multilingual safety culture perception survey. The development of the questionnaire involved the creation of an IAEA expert working groups (chaired by Dr. Fleming) to create survey items. This multilingual expert group crafts items that are easier to translate, by keeping the language simple and avoiding the use of expressions (paperwork exercise). The IAEA safety culture perceptual survey assesses the five elements of the IAEA safety culture model (safety as a recognized value, clear leadership support, clear accountability, integration of safety into all activities and safety being learning-driven).

The survey has now been tested in multiple languages (e.g. Portuguese, Dutch and Flemish). The research team at SMU supports the IAEA when they are conducting independent safety culture assessments by collecting and analyzing the survey data. This process involves supporting the nuclear power plant in customizing the questionnaire and overseeing the translation and back translation of the survey. Survey responses are analyzed and used to prepare a report for the IAEA. This report is used as part of the comprehensive safety culture assessment. The survey data are then used to evaluate and refine the survey. We are now helping to facilitate the second survey assessment of one nuclear power plant and therefore will be able to provide a report on any potential changes across time within the perceptual safety culture survey based on different demographics. In addition, the research team provides ongoing support to the IAEA including contributing to the IAEA’s safety culture self-assessment and improvement guidance documents.

This research is important for both practical and theoretical reasons. On a practical level, it is important to have a safety culture perception survey that is valid in multiple languages. On a theoretical level, this research enables us to explore cross-cultural differences that influence safety culture perceptions. It is also hoped that the survey responses can be used to test the validity of the IAEA model of safety culture.
The past 30 years of safety culture research has focused mainly on assessment and much less on improvement. There is very little guidance for organizations on how to identify practical safety culture improvement strategies. The guidance that is available tends to recommend generic strategies, such as safety leadership training, which many organizations already have in place. It is therefore not surprising that this is the area where companies struggle the most. The Safety Culture Improvement Audit Process (SCIAP) was developed to meet this need. SCAIP was designed to enable organizations to assess the presence and sophistication of the systems currently in place to promote a positive safety culture. SCAIP does not assess safety culture, but rather systems the organization may have in place to support the safety culture. SCAIP uses the maturity model concept to classify safety culture interventions in terms of sophistication.

SCAIP consists of 12 elements grouped into four broad dimensions, namely, Leadership (e.g. safety performance evaluation), Involvement and Accountability (e.g. employee safety leadership training), Vigilance (e.g. incident reporting and analysis) and Resiliency (hazard assessment systems).

Each element contains a list of practices that may be in place and by selecting all practices that are in place a maturity score for that element is produced. Improvement opportunities are identified by reviewing the practices that are currently not in place and considering if they would add value. To date, SCAIP has been used in the petrochemical industry, construction marine industry and rail industry. Recently, SCAIP was pilot tested by EnForm to assist members with their safety culture improvement journey.

SCAIP is a self-assessment process and can be completed by an organization’s safety department or senior management team. SCAIP is typically used in three different ways: as an online self-assessment, as interview protocol for external expert use and lastly, as an external auditing tool of safety culture systems. SCAIP is currently available as an online survey, hard copy survey or excel spreadsheet. The self-assessment can be integrated into pre-existing audit processes and organizations can systematically determine the presence or absence of processes that promote a positive safety culture.

There are three steps to using the SCAIP, they are as follows:
(1) distributing the self-assessment audit to key informants (safety advisors, senior managers),
(2) validating the self-assessment (interview to review the self-assessment responses),
(3) enter the validated responses into the excel spreadsheet, which produces the SCAIP report including improvement opportunities.

Organizations who participate in our ongoing SCAIP research receive a report on their current safety systems that promote a positive safety culture, as well as a list of other systems they could consider applying in the future. Participating organizations also receive support in conducting the self-assessment and in selecting potential safety culture improvement opportunities.
The safety culture improvement journey is long, so it is important to have indicators ensure that you are moving in the correct direction. The safety culture metrics were developed to help organizations monitor safety culture changes on a continuous basis. This research was also support by research funding from EnCana. The rationale behind the metrics is that safety culture changes are reflected in daily processes or key practices that can be tracked as an indicator of culture change. The metrics are not intended to be a safety culture assessment, as they only provide a general indication of changes over time. In contrast to other safety indicators, the metrics focus on the quality of a safety activity rather than the frequency.

