Dynamics of safety performance and culture: A group model building approach

Yang Miang Goh\textsuperscript{a,\*}, Peter E.D. Love\textsuperscript{b}, Greg Stagbouer\textsuperscript{c}, Chris Annesley\textsuperscript{c}

\textsuperscript{a} Det Norske Veritas Pte Ltd, DNV Technology Centre, 10 Science Park Drive, Singapore 118224, Singapore
\textsuperscript{b} School of Built Environment, Faculty of Humanities, Curtin University, GPO Box U1987, Perth, Western Australia 6845, Australia
\textsuperscript{c} Audrill Ltd, 6–12 Uppsalai Pl, Canning Vale, Western Australia 6155, Australia

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\section*{Abstract}

The management of occupational health and safety (OHS) including safety culture interventions is comprised of complex problems that are often hard to scope and define. Due to the dynamic nature and complexity of OHS management, the concept of system dynamics (SD) is used to analyze accident prevention. In this paper, a system dynamics group model building (GMB) approach is used to create a causal loop diagram of the underlying factors influencing the OHS performance of a major drilling and mining contractor in Australia. While the organization has invested considerable resources into OHS their disabling injury frequency rate (DIFR) has not been decreasing. With this in mind, rich individualistic knowledge about the dynamics influencing the DIFR was acquired from experienced employees with operations, health and safety and training background using a GMB workshop. Findings derived from the workshop were used to develop a series of causal loop diagrams that includes a wide range of dynamics that can assist in better understanding the causal influences OHS performance. The causal loop diagram provides a tool for organizations to hypothesize the dynamics influencing effectiveness of OHS management, particularly the impact on DIFR. In addition the paper demonstrates that the SD GMB approach has significant potential in understanding and improving OHS management.

\section*{1. Introduction}

Significant improvements in occupational health and safety (OHS) have been made within the construction and engineering industry over the last decade. Emphasis has traditionally focused upon the victims of accidents as being their cause (e.g. Heinrich, 1959), but there has been a subtle shift in direction by organizations in recognizing the importance and role of their culture and management systems and processes contribute to accidents (Flin et al., 2000; Zohar, 2000; Mearns et al., 2003; Fernandez-Muniz et al., 2007; Robson et al., 2007; Fernandez-Muniz et al., 2009). Despite the advancement of OHS management, major accidents still arise. For example, in April 2010 the BP/Transocean Deepwater Horizon catastrophe occurred (Chemical Safety Board, 2010). Lessons from the accident at the BP Texas oil refinery explosion in 2005 should have been made (Baker, 2007). Evidently, they have not been and there is still much to be learned in terms of OHS management.

The difficulties in managing OHS not only arise due to major accidents, but also confront most managers on a daily basis. There is a growing realization that OHS management has become a more complex and challenging task particularly in the minerals and petroleum sectors due to increasing demands from India and China (Goh et al., 2010a,b). The complexity that arises with OHS management may result in problems being difficult to define, analyze and resolve, and may even be compounded as managers attempt to solve them. Such problems are messy and are classified as being ‘wicked’ (Rettel and Webber, 1973; Peter Wagner & Associates, 2010).

To add to such complexity, the impacts of actions to deal with OHS problems are frequently delayed. As a result, managers may not be able to observe their effects. Such characteristics of OHS management render system dynamics (also known as systems thinking) a suitable analysis tool for representing and better understanding OHS issues (Sterman, 2000; Goh et al., 2010a,b). In contrast to the linear paradigm of cause and effect, where dependent and independent variables are clearly defined, system dynamics emphasizes the importance of feedback by expressing problems systemically (Morecroft, 2007). Against this contextual backdrop, this paper utilizes the deep individualistic knowledge of employees from a leading Australian Drill, Blast and Exploration organization to examine how the underlying dynamics influence safety performance and culture. In particular, the paper demonstrates how system dynamics can be used as an effective medium to comprehend the messiness of causal factors impacting safety performance and culture. Such understanding is needed to determine appropriate OHS management practices to implement, especially in relation...