



The impact of organizational culture on Concurrent Engineering, Design-for-Safety, and product safety performance



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ABSTRACT

This paper empirically extends the research on the relationships between organizational culture, new product development (NPD) practices, and product safety performance (PSP). Using Schein's conceptualization of culture (i.e., underlying assumptions, espoused values, and artifacts), we build and test a model among five variables: top management commitment to safety (MCS), group level product safety culture (PSC) at NPD, Concurrent Engineering (CE), Design-for-Safety (DFS), and product safety performance. We propose that the underlying assumption of safety first affects the espoused values (group level product safety culture at NPD) and artifacts of organizational culture (Concurrent Engineering and Design-for-Safety); espoused value influences artifacts; and artifacts impact product safety performance. These hypotheses are tested by structural analyses of 255 survey responses collected from 126 firms in the juvenile product sector. While management commitment to safety, product safety culture, and Design-for-Safety are significant product safety predictors, as expected, Concurrent Engineering has no significant direct effect on product safety. We discuss the implications of these findings for the field of product safety.

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1. Introduction

Product safety is a matter of enormous economic and societal concern. The U.S. Consumer Product Safety Commission (CPSC) estimates that in the United States alone, “deaths, injuries and property damage from consumer product incidents cost [the US] more than \$1 trillion annually” (CPSC, 2009). Hundreds of millions of consumer products are recalled every year for safety risk reasons, and the financial risks to individual firms are significant, too: White and Pomponi (2003) estimated the average cost to manufacturers for every recall at about \$8 million. For example, General Motors recalled 28 million cars worldwide due to faulty ignition switches in 2014 at a cost estimated in the billions of dollars (Popper, 2014). At the very least, sub-par product safety and product recalls tarnish a manufacturer's reputation and damage product brands.

There is overwhelming research that shows product safety is

largely determined by how well a firm controls its NPD process: approximately 70% of product recalls have been traced to shortcomings in product development (Beamish and Bapuji, 2008; White and Pomponi, 2003). Our paper empirically examines the impact of NPD on product safety. We add to the pertinent literature on product safety in three aspects:

- 1) Product safety and its relationship with NPD. Most empirical studies on product safety focus on technical aspects and overlook the effect of product safety on culture (Abbott and Tyler, 1997; Main and Frantz, 1994; Main and McMurphy, 1998; Moller and Hansson, 2008; Wang and Ruxton, 1997). Much of the literature on this topic appears to be anecdotal and prescriptive.
- 2) Product safety performance rather than general product quality. Only a handful of studies on NPD include product safety when measuring product quality (Koufteros et al., 2001, 2002; Koufteros and Marcoulides, 2006; Sethi, 2000). Product safety has never been included as an independent variable, and product safety management practices and tools are not explicitly explored in any of the studies on NPD and product quality (Callantone and Benedetto, 1988; McDonough, 2000; Millson and Wilemon, 2008; Rusinko, 1997; Song et al., 1997; Song and Parry, 1997; Tatikonda and Montoya-Weiss, 2001), although

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some (e.g., Fynes and De Búrca, 2005) have considered conformance quality (design quality, conformance quality, external quality-in-use, product cost, time-to-market and customer satisfaction) and customer complaints as measures of product quality performance.

- 3) Product safety and NPD in the context of organizational culture. Only a few studies have investigated the relationship between organizational product safety culture and product safety (European Commission, 2008; Svenson, 1984; White and Pomponi, 2003) both from theoretical discourse and industry best practice.

Earlier work using Schein's (1992) conceptualization of culture (e.g., Koufteros et al., 2007; Nahm et al., 2004; Yauch and Steudel, 2002) evaluated the effects of organizational culture on manufacturing practices and firm performance. Extending this conceptualization of culture, we test a model among five variables: (1) top management commitment to safety, (2) group level product safety culture at NPD, (3) Concurrent Engineering, (4) Design-for-Safety, and (5) product safety performance. We investigate the assumption that improvements in those five key variables lead to better product safety performance.

Our empirical analysis is based on an individual-level survey of product category/business unit perceptions of 255 NPD quality and engineering directors sampled from 126 firms in the juvenile product sector. The results from this research, as well as its managerial and theoretical implications, are intended to help managers further improve product safety through the design of better NPD processes and guide researchers towards better explanatory models about product safety and innovation. The following section includes theory development, key hypotheses, and an explanation of data collection methods and model analysis. After the discussion of the main findings, we draw conclusions and propose implications for theory and management practice.