The safety culture metrics were developed by reviewing the research literature and guidance documents (e.g. Canada-Nova Scotia Offshore Petroleum Board (CNSOPB) policy statement on safety culture) to identify the attributes of a positive safety culture. This review produced a listed of common safety culture attributes. These attributes were used to produce an initial set of 20 observable indicators. Operational safety experts were involved in developing the observable measures in order to ensure they could be used in practice. The 20 metrics were finalized and categorized under four safety culture dimensions, which are: Leadership (e.g. speed and quality of management response to employee safety concerns), Empowerment & Accountability (e.g. quality of peer observations, involvement of employees in safety), Resilience (e.g. effectiveness of corrective action process) and Vigilance (e.g. insight gained from management observation, quality of near miss reports).

The safety culture metrics need to be customized for each organization, to work with their management systems. Each metric contains three elements: a description of the relationship with safety culture, the data collection process and assessment criteria. The element on the relationship with safety culture provides a rational for the metric and explains how the metric reflects the safety culture. The data collection section describes how to collect information about this metric. The assessment criteria provide guidance on how to judge if the metric has degraded, not changed or improved in comparison with the previous time period. The score (-1, 0, 1) associated with each of these outcomes is provided. Organizations need to select the metrics that will work best for them, as it is not intended for an organization to use all 20 metrics.

It is important to introduce the safety metrics in a systematic way. The graphic on the right indicates the systematic approach to utilizing the metrics. Organizations need to build their capacity by educating leaders about the metrics in relation to safety culture.

One advantage of the safety culture metrics is that the outcome is based on quality not quantity. If utilized within an organization over a period time, the metric can encourage consistency within systems or processes, as the associated quality score will provide an indication as to what needs to be altered or adjusted.
There is growing interest in workplace health promotion programs. In Canada specifically, recent research has highlighted the positive impact that workplace health promotion programs can have on the organizational culture and levels of engagement, while also increasing individual physical activity in employees. Although workplace health initiatives are not mandated by law, these programs can be part of an overarching health and wellness strategy that provides resources and services for employees, in turn benefitting the employee as well as the organization. In order to learn about what organizational and individual factors encourage employee engagement in health promotion programs, Brianna investigated how safety culture theory could be applied to workplace health promotion.

While the importance of safety culture and climate is supported in the literature, health culture and climate are relatively unexplored concepts. Health climate is defined as "employee perceptions of active support from coworkers, supervisors and upper management for the physical and psychological well-being of employees." Climate is especially pertinent through an intervention process, as it is the perceived environmental context that sets the tone or mood of the entire organization. Understanding the climate would highlight the extent to which the organization is open for a change in workplace health, as demonstrated by the attitudes, behaviours and interactions between all levels of the organization.

As there is little research on health climate, there was no existing measure or tool that was appropriate, therefore, this research involved developing and testing a health climate survey. Participants were asked to complete an online questionnaire, consisting of the health climate survey, and other individual and organizational-level measures/tasks representing different elements within the framework. Individual elements that were measured included employee attitudes towards health, health values and health orientation preferences. Organizational level elements included the health climate (consisting of Management Values, Organizational Practices, Health Receptivity & Communication), perceived social support and current workplace health promotion engagement.

Brianna concluded that although health climate was important, individual attitudes were significantly more important in terms of potential health engagement at work. Consistent with the guiding workplace safety framework, closely related factors like willingness to participate in health behaviours at work, or individual attitudes, were more closely related to the outcome of engagement than the further removed variables like health climate. One factor within the health climate survey titled Management Values was positively related to program engagement. This is because managers have a great influence on employee behaviour. If management is perceived to be unreceptive to the health changes, they will most likely perceive the organization to be unreceptive as well. Understanding the employee's person-related factors like their health-related attitudes can be helpful when developing a health initiative, but organization-related factors like climate should also be taken into consideration.

