Safety Science 77 (2015) 102–111

Contents lists available at ScienceDirect

Safety Science

journal homepage: www.elsevier.com/locate/ssci

Can we examine safety culture in accident investigations, or should we? ☆

Barry Strauch

National Transportation Safety Board, United States

ARTICLE INFO

Article history:
Received 16 May 2014
Received in revised form 23 January 2015
Accepted 23 March 2015

Keywords:
Safety culture
Safety climate
Accident investigation
Organizational accidents
System safety

ABSTRACT

Considerable attention has been paid to safety culture since the 1986 Chernobyl nuclear power station accident. Researchers have studied it and companies and regulators have applied it to enhance safety. However, few research studies have been conducted that establish a link between safety culture and operational or process safety and methods used to assess safety culture, primarily questionnaires, have been criticized on methodological grounds. One way to enhance system safety is through applying the lessons of investigations of accidents of process safety to remediate organizational shortcomings identified in the investigation. Rather than attempting to assess safety culture directly, examining company actions and decisions directly after an accident can allow investigators to make inferences about safety culture at the time of the accident. This study suggests a method to directly examine the role of organizations in accidents by identifying the nature of organizational errors and describing the logic that can link these errors to accident causation. The application of this method in several accident investigations is described.

Published by Elsevier Ltd.

1. Introduction

There has been a considerable amount of attention devoted to safety culture recently, both by researchers seeking to better understand it and companies seeking to apply it to enhance the safety of their operations. Some have applied it retroactively, to explain incidents and accidents. As a 2007 editorial in this journal noted (Baram and Schoebel, 2007, p. 632), "it has become convenient for investigators of accidents to aggregate their findings about contributing factors and hold an organization accountable for an accident by concluding that it had an inadequate safety culture." But is investigating safety culture as a potential cause of an accident warranted? Given what is known about safety culture, is it reasonable that accident investigators, using investigative techniques that meet the requirements of accident investigations, assess the role of a company's safety culture in the cause of an accident? To answer these questions, it is necessary to examine safety culture and the ways it is currently assessed.

The term safety culture was used initially by the International Atomic Energy Agency (IAEA) in reference to the April 1986 Chernobyl nuclear power station accident. Following the accident the International Nuclear Safety Advisory Group or INSAG published protocols for nuclear power facilities to enhance their safety culture (INSAG, 1991), so that reactor operational safety would be improved. Since then researchers have devoted considerable attention to the topic and regulators and companies have endeavored to improve operational safety by applying safety culture to their industries and to their operations, respectively. In the United States the Nuclear Regulatory Commission, the government agency that regulates civilian nuclear power plants, formally endorsed the application of safety culture principles in that industry, proposing elements of a positive safety culture to guide their licensees (Nuclear Regulatory Commission, 2011), as did another United States regulator (e.g., Bureau of Safety and Environmental Enforcement, 2013).

Yet safety culture, despite its origins in an accident investigation and its increasing acceptance by companies and regulators, has rarely been directly addressed in investigations of operational accidents. In this paper I raise the question of whether safety culture can and should be examined in accident investigations and if not, I consider alternative methods that may address a company's role in an accident. These methods can allow investigators to make inferences about aspects of an organization's culture from the findings of an accident investigation.

☆ The views expressed in this article are those of the author and not those of the National Transportation Safety Board or any agency of the United States government.

http://dx.doi.org/10.1016/j.ssci.2015.03.020
0925-7535/Published by Elsevier Ltd.

2. Safety culture

To understand safety culture the meaning of culture should first be examined because safety culture is considered an element of a particular type of culture, that of companies or organizations. Thomas et al. (2003, p. 454), define culture as:

> Systems of values, attitudes, beliefs, and behavioral meanings shared by members of a social group (society) and learned from previous generations. Culture itself, a group level construct, is neither genetic nor about individual behavior. However, it exists within the knowledge systems of individuals, which are formed during childhood, and reinforced throughout life.

Because culture is formed by beliefs, interpretations, and behaviors, it is considered to be "deep seated," or as Antonsen (2009) describes, "conservative." Culture, he writes (2009, p. 249), is "not something that changes rapidly." Traditionally, culture has been applied to large groups of people, such as those inhabiting nations and geographic areas, and members of tribes and religions. Hofstede (1980, 1991), among prominent contemporary cross-cultural researchers, initially identified four dimensions (later adding a fifth) that distinguished national cultures. He derived the dimensions from multivariate statistical analyses of responses to Likert-type questionnaires administered to employees of a multi-national corporation. Hofstede's work has been criticized on a variety of grounds (e.g., Fang, 2003; McSweeny, 2002), including his use of questionnaires to measure cultural characteristics. Nevertheless, although Hofstede's measurement methods and conclusions have been criticized, the influence of culture has not; it is a widely accepted construct that effectively distinguishes groups of people according to dimensions or characteristics of behaviors, norms, and values.

