Review

Health and safety management systems through a multilevel and strategic management perspective: Theoretical and empirical considerations

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A R T I C L E   I N F O

A B S T R A C T

Multilevel and strategic management theory and research methods are presented and applied to current issues in occupational health and safety (H&S), the primary goal being to better understand health and safety management systems (HSMS) from a theoretical and empirical perspective. Through these perspectives, a strategic HSMS may be understood as a construct that exists objectively at the strategic level of the organization—its objective content often distinct from the implemented practices and procedures within a workgroup and from worker perceptions and interpretations of its content. These nuances highlight the types of biases that can arise when choosing a level of measurement to assess the HSMS and techniques that can be used to minimize measurement error and increase the validity of inferences made. These nuances also illuminate the contingencies important for the success of a strategic organizational HSMS. The contingencies are discussed from a theoretical perspective and presented in a conceptual HSMS model.

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Contents

1. Introduction

As defined by available system standards (e.g. ANSI/AIHA Z-10; OHSAS 18001; Responsible Care; ILO-OSH-2001), a health and safety management system (HSMS) is a set of institutionalized, interrelated, and interacting strategic H&S management practices designed to establish and achieve occupational safety and health goals and objectives. Because of the potential importance of an HSMS in occupational injury and illnesses prevention, it has emerged as an important research topic in the H&S academic community. To date, however, empirical measurement of an organizational HSMS for the purpose of understanding its effect

on other important H&S phenomena in research studies has taken on different forms. Robson et al. (2007) conducted a systematic review of the empirical literature that explored the effectiveness of an HSMS and found that common limitations across studies were a lack of consistency in HSMS measurement techniques and an underreporting of the potential biases that the technique introduced.

These limitations are problematic from both a research and policy perspective. First, the distinct HSMS measurement approaches used within the H&S academic literature imply very different operational definitions of the construct. Importantly, valid inferences about the effect of an HSMS on specific outcomes (e.g., injuries and illnesses) require that the content of the HSMS in place be accurately measured. Secondly, given that occupational standard setting bodies throughout the world (e.g., the United States, ILO, Canada, Australia, and the European Union) have made and continue to make efforts toward mandatory HSMS-related standards, valid empirical research of HSMS effectiveness is increasingly important.

In what follows, multilevel and strategic management theories are used to distinguish between a strategic HSMS (a top-down construct that exists at the level of the organization and is a key part of its structure), HSMS implementation (the behaviorally executed policies and practices that often exist within organizational workgroups), and worker perceptions and interpretations of the HSMS. Through these basic lines of delineation, two important developments related to HSMS theory and research are illuminated. First, the types of biases, measurement error, and construct validation issues relevant to empirical assessment of an HSMS for use in research models becomes apparent. Second, contingencies important to the success of a strategically designed organizational HSMS can be theoretically developed, providing insight into important research questions that may be answered in future studies.

2. Health and safety management systems in practice, theory, and research

2.1. HSMS in practice

As noted above, an HSMS can be broadly characterized as a set of institutionalized interrelated and interacting strategic elements designed to establish and achieve occupational H&S goals and objectives. Makin and Winder (2008) defined a comprehensive HSMS as a system that is comprised of purposefully distinct but complementary H&S management practices. These ideas can be briefly illustrated through the ANSI/AIHA Z-10 HSMS consensus standard. ANSI/AIHA Z-10 advocates the following elements: top-management leadership and employee participation; planning; implementation and operation; evaluation and corrective action; and management review. Each of these elements has a distinct function within the HSMS but all have the same objective: to prevent occupational injuries and illnesses. Numerous policies, practices, and procedures can be listed under each element and each of the practices listed under an element fundamentally aligns with the element's function. For example, the top-management leadership and employee participation element can include: a written H&S policy that articulates H&S management commitment, employee participation in risk management activities, and compliance with applicable laws and regulations; appropriate resource allocation; defining H&S roles and responsibilities and an accompanying accountability system; design of employee feedback systems; and integrating aspects of employee involvement into various practices that make up the HSMS (e.g., accident investigation, H&S inspections and audits, etc.).