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A key indicator of a positive patient safety culture is the degree of patient involvement in their care. It can be difficult to involve patients in community settings in their care, yet there is good evidence that the transition between acute care (e.g. hospital) and the community is critical. Dr. Andrea Bishop partnered with Dr. Mark Fleming and the Canadian Patient Safety Institute (CPSI) to develop a patient journal tool for use by patients, their families, and their care providers. The intent of the journal is to assist in tracking patient information, particularly patients who receive home care. Traditionally, efforts towards patient safety and engagement have focused on the acute care setting (i.e. within hospitals).

Patients can be at a higher risk for experiencing an adverse event when they are experiencing a transition of care, particularly at the interface between primary care and home care. There is evidence that one in ten home care patients experience an adverse event, which supports the need for patient safety efforts with a focus on the home care sector. Common adverse events in home care include: falls, wound infections and medication errors. Furthermore, 56% of adverse events were judged to be preventable if there was greater coordination of care and patient education and involvement. One of the challenges in the homecare setting is the lack of organizational protocols available to ensure effective communication and coordination.

This research was focused on the transition of care from primary care to home care and how those transitions can be made safer for patients and all those involved. More specifically, the aim was to not only improve patient knowledge regarding their health status and treatments, but also at enable the patient and family caregivers to play a key role in their care transitions.

In order to explore this aspect of patient safety culture further, interviews and focus groups were conducted with patients, family caregivers and health care providers (physicians and home care providers) from Halifax and Toronto. The information collected was used to produce a patient journal to facilitate communication between healthcare providers, patients and family. The majority of participants stated that a hard-copy journal tool to compile all health care information would be most applicable option. While in the future there could be an electronic option, many participants felt more comfortable keeping record by hand. These perceptions guided the development of the patient journal tool and how to best involve the patient during transitions of care.

The journal tool is titled the Portable Health Profile (PHP) and includes: a how-to guide, tip sheet for getting the most out of the journal, tips on how to be better involved in your own care, health goals and concerns, patient safety resources, an emergency contact sheet, list of health care providers, medications list, health care visits, medical procedures, treatment changes, health notes, and a medical history section. The journal is currently available through CPSI and patients across Canada are welcome to utilize it.
Research Collaboration Opportunities

The following is a list of projects that require additional research collaborators:

**Championing safety culture improvement**
This research aims to increase our understanding of safety culture improvement by training safety culture champions and tracking their progress overtime. This is a long-term project that requires significant support from the organization employing the champion. Champions receive training on a wide range of safety culture improvement strategies and participate in a cross-industry safety culture community of practice. Regular interviews with champions capture their experience and gain insight into the nature of safety culture improvement.

**Safety culture case studies**
Currently there are very few case studies systematically describing safety culture improvement initiatives. This research aims to collect safety culture case studies from a wide range of organizations so that others can learn from their experience. Each case study will follow a standard format to make comparison between case studies possible. The case studies need to include successes and barriers encountered so that a realistic view of the process is provided.

**Understanding how safety culture has evolved overtime and across industries**
Approaches to safety management have evolved overtime and these changes are likely to reflect changes in safety culture. Different industries have adopted advanced safety strategies at different times, which may reflect the evolution of their safety culture. This research project aims to collect information on the introduction and revision of key safety practices (e.g. hazard assessment, behavioral safety) from partners and experiences and retired safety professionals about how safety evolved in their industry.

**Senior leader safety culture education**
It is widely accepted that safety culture improvement requires senior management action, yet there is no validated senior leader education program available. A small interview study with senior managers showed that senior managers have many misconceptions about safety culture. In addition, much of the guidance currently available is not suitable for senior managers as it is aimed at safety professionals. A research project funded by EnCana resulted in the development of a series of one sheet safety culture information written for managers. These sheets were positively rated by managers but the research concluded that a more structured approach was required. This would involve a combination of reading material and online education that are specifically designed for senior leaders.

Please contact Dr. Mark Fleming to learn more about any of these projects (mark.fleming@smu.ca).