An Integrated Conceptual Framework for Proactive Improvement of Safety Culture

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ABSTRACT

Over the past three decades safety culture studies have bridged many gaps by developing specific existing culture models to workplace environment. But there is still no consensus over the core factors of safety culture, methods and improvement strategies. This conceptual work proposes a different approach by integrating the present general and workplace models to develop a new integrated framework of proactive assessment model for safety culture. In doing so, an summary of the current general and workplace literatures will be provided as well as their homogeneities and differences emphasized. This conceptual framework can be the basis for further research in order to provide a comprehensive picture of the safety culture assessment process. Lastly, implications for specific interventions to develop targeted safety culture assessment practices and work towards achieving sustainable safety culture will be discussed.

Keywords: Safety Culture, Proactive, Reactive, Benchmarking
JEL Classification: M1

1. INTRODUCTION

Early review of incident causation were strictly linearly viewed, accident prevention and safety management in the previous ages were based on contemporary approaches involving technical and mechanical faults, reducing human errors and adoption of safe behaviors, and ergonomic design of equipment and work activities.

It was from the initial analysis report of the 1986 Chernobyl nuclear power plant accident, where the term "safety culture" emerged and gained its first official (IAEA, 1986). This report introduced the concept, which can be regarded as an advanced way of managing safety, to look beyond the immediate engineering and technical failures by moving towards a standard industrial practice of inquiring more deeply into the underlying factors of accidents.

Safety culture has been defined in many ways with different hypothetical constructs, research paradigms and represents

interpretations of different finding which are most of the times very global and therefore highly implicit. The most explicit definition of safety culture outlining most of the assumed contents is by health and safety executive (HSE) (2005) as:

"Organizations with positive safety culture are characterised by communications founded on mutual trust, by shared perceptions of the importance of safety, and by the confidence in the efficacy of preventive measures" (HSE, 2005).

The identification and development of factors for safety culture depend highly on the different type of methodological facets such as, different analysis tools (Clarke, 2006), on sample size and composition (Seo et al., 2004), strictly depends on environment (Flin et al., 2000), and the labeling of factors (Clarke, 2006), method of selection (Weigmann et al., 2002). Such type of dependencies has resulted in a considerable number of disparities and is probably the reason for having not a proper agreement on a reliable set of safety factors (Farrington-Darby et al., 2005),

(Nardo et al., 2005), (Clarke, 2006). Literature can be found on application of selected factors or single factor, as well as on application of framework methods of performance measurement and as well as their effect on safety improvement such as, frequency of accidents or other safety outcomes. Furthermore, methods of assessment methods lack theoretical framework, holistic features, flexibility, and motivation for improvement (Sgouru et al., 2010). Also, what makes it even more disappointing is that, despite the plethora of different initiatives, we don't seem to be able to overcome the problem that almost all major injuries in our industry are foreseeable and preventable (Alteren, 1999). These are telling signs that contemporary approaches for improving safety culture are failing to meet its mark, and new approaches are required. With this drawback, it calls for a simplified process to develop a conceptual integrated framework of proactive assessment model for safety culture. In this work, only three areas that have significant impact on safety culture will be discussed, that are the process of selecting factors of safety culture, methods of assessment and proactive versus reactive approach to safety culture.

1.1. Common Factors of Safety Culture

Clarke (2006), analyzed 16 studies that performed factor analysis and extracted the dominant themes common across the studies and ended up with five main categories (Clarke, 2006). A review conducted suggests that there are five main factors of safety culture (Seo et al., 2004). A similar analysis was conducted analyzing 18 studies and identified the five most common themes (Flin et al., 2000). Another literature review of 10 studies identified five indicators of safety culture (Weigmann et al., 2002), Farrington-Darby et al. (2005), after reviewing 15 studies, identified some common factors (Farrington-Darby et al., 2005), and the report prepared for the HSE identified five core dimensions (HSE, 2005). Table 1 provides the names of the factors identified for every review paper.

This summary shows that there is no consistency in the structure and no definitive set of factors exits. However, some of the common factor identified in all these reviews, was leadership and its different aspects (management attitudes and actions, commitment, involvement, supervisory support and relationship). The second most common factor was employee involvement/empowerment. Four out of six review studies identified it as common to most of the research papers they reviewed.