From a practical perspective, the decision as to which elements to include within an HSMS (and practices aligned under those elements) can be challenging. As an HSMS is a strategically designed, context-specific organizational asset, there are various activities that can be administered and a variety of ways that the activities can be designed. However, consistent with the arguments of Makin and Winder (2008), the building blocks of an effective HSMS should include practices related to creating a 'safe place' (e.g., access/egress, electrical, noise, hazardous substances, preventative and predictive maintenance, housekeeping, etc.), sustaining 'safe people' (e.g., H&S training, psychosocial risk management, health surveillance, performance appraisals, etc.), and continuous improvement (e.g., recordkeeping, management review, etc.).

2.2. HSMS theory and research

Within the H&S academic literature, HSMS have been traditionally conceptualized to exist as an artifact of or manifestation of an organization's safety culture (Edwards et al., 2013; Cooper, 2000; Guldenmund, 2007; Mearns and Flin, 1999). Thus, current HSMS research work has been shaped by overarching organizational and safety culture themes. Although, efforts to clarify the distinct space between them have been made (Edwards et al., 2013; Guldenmund, 2010; Zohar, 2008), the theoretical development of HSMS as a safety culture artifact has seemingly created some confusion within the safety research community as to where to draw the methodological lines between these constructs (Reiman and Rollenhagen, 2013). It is suspected that this confusion has led, in part, to a loose operational definition and measurement of an organizational HSMS in H&S empirical studies.

Table 1 suggests that in H&S empirical investigations, two general approaches are commonly used to assess an HSMS in relation to important organizational and individual level outcomes.

The first approach (Worker Level Measurement) entails asking individual workers to provide perceptions of the elements and/or practices used within the HSMS. These gathered observations can then be aggregated upward to the group level or, as is common in the existing research, used at the individual level in research models. The second approach (Manager Level Measurement) entails asking managers and/or supervisors to supply information on the organization's HSMS and using this data to derive estimates of its effect on important H&S outcomes. As reflected in Table 1, the first approach suggests that an HSMS is operationally a bottom-up, worker-derived perceptual construct. Conversely, the second measurement approach suggests that an HSMS is a top-down, management derived, structural construct.

As an HSMS is often regarded as a component of safety culture, and safety culture is considered an emergent construct by many H&S theorists (Guldenmund, 2007, 2010; Christian et al., 2009), the bottom-up measurement approach has some appeal. There are, however, potential limitations when the resulting empirical inferences are reported to correspond to the practices and policies as formally specified by top organizational managers. First, because the responsibility to develop, implement, monitor and improve the HSMS policies and practices is fundamentally within the sphere of management, the bottom-up approach may not accurately reflect their actual development and function within an organization. Second, worker perceptions and interpretations of an HSMS may not accurately reflect the codified practices developed through strategic management processes. Perceptions of HSMS are limited, not only by bounded rationality and important cognitive, social, and psychological biases (Podsakoff et al., 2003; Hoyt, 2000), they are often filtered through various contingencies involved with the sometimes imperfect implementation of the HSMS. Because of the importance of workgroup supervisors and an organization's internal value systems in shaping the perceptions

Table 1
Common HSMS measurement approaches in the H&S empirical literature.

HSMS level of measurement	HSMS level of analysis	Empirical operationalization	Example studies
Worker level	Worker level	Bottom-up, worker-derived perceptual construct	Vinodkumar and Bhasi (2010) Dejoy et al. (2004) Frazier et al. (2013) Arboleda et al. (2003)
Manager level	Organizational or work-group level	Top-down, organizationally derived structural construct	Fang and Wu (2013) Fernandez-Muniz et al. (2009) Macdonald et al. (2000) Arocena and Nunez (2010)

of the strategically developed and codified HSMS policies, practices, and procedures, an objective assessment of HSMS attributes through worker perceptions is more consistent with the theoretical nature of safety climate[1] than the objective content of the strategic HSMS.