2. Theory development

2.1. Organizational culture

Organizational culture has been researched for decades (Deal and Kenney, 1982; Hofstede, 1997; Schein, 1992). A fundamental difference in understanding culture is whether to focus on the way people think or the way people behave (Cooper, 2000), and one of the most well-known behavior/practice definitions for organizational culture is "the way we do things around here" (Deal and Kenney, 1982, p. 4). Hofstede (1997, pp. 182–183) concluded that "shared perceptions of daily practices should be considered to be the core of an organization's culture."

In a comprehensive definition, Schein (1992) summarized organizational culture as a set of observed behavioral regularities, group norms, espoused values, formal philosophy, rules of the game, climate, embedded skills, habits of thinking, shared meanings, and root metaphors. He aggregated these into three levels: (1) artifacts, (2) espoused values, and (3) underlying assumptions. At the surface, there are observable artifacts that one sees, hears, and feels when one enters an organization (e.g., organizational structures, policies, procedures, processes, practices, rituals, language, etc.). At the second level, there are espoused values (e.g., norms, ideologies, philosophies, strategies, and goals) that govern behaviors and explain why members behave the way they do. The third level of the hierarchy is composed of underlying assumptions, such as preconscious, taken-for-granted, and invisible beliefs that determine perceptions, thought processes, feelings, and behavior.

2.2. Underlying assumptions

Organizational culture and organizational structure are inter-related, according to Harrison (1972) and Handy (1976). As this paper's purpose is to evaluate how organizational culture and NPD practices affect product safety performance, we map how various components of a company's product development system represent those artifacts, values, and assumptions as defined by Schein (1992).

Top management plays a critical role in establishing company culture (Hofstede, 1997) and in setting the tone of product safety and establishing a safety-oriented culture (Eads and Reuter, 1983; Roland and Moriarty, 1983), especially through top-level commitment in all matters related to product safety, establishing priorities, policies and procedures, and allocating dedicated resources. Other indicators of safety-oriented culture can be found in the formulation of Key Performance Indicators (KPIs) and the review of safety performance and evaluation of individual attitudes towards safety (International Nuclear Safety Advisory Group, INSAG, 1991). White and Pomponi (2003) found that the highest performers integrated safety, regulatory, environmental, and health initiatives into their corporate strategy and articulated specific goals for each area. Given the significant moral and legal risks for top managers, their views and beliefs on what constitutes a safety-oriented culture transcends all layers of an organization and requires full, genuine, and constant commitment by its company leaders (Ryan, 2003). We therefore posit that top management's commitment to safety (i.e., how product safety is perceived and positioned) is one of the manifestations of the underlying assumptions in organizational culture in the context of product safety, and is consistent with Hofstede's (1997) view of top management's involvement in defining organizational culture.

2.3. Espoused values

An organization's underlying assumptions give rise to what Schein (1992) called a company's espoused values: common beliefs shared by the members of an organization about "what ought to be" rather than "what is"—the domain of artifacts. Such a set of values also exists in the context of an organization's attitude towards product safety. A strong organizational "safety first" philosophy impacts members' beliefs and attitudes towards product safety, and consequently, leads to its high priority and adoption of processes and practices that support the organization's commitment to product safety. Moreover, this espousal of occupational health and safety culture has been linked to safer work behaviors (Hofmann and Stetzer, 1996; Varon and Mattila, 2000) and fewer employee injuries (Barling et al., 2002; Hofmann and Stetzer, 1996; Mearns et al., 2003; Zohar, 1980).

The literature on product safety culture is still sparse. Svenson (1984) made one of the earliest contributions when he studied Volvo's accident hazard management system and the general quality and product safety attitude of its technicians. Focusing on business safety measures in the toy industry, the European Commission (2008) echoed the importance of a strong quality and product safety culture. This is especially critical in design organizations (Rollenhagen, 2010).

While the literature emphasizes the value of a strong product safety culture, it is unclear how a product safety culture influences activities and practices in NPD. Consequently, we define group level Product Safety Culture as product safety related beliefs, norms, and values shared by the employees involved in NPD to determine how they act and react during product development in relation to product safety.

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