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A sociotechnical systems approach to enhance safety climate in the trucking industry: Results of an in-depth investigation

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ABSTRACT

The purpose of this study was to develop a methodology that extends safety climate beyond an overall score by using the framework of macroergonomics to examine the entire system in a more comprehensive manner. The study is discussed in two papers: one paper describes the study methodology in detail (Murphy, Robertson, Huang, Jeffries, & Dainoff, in press), and the current paper describes the results of the study. Multiple methods were combined to create a systems approach, and those methods include the critical incident technique, contextual inquiries with functional role diagrams, and affinity mapping. Key informants in the trucking industry identified 19 themes that affect safety. The themes ranged from balancing work and family/personal time, the company's policy vs. practice, respecting the job of the driver, and active listening and meaningful feedback. The most prominent themes were related to the workers and their activities; the internal environment, including psychosocial job design elements; and organizational design. Such information can be used to design interventions to change the safety climate of an organization in order to reduce negative safety outcomes.

1. Introduction

Safety climate is based on the workers in an organization and the ways their perceptions regarding the value of safety in their company impact their behavior (Zohar, 2003). One focus of current safety climate research has been the communication between supervisors and employees. Supervisors interact with their employees presumably on a daily or near-daily basis and are able to convey the message, through words and actions, that safety is a priority. Therefore, generally speaking, workers will act in a safer manner if they believe that safety is a priority. Human factors and ergonomics (HFE) also focuses on the people in a work environment and influencing their capacities and aspirations so that well-being and performance are optimized (Dul et al., 2012). The purpose of HFE, and the emphasis of this study, is to understand the interactions between the person and the system (International Ergonomics Association, 2016). Fitting workers to the system, through selection or training, should be done only when the system cannot be changed (Dul et al., 2012). A specific advantage of HFE is its consideration of the broader context of an individual within the work environment (Dul et al., 2012). Additionally, assessments and analyses performed by HFE specialists may often lead to recommendations and actions for designing or redesigning the work system (Dul et al., 2012). Both safety climate and HFE have strong bodies of research showing that performance can be positively impacted by changing different components of the system (e.g., communication, equipment) and/or by changing or appropriately managing the interactions between those components. The goal of this study was to integrate the research area of safety climate and the HFE subdiscipline of macroergonomics to find aspects of the system that could be modified through the design of future organizational interventions.

This paper is the second in a series that extends safety climate theory through the assessment of trucking companies using macroergonomic principles. The first paper presented the methodology to examine the work system in detail (Murphy, Robertson, Huang, Jeffries, & Dainoff, in press), and the purpose of this second paper is to present the results of the systems analysis. This systems

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analysis study contributes to the literature in two distinct ways. First, the safety climate literature can benefit by incorporating a systems perspective. It has been common practice to measure safety climate without first conducting an organizational assessment, even though workers' perceptions are based on a number of factors in the work environment. There are multiple components in a work system, including the interactions between workers and supervisors in which safety is discussed, and those interactions are emphasized in safety climate scales. However, researchers' focus cannot be mostly on worker and supervisor interactions because there are other things within the work environment that are impacting the worker, like training and equipment issues. Therefore, it is necessary to assess factors within the work environment that impact safety climate in order to determine which factors should be intervened on to change those climate perceptions. Second, the components of the work system that affect safety were analyzed qualitatively, using principles from macroergonomics. A qualitative methods approach is important because quantitative surveys are limited by the items researchers use, while qualitative interviews allow participants to emphasize what they perceive to be important. As will be discussed, the specific themes derived from the qualitative interviews suggest that other factors not usually assessed by safety climate scales, including family distractions and health concerns, impact the safety of truckers.

2. Method

2.1. Study approach

The proposed methodology, described in detail in Murphy et al. (press), has the following components (see Fig. 1). Two long-haul trucking companies were recruited for in-depth systems analyses and data collection was conducted within the framework of proven macroergonomic methodology (i.e., Kleiner's MacroErgonomic Analysis and Design (MEAD) framework; Kleiner, 2004, 2006). Step 1 is the initial scanning of the organization, and an initial scan of each organization included the examination of identity statements (i.e., mission, vision, and principles) and contextual interviews conducted during the development of the trucking-specific safety climate scale (Huang et al., 2013). Also, a sophisticated analysis using Item Response Theory (IRT) was performed on the existing set of safety climate data from the trucking companies studied in Huang et al. (2013). This analysis identified a small set of individual items that were the best discriminators with respect to objective safety outcome measures. The scanning of each of the two participating companies' identity statements, contextual interviews, and safety climate items occurred before the initial data collection and that information was used to inform the creation of the interview protocol and potential follow up questions for this study. Understanding the context of the organizations prior to site visits allowed us to focus on pertinent information during the interviews. Context in this study refers to any element of the work environment that can be observed or perceived by people.

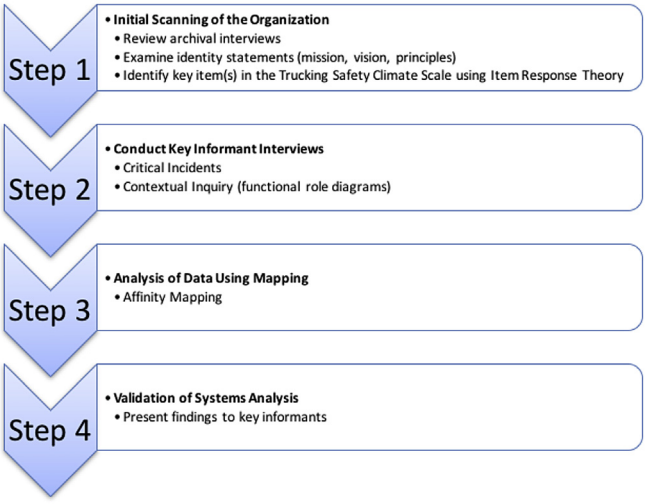

Fig. 1. Systems analysis procedure based on macroergonomic principles.

Step 2 is conducting key informant interviews. Key informants (i.e., drivers, direct supervisors, senior managers, safety specialists, and operations personnel) were recruited within each participating trucking company. The interviews involved the use of the following tools: (a) the critical incident technique allows participants to report from memory extreme incidents that are more accurately recalled than average incidents (Flanagan, 1954) and (b) the contextual inquiry technique is an iterative process in which researchers interact with key informants to create a dialog where current work practices, system practices, and associated experiences are discussed in order to produce a functional role diagram illustrating key informants' job functions in relation to the system (Holtzblatt and Jones, 1993). Step 3 is data analysis using affinity mapping. Affinity mapping is an inductive procedure that was used to qualitatively analyze the interview data derived from the contextual inquiries and critical incident questions (Holtzblatt and Jones, 1993; Shaw et al., 2003). There were no predetermined categories into which data were forced; the categories were formed during the data analysis process. Themes were identified as they emerged to create a description of the system. Step 4 is validating the system diagrams and themes. Results (i.e., themes and functional role diagrams) were validated through an iterative process in which the researchers presented the themes with their descriptions and the functional role diagrams to key informants from the participating companies to discuss how the data were interpreted. Key informants either agreed or suggested changes to the themes and diagrams. The discussions occurred until there was consensus (i.e., agreement among a majority of the key informants), and consensus signaled the endpoint of data collection.

2.2. Industry and participants

Two companies were targeted for recruitment based on overall safety climate scores from Huang et al. (2013); one with a lower safety climate score and one with a higher safety climate score compared to all eight companies participating in the study. However, companies involved with the Huang et al. (2013) study with either high or low safety climate scores did not agree to participate in the current study. In the end two long-haul trucking companies with similar safety climate scores that were more average did agree to participate in this study. Since the two companies participating in this study were similar in their safety climate scores and other attributes, such as union status and size (fewer than 6000 drivers), the data were combined.

A total of 27 1-h long, semi-structured interviews were conducted during the initial data collection with a total of 28 participants; one interview included one set of team drivers. Company 1 included six drivers, two direct supervisors, three operations personnel, two senior executives, and two safety personnel. Company 2 included four drivers, four driver trainers, two direct supervisors, one operations personnel, and two safety personnel. The validation data collection involved 19 interviews that each took one-half hour to complete. Company 1 included two safety personnel, three direct supervisors, two drivers, one driver trainer, and one maintenance/road service personnel. Company 2 included