2.3. HSMS through a multilevel perspective

Given the multilevel nature of an organizational HSMS (and other important H&S phenomena such as safety culture, climate, and safety outcomes), there is much that can be gleaned about it through multilevel theory. The H&S academic community has recognized the importance of multilevel theory in the study of workplace H&S. For example, Zohar (2008) suggested that multilevel theory is one of the fastest growing fields in management research and that "it is important that safety climate research becomes integrated in such developments, benefiting from the conceptual, methodological, and statistical rigor of the framework" (p. 385). The same may be said of other topics important to H&S research, including HSMS. Similarly both Cooper (2000) and Guldenmund (2010) have suggested that with the recognition that important contingencies within the safety culture model are multilevel in nature comes the responsibility to ensure they are measured in accordance with current multilevel methodological approaches.

The theme which underpins the multilevel approach is that organizations are comprised of a series of nested structural arrangements. In a hypothetical nested organizational arrangement individual workers are nested within workgroups, workgroups are nested within departments, and departments are, in turn, nested within the greater organization. The basic assumption behind this perspective is that outcomes (e.g., behavior, performance, knowledge, efficacy, etc.) exist at different levels within an organization (i.e., at the level of the individual, workgroup, department, and/or division) and these outcomes can be influenced by phenomena that exist at a different level within the same organization. Through this perspective, for example, hypotheses can be generated in which a construct at a given level influences an outcome at the same level (e.g., the relationship between workgroup safety climate and the number of injuries and illnesses the group collectively experienced) while also encouraging hypotheses in which a higher level construct can influence an individual level outcome (e.g., the relationship between workgroup safety climate and worker safety behavior).

Hitt et al. (2007) traced the historical impact that multilevel theory has had on traditional organizational theory and research. With the development of the multilevel perspective, traditional psychologists began to recognize the importance of context in shaping and constraining behavior that takes place within organizations and groups (Hitt et al., 2007; Johns, 2006). For traditional

economists and sociologists, this perspective highlighted the importance of the individual in shaping and creating the context of organizations (Hitt et al., 2007; Schneider, 2006). A multilevel perspective has, then, helped to clarify and refine the nature of context in organizations—the different types of contextual variables and the various mechanisms through which they can be formed.

A byproduct of this perspective is a classification scheme and typology of distinct multilevel constructs; each distinct type having its own theoretical and methodological idiosyncrasies. Important to this classification scheme is the recognition of the difference between the level of measurement and the level of analysis (Klein et al., 1994; Rousseau, 1985). Rousseau (1985) defined the level of measurement as "the [organizational] unit to which the data are directly attached" and the level of analysis as "the [organizational] unit to which the data are assigned for hypothesis testing and statistical analysis" (p. 4). With this recognition comes the realization that a higher level theoretical construct (one that exists at the level of the workgroup, department, division, etc.) can be measured at the individual level and then aggregated up to the higher level for analysis purposes (emergent, bottom-up constructs), or measured and analyzed at the higher level (global, top-down constructs) (Chen et al., 2004; Kozlowski and Klein, 2000; Klein and Kozlowski, 2000). Each of these general types of higher level constructs has distinct methodological and construct validity concerns.

Global constructs can be described as objective, descriptive, and observable characteristics of a group (Kozlowski and Klein, 2000). Distinct from bottom-up processes which form emergent constructs, global constructs do not originate (nor emerge) from individual characteristics. Rather, they are independent of individual perceptions, attitudes, behaviors, or other characteristics and can be seen as a representation of the collective group. For global constructs, the level of measurement and analytical inference are consistent and both exist at the level at which hypotheses are derived (Chen et al., 2004). Global constructs can be further conceptualized as those that can vary between groups but not within groups (Bliese and Jex, 2002).