1.2. Selection of Factors

Selection process of factors are strictly dependant on the type of analysis tools (i.e., principal component analysis, factor analysis) depends on environment, i.e., such as type of industry and country. Some factors might be of importance in one organizational setup while others will be at different. It depends on the sample size, i.e., number of respondents and its composition.

Selection of factors can be performed by aggregate method such as by linear or arithmetic mean but only if the unit of measurement in the hierarchy the same. Other means like geometric aggregation can also be applied without compromising on the units, but the condition is it cannot be a negative value (Nardo et al., 2005).

Furthermore, selection of factors based on aggregate mean, requires collecting of data on a large number of factors. Therefore, these methods do not have the potential to simplify the system or reduce the burden of carrying out large amount of measurements process.

1.3. Methods of Assessment

Many reports can be found literature regarding application of framework methods on the application of selected factors or single factor and their effect on frequency of accidents or other safety outcomes. Some of them are being listed as:
1. Universal assessment instrument
2. Safety element method
3. Self-diagnostic OHS tool
4. Safety climate assessment questionnaires.

Sgouru et al. (2010), assessed the first three methods on the following criteria: (1) Theoretical framework, (2) holistic features,

Table 1: Comparison of safety culture dimensions identified in meta-analysis studies

Factors identified in the meta-analysis of studies that used factor analysis			Factors identified in the literature reviews		
Clarke (2006)	**Flin et al. (2000)**	**Seo et al. (2004)**	**Wiegman (2002)**	**Farrington-Darby et al. (2005)**	**HSE (2005)**
Work task/work environment	Work pressure	Co-worker safety support	Reporting systems	Reporting system	Two-way communication
Management attitudes	Management/ supervision	Management commitment to safety	Management involvement	Management commitment	Leadership
Management actions	Risk	Supervisor safety support	Reward systems	Immediate and Supervisors Supervisor subordinate relationships	Involvement of staff
Individual responsibility and involvement	Competence	Competence level with regard to safety	Employee Empowerment	Involvement, competency, training, attitude, behaviour rules and procedures	Existence of learning culture
Safety management system	Safety system	Employee participation in safety-related activities	Organizational commitment	Communication	Existence of just culture

HSE: Health and safety executive

(3) validation of the method, (4) required expertise, (5) flexibility, and (6) motivation for improvement. The results showed that none of the analyzed methods satisfactorily fulfills all the mentioned criteria.

The essential features of these methods are tabulated as follow in Table 2.

1.4. Proactive Versus Reactive Approach to Safety

Accidents and incidents are confined by multiple barriers or controls, these barriers and controls are the system's defences, i.e., management systems, physically engineered containment, or other layers of protection designed to protect an incident (IOGP, 2011), (Reason, 1997). Many authors agree that the general approach to safety within the industries in general is one that is mostly "reactive." The reactive measures tend to be limited to realistic data and lack other vital information such as environmental conditions, task factors and behavioral factor. Incidents and accidents reporting and error analyzing, in itself, cannot improve safety to a higher level in complex systems and hazardous environment.

The key differentiating feature between proactive and reactive method is that these objectives are achieved before the potential harm or after the potential harm (IOGP, 2011).

Proactive method looks vigorously for weak spots in the system and provide essential feedback on performance before injury or incidents occur and involve compliance with performance standards and objectives, active participation of all levels of management. With proactive measures, assessment is constantly carried out such that they are recommended as a sensitive and reliable safety measures.

With these shortcomings the objective of the current paper is to develop an integrated conceptual framework for proactively improving safety culture by utilizing models and concepts from the three main areas discussed above in the literature.

2. METHODOLOGY

Building upon the gaps and similarities highlighted in the previous sections the current section will create a new framework from both literature sources (general and workplace).

The data analysis was done in three stages. The features and uses of these stages are explained below:
i.   First Stage: The process of selecting and identifying factors and models of assessment from the analysis of existing literature. It is the initial stage which describes the process and phenomenon involved in identification and selection of key factors.
ii.   Second Stage: The data is put together in new ways. This is achieved by seeking to identify relationships between selected models. The aim is to make explicit connections between categories and sub-categories know-as the "paradigm model." It involves explaining and understanding relationships between categories in order to understand the phenomenon to which they relate.
iii. Third Stage: The last stage involves the process of selecting and identifying the core category and systematically relating it to other categories. It involves validating those relationships, filling in, and refining and developing those categories.