Studies of characteristics that distinguish among cultures of large groups of people have also been conducted on smaller groups. When applied to those within organizations, the particular category is referred to as organizational culture. Schein (1990, 1996) described characteristics that "cut across a whole social unit" of organizations and companies. That is, employees of corporations can be distinguished from those of other corporations by their organizational beliefs and behaviors, differences that would be present even among employees of corporations engaged in similar endeavors. Those differences have been attributed, in part, to the employees' acculturation through their affiliation with their respective organizations.

Since the Chernobyl accident the study of organizational culture has been further applied to the safety characteristics of organizations engaged in high risk operations, that is, to their operational safety, i.e., safety culture. As Hopkins (2006, p. 876) describes,

> Every organisation has a culture (or perhaps a series of subcultures) and that culture can be expected to impact on safety. Understanding how this happens can provide insights into ways organisational cultures need to be modified to give a higher priority to safety.

Guldenmund (2000) suggests that safety culture, consistent with other types of culture, is a relatively stable multidimensional construct, with characteristics and aspects shared by members of the organization.

Nonetheless, both the study and application of safety culture has not been without criticism. Silbey (2009), for example, disparages the widespread but uncritical use of the concept, and its use as an explanation for organizational and technological shortcomings. Similarly Reiman and Oedewald (2007, p. 748) note:

> The sometimes careless and vague use of the term safety culture has resulted in criticism among academic organizational researchers. According to them the concept of safety culture has become a catch-all concept for psychological and human factors issues in complex sociotechnical systems.

2.1. Defining safety culture

Such criticism may be due to the absence of a commonly accepted definition of safety culture. As Guldenmund (2000) observed, "the concepts of safety culture and safety climate are still ill-defined and not worked out well; there is considerable confusion about the cause, the content and the consequence of safety culture and climate ... and the consequences of safety culture and climate are seldom discussed (p. 247)." More recently, an editorial in this journal (Baram and Schoebel, 2007, p. 633), presented a similar view, "there is considerable confusion," it observed, "about what safety culture means and controversy over how to deal with the concept's many implications for complex organizations."

Unlike national culture, a concept that is widely understood and accepted, safety culture calls for an understanding of safety, which has proven challenging to operationally define and measure. As Stoop and Dekker (2012) suggest, "safety is a difficult performance parameter to measure accurately due to its stochastic nature ... safety is an emergent property, which is difficult to express in quantifiable parameters, such as the frequency and severity of accidents, incidents and occupational diseases (p. 1428)."

Further, because the rate of accidents in high risk systems is (fortunately) low, despite the occurrence of the accident at Chernobyl, defining measures of system safety is difficult. As Lofquist (2010, pp. 1521–1522) observed, "academic contributions have increased our understanding of the underlying organizational dynamics of how safe systems contribute to unacceptable outcomes, [but] all [of the cited contributions] fall short of defining a true systems perspective for measuring safety as a process within high-risk industries..."

Several definitions of safety culture have been proposed. Wiegmann et al. (2004, p. 124) define it as "an enduring characteristic of an organization that is reflected in its consistent way of dealing with critical safety issues," characterized by organizational commitment to safety, management involvement and employee empowerment with regard to safety issues, a system that rewards employees for safety behaviors, and a system that encourages the reporting of safety concerns. Richter and Koch (2004, p. 705) define it as "the shared and learned meanings, experiences and interpretations of work and safety – expressed partially symbolically – which guide peoples' actions towards risks, accidents and prevention."

Grote (2012) suggests that characteristics of a "common denominator" of safety culture include safety policy, safety resources and responsibilities, risk identification and mitigation, standards and procedures, human factors based system design, safety training, safety performance monitoring, incident reporting and investigation, auditing, continuous improvement, and management of change. The Nuclear Regulatory Commission, in its 2011 safety culture policy statement, identified characteristics of "a positive safety culture," including leadership safety values and actions, problem identification and resolution, personal accountability, work processes (the process of planning and controlling work activities so that safety is maintained), continuous learning, environment for raising concerns, effective safety communication, respectful work environment, and questioning attitude. Some of the elements of safety culture that have been proposed are observable; however, many address norms, attitudes and styles of behavior, e.g., leadership commitment, that are not. Further, as will be discussed subsequently, the incorporation of established programs that manifest "good" safety culture, such as risk identification and