Considering the HSMS definition (i.e., a set of commonly purposed and complementary H&S management practices, policies, and procedures) and its prominent characteristics (e.g., a top-down, controllable phenomena that must be proactively developed and administered by organizational leaders) an HSMS may be more consistent with a global construct than an emergent one. Based on the most fundamental properties that all strategically designed organizational HSMS share, an HSMS may be most appropriately studied as a structural aspect of the organization which provides a context for how work is performed. The choices as to which elements and corresponding policies, practices, and procedures make up the HSMS may indeed be informed through the values of executives and top-managers and/or through the influence of workers; however, the codified choices exist independently of them (Mearns et al., 2003).

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[1] Where safety climate can be generally defined as socially construed indications of desired role behavior originating from interpretations of the organizational health and safety management policies, procedures, and programs (Zohar and Luria, 2005).

This view is consistent with recent developments in the theory that underpins safety culture (Edwards et al., 2013). Edwards et al. (2013) argued that, to improve its understandability, the concept of safety culture should be viewed in terms of its three fundamental components: normative, anthropological, and pragmatic elements. The normative element reflects the readily controllable attributes of the organization such as the policies and procedures contained within the HSMS. The anthropological element reflects the beliefs, values, attitudes, and assumptions that support the implementation of the normative attributes. And the pragmatic aspects of safety culture incorporate the observable behaviors and norms and, therefore, the implementation of the policies, procedures, and practices contained within the HSMS.

Thus, consistent with the strategic management literature (Becker and Huselid, 2006), HSMS may be studied within organizations as two district constructs: the strategically developed HSMS and HSMS implementation. The strategically developed HSMS represents the decreed and codified practice content designed by the strategic leaders and top managers of the organization. Its implemented counterpart is comprised of the actual front-line supervisor and worker H&S related behaviors based on perceptions and interpretations of the strategic system. This proposition is consistent with Zohar and Tenne-Gazit (2008) suggestion that the

> ...assessment of [H&S] policies, procedures, and practices can be quite complex, requiring, among other things, the establishment of differences between formally declared policies and procedures and their enforced counterparts. Formal policy is explicit, relating to overt statements and formal procedures, while enforced policy or enacted practices are tacit...(p. 376).

Seemingly then, the validity of the inferences derived from an empirical study depend, in one respect, on who within an organization (e.g., top leaders and/or managers, front-line supervisors, or workers) is asked to provide information regarding the HSMS content. As opposed to measuring a strategic HSMS by asking workers to provide their perceptions (which may vary from one person to the next), the strategically designed and developed HSMS may be most appropriately assessed through the use of archival data and/or key informants who hold the responsibility of its strategic design, development, and continuous improvement. Similarly, when empirical investigations are designed to study HSMS implementation, behavioral norms may be observed or inquiries made from workgroup front-line supervisors.

2.4. Assessing the content of a strategic HSMS: biases and techniques to increase measurement validity

Just as multilevel theory can be used to illuminate the importance of organizational levels when measuring the content of a strategic HSMS, it can also be used to illuminate the most important sources of measurement error and threats to construct validity when the level of measurement and inference are appropriate.

To the extent that the strategic HSMS is objective and easily observable, a single expert (or key informant) can be the appropriate source of data (Kozlowski and Klein, 2000). Key informants should be chosen based on their specialized knowledge or position and be used to provide information on the structural properties of the HSMS as opposed to their feelings or opinions (Chen et al., 2004; Kozlowski and Klein, 2000; Bagozzi et al., 1991). Various types of archival data and/or information provided by key informants (via surveys with various response options, interviews, log books, journals) are all sources of evidence that can be used to measure an HSMS for empirical research purposes.

However, as organizations change and evolve, informal changes in the strategic HSMS may be more or less inconsistent with archival data and/or may be imprecise in the minds of the top organizational leaders and managers. Given these dilemmas, method variance is a potentially important form of measurement error in the assessment of an HSMS as well as other organizational management systems (Gerhart et al., 2000; Wright et al., 2000). Method variance has been described as a systematic source of measurement error that is due to the measurement method rather than to the construct of interest and its sources can include inaccurate or outdated archived records, limitations of key informants, as well as informant biases (Bagozzi et al., 1991).