Data from various sources provides different perspectives and increases the validity of the conceptual integrative framework by bringing together evidence from different disciplines, including occupational health and safety management system, general workplace safety culture, and benchmarking studies on road safety were included to ensure generalizability. The search found a total of three models of literature explaining general or workplace safety culture which met the above criteria. Different stages of the process are described in Table 3.

3. DISCUSSION

3.1. Conceptualizing the Integrated Framework for Safety Culture

Based on these findings, a conceptual framework for proactive improvement of safety culture assessment was formulated. Figure 1

Table 2: Safety performance related methods

Method	Author	Objective	Number of elements	Safety outcome
SEM	(Alteren, 1999)	Evaluation and improvement of OSH management performance	Six key elements: Management, feedback systems and learning, safety culture, documentation, results, goals and ambitions	Lost time injuries frequency, and a severity rate of injuries
UAI	(Redinger, 1998)	Evaluate the performance of OSH management system	Consists of 27 sections, 118 OSH MS principles, and 486 measurement criteria	N/r
Self-diagnostic OHS tool	(Roy et al., 2004)	Subjective self-evaluation of OSH MS performance	Nine subject areas namely: Organizational systems, management commitment, employee responsibility, norms and behaviors, continuous improvement, prevention-oriented activities, organizational structures, communication, and workplace compliance	The need for alteration to attain a satisfactory validation level (Cadieux and Desmarais, 2006)
Safety climate assessment questionnaire	(Zohar, 1980)	Correlation btw the safety culture and the results in terms of reduced accident rates	This method shows both "leading" and "lagging" features at the same time	Positive results in terms of safety management (Zohar, 2010)

SEM: Safety element method, UAI: Universal assessment instrument

Table 3: Models of assessment

| Number	Andersen (1995)	IOGP (2011)	ILO (2001)
1	Plan	Establish implementation team	Policy
2	Find	Assess performance	Organizing
3	Collect	Confirm critical process and barriers	Planning and implementation
4	Analyze	Monitor weaknesses	Evaluation
5	Improve	Set improvement actions and regular monitoring	Action for improvement

is the finalized conceptual framework that is being derived by utilizing various stages involved in developing culture assessment model. Figure 1 is not intended to be rigid structure but is rather meant to provide a guidance for discussion and further research.

Further, the assessment framework is divided into three main stages. Those are being discussed as follow.

3.1.1. Criteria based selection
Taking into account the aforementioned shortcomings of the aggregation method the other approach should be considered

Figure 1: Conceptualizing the integrated framework
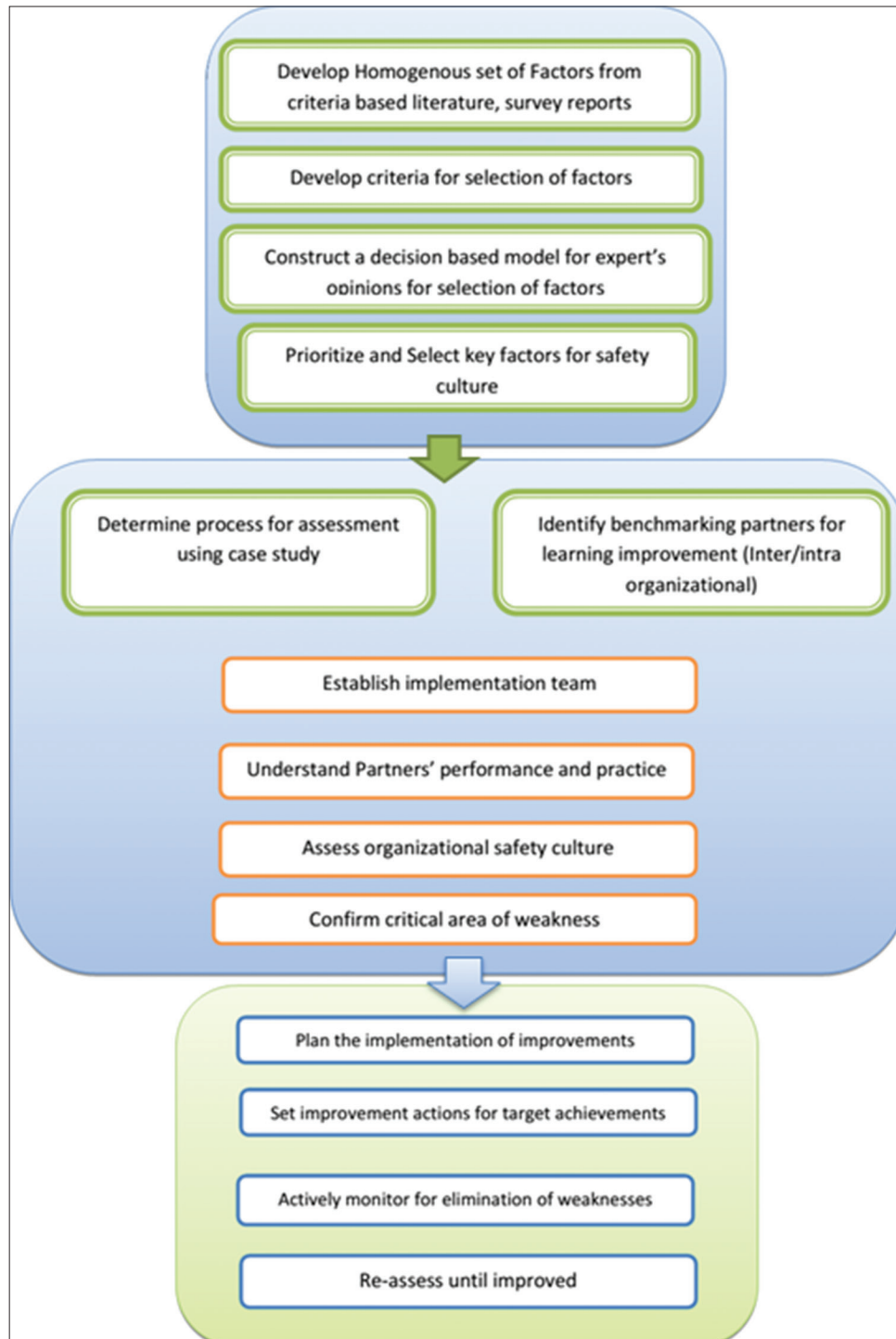
and deliberated on, namely the selection of the most significant and representative indicators out of the relatively large number of initially defined factors. A definitive criteria can be found in literature for the evaluation and selection of most representative factors from a given set of factors, or how to prioritize these indicators by employing a relevant method in the domain of multi-criteria decision making analysis.

3.1.2. Assessment process

i.   Phase 1: Review and select the safety factors of safety culture to be compared and thoroughly understand how the process to be conducted for the assessment in the company.
ii.   Phase 2: Find organizational partners, and obtain acceptance for their participation in the study or identify inter-organizational departments for improvements and learning process.
iii. Phase 3: Conduct the inter-organizational or intra-organizational safety culture assessment.
iv.   Phase 4: Analyze the prioritized factors and confirm critical weak areas for improvement.

3.1.3. Improvement process

Plan improvements based on the analysis and findings. Implement improvements based on the findings from the observation and analysis of the benchmarking partners. It can be a basis for learning and speeding up positive developments and can be considered a promising step in improving safety culture. Such a process inter-organizational and intra-organizational has the potential to evaluate various aspects of safety culture and safety performance in relation to others that are best in practice.

The outcomes can be used for the next assessment study with the purpose of continuous improvement and to learn from others as a basis for developing measures and programmes which are aimed at increasing their own performance.

4. CONCLUSION

Despite the fact that safety culture measurment systems have been implemented and maintained in numerous enterprises all over the world for more than three decades, there has so far been no agreement on what factors make up the culture and what methods can be used to improve the safety culture. Since the the strength of a company's safety performance lies within the strength of its safety culture, identification of the most representative factors is critical to safety performance and measurement system.

Understanding the safety factors of organization performing well in process safety culture helps other companies to plan for necessary improvements in order to achieve safety goals. This conceptual framework shows and confirms a simplified integrated model for proactive improvement of safety culture by helping identify crtical areas of improvement and integrates a mutual learning and improvement process. Lastly, this paper shows that synthesizing the current literature from different fields of research is a useful tool for theory generation and synthesis research. For future research, the various steps involved can be used identify

criteria for selection of factors and proactively improving safety culture.

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