In short, even when the level of measurement and inference are consistent, method variance can lead to an inaccurate assessment of the strategic HSMS, thereby calling into question the validity of the inferences drawn from empirical tests related to it. Given such high stakes, it is important that empirical H&S researchers take steps to counteract the potential influence of method variance and provide validity evidence for the HSMS. A classic approach to address the potential negative influence of method variance that has been previously applied is the multiple measures-multiple methods approach (Bagozzi et al., 1991; Wright et al., 2000). As an example, Chen et al. (2004) recommend the use of one or more key informants which can be combined with archival data to measure global constructs. Through a multiple measures-multiple methods approach, various forms of construct validity evidence can be derived using psychometric, correlational, ANOVA, and/or factor analysis approaches (e.g. estimates of reliability and inter-rater agreement indices, convergent/discriminant analyses, and variance partitioned into sources of error).

The use of more sophisticated methods to validate a global construct depends, to some extent, on the existing evidence that method variance is an issue in a particular study. Over the last decade within the strategic human resource management (SHRM) literature, theorists and researchers have debated the extent to which method variance affects the measurement of objective, SHRM policies, practices, and procedures. Gerhart et al. (2000) called into question the traditional, single-source key informant method to measure SHRM practices and policies when they argued that using a single organization-level manager introduces unacceptable levels of method variance due to rater bias. In contrast, Huselid and Becker (2000) argue that a single key informant can be used to accurately measure SHRM practices.

Huselid and Becker (2000) suggest that in lieu of the multiple key informant and supporting psychometric evidence, sufficient construct validity evidence can be provided through organizational contextual variables that suggest method variance may not be an issue. They suggest that increases in employee count and complex internal and external structures (e.g. union status, layers of management, number of divisions/departments, subsidiary status) can increase the potential for method variance when measuring SHRM policies and procedures. In the absence of such moderating conditions, however, they argue that a single key informant is capable of providing an accurate assessment.

3. A conceptual model

Consistent with the discussion thus far, Fig. 1 presents a conceptual HSMS model that differentiates between its strategy and its implementation. The model suggests that the top organizational leadership is responsible for strategically developing, articulating, recording, and communicating the strategic organizational HSMS. HSMS implementation represents the execution of the policies and practices contained within the strategic organizational HSMS. It is through the behaviorally enacted policies, practices, and procedures contained within the HSMS (HSMS implementation) at the workgroup and worker level that the
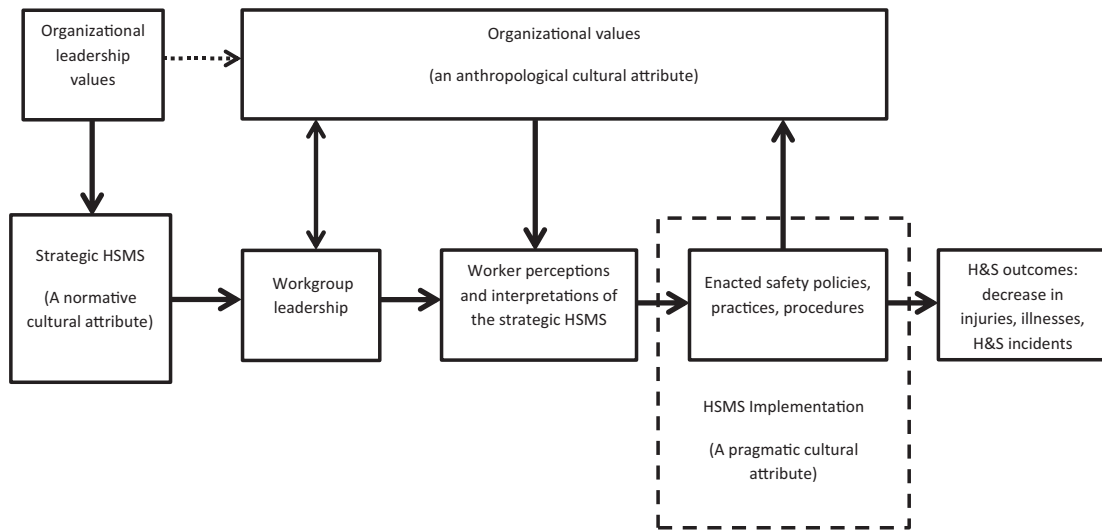
Fig. 1. HSMS conceptual model.

benefits of decreased injuries, illnesses, and H&S incidents are expected to be realized.

The argued distinctions between the strategic HSMS and its implementation illuminate the prominent, somewhat generalizable contingencies that determine the extent to which HSMS implementation preserves the H&S practices, procedures and programs contained in the strategic HSMS as intended. Based on a review of the strategic management literature, we identified three distinct theoretical constructs that can moderate or mediate the relationship between the organizational HSMS, its implementation and overall success: workgroup leadership, organizational values, and worker perceptions and interpretations of the HSMS. Each of the three contingencies important to the success of the HSMS is discussed in more detail below.

3.1. Workgroup leadership

Numerous theoretical and empirical works have positioned group H&S leadership to be a critical component to the success of an organizational HSMS. Naumann and Bennett (2000) suggest that the importance of workgroup leadership at the supervisory level is paramount to orchestrating and shaping individual perceptions of organizational characteristics. Theory suggests that HSMS are most likely to be effective when the codified management practices are administered and managed by quality leaders in a consistent and disciplined manner with unwavering attention to the values that informed the HSMS choices (Denison, 1996). Visible leadership (Naumann and Bennett, 2000), informing leadership (Gonalez-Roma et al., 2002), transformational leadership (Zacharatos et al., 2005; Zohar and Tenne-Gazit, 2008), constructive leadership (Zohar, 2002a), and leader-member exchange (LMX) (Hofmann and Morgeson, 1999) have all been found to be associated with favorable perceptions of HSMS.

As reflected in the model, the leadership contingency is not integral to the strategically designed organizational HSMS. From a strategic management perspective, the selective appointment of individuals who have displayed desirable leadership characteristics is the extent to which strategy has direct control over this HSMS implementation contingency. Significant components of leadership exist as person-based, inherent to the personality and the idiosyncratic experience of the individual leader (Judge and Bono, 2000). Further, prominent concepts of leadership suggest that worker perceptions of strategic management and safety

management practices are shaped through unique leader-member interactions that take place (Hofmann and Morgeson, 1999; Graen and Uhl-Bien, 1995). Thus, once a workgroup leader has assumed his/her role, workers within the workgroup will necessarily look to him/her for cues as to how to interpret the content and the importance of the HSMS. Therefore individual interpretations of HSMS policies, practices, and procedures are derived in part from workgroup leadership, and in some cases, the leaders of other proximal groups.

In line with this argument, many strategic HSMS models include leadership elements and practices that are believed to develop more effective H&S leaders, managers, and supervisors. For example, the National Mining Association's Health and Safety Management System (CORESafety)—a strategic organizational HSMS designed for the mining industry—incorporates 'leadership development' administrative practices such as: identification and communication of desired leadership competencies; the use of 360 degree feedback systems for leadership development purposes; and personal development plans for leaders.

3.2. Organizational values

In addition to workgroup leadership, organizational values, an aspect of anthropologic safety culture (Edwards et al., 2013), are an important source of information that workers use to make sense of the enacted HSMS polices, practices, and procedures. Values at work have been defined as evaluative standards relating to work or the work environment by which individuals discern what is right/wrong and the importance of competing preferences when making decisions (Finegan, 2000). Health and safety academic research suggests, for example, the organizational values related to organizational loyalty, open communication, trust, high quality social relationships, learning, continuous improvement, safe work, work demands, job control/autonomy, and how to handle safety incidents are critical for safety performance success (Edwards et al., 2013; Hale et al., 2010; Colley et al., 2013; Zammuto et al., 2000).

As implied in the model (reflected by the one-headed arrow from organizational values to worker perceptions and interpretations of the HSMS) and consistent with previous research, a direct, independent influence of organizational values on worker perceptions and interpretations of the HSMS is hypothesized. Zohar and Tenne-Gazit (2008) suggest that individuals engage in active

communication with other organizational members in an attempt to arrive at some mutual understanding and interpretation of the organizational context. They further suggest that, as uncertainty increases, individuals may seek to model the construed values and perceptions of others in a way that aligns with their self-interpretations.

Also, as implied in the model, values that exist within the organization can change (albeit slowly) through the influence of the organizational leaders. The extent to which organizational leaders can influence these values depends on their degree of contact, communication, and visibility within the organization (thus, the arrow that reflects the influence of top organizational managers on organizational values is dashed). Further, shared organizational values can change over time via the consistently implemented, and eventually institutionalized, practices and policies within the HSMS (reflected by the one-headed arrow from HSMS implementation to organizational values). Consistently implemented HSMS practices and policies over time can bridge weak ties, foster H&S cooperation, create formal and informal opportunities for H&S communication and trust building between coworkers, and enhance norms around organizational learning thereby having a direct influence on the values that exist within the organization (Evans and Davis, 2005). Finally, given that workgroup leadership has direct and frequent interactions with workers, workgroup leaders are most likely to influence and be influenced by the organizational values (reflected by the two-headed arrow between workgroup leadership and organizational values).

3.3. Worker perceptions and interpretations of an HSMS

The place of worker perceptions and interpretations of the HSMS as the proximal antecedent of HSMS implementation is consistent with the Neal and Griffin (2002) model of safety performance in which they theorized that safety climate precedes safety behaviors. Thus, individual or aggregated worker perceptions and interpretations of the HSMS may be considered to be an indicator of the effectiveness of the set of strategic organizational HSMS policies, practices, and procedures chosen.

As an indicator of HSMS effectiveness (and from an empirical research perspective), worker perceptions of an HSMS can be used in numerous ways. Perceptions of HSMS can be left at the worker level and analyzed for practical or empirical purposes. When aggregation of the individually measured perceptions is desired, the degree of variance among worker perceptions within a group is an important consideration. Low variance among a distribution of perceptual ratings[2] can be used to justify aggregation of the individually measured perceptions of an HSMS to a workgroup or organizational level as an emergent construct (most often operationalized as a component within a safety culture model or as safety climate). Multilevel theory suggests these emergent models can be categorized as consensus and referent shift composition models of emergence[3] (Chen et al., 2004; Kozlowski and Klein, 2000; Klein and Kozlowski, 2000). When the conditions of agreement and reliability for the group of worker's HSMS perceptions have been satisfied, the average perceptual score is then a meaningful representation of the group and can be subsequently used as an indicator

of HSMS effectiveness for management review purposes and/or in empirical research models.

In addition to the preceding approach to aggregation, there is growing interest in using the dispersion among perceptions of HSMS as an important indicator of HSMS effectiveness. This is accomplished through the use of, for example, the standard deviation of the perceptions of HSMS rather than the average. The degree of dispersion among individual perceptions of organizational safety policies, practices, procedures, and goals is commonly referred to as the 'strength' of HSMS perceptions (sometimes operationalized as 'safety climate strength').

Theories of perceptual strength are grounded in Mischel (1973) distinction between strong and weak contexts. Mischel (1973) argues that contexts are powerful to the extent that they: (1) lead all individuals within the group to construe the particular context in the same way; (2) induce uniform expectancies regarding the most appropriate response pattern; and (3) instill the skills necessary for satisfactory construction and execution. Mischel (1973) goes on to argue that individuals have increasing control over personal responses when a given context is weak and unstructured (i.e., where situational variables are unstructured, any personal response is equally likely and variance of individual differences will be greatest). Conversely, when situational variables are strong and structured, a limited number of reinforced responses are appropriate and variability between personal responses will be minimized. Theory and research within the strategic management and organizational behavior disciplines suggest that the perceptual strength may be a fundamentally important indicator of management systems effectiveness and an important contingency within the management system-organizational performance link (Bowen and Ostroff, 2004).

The notion of strength within perceptions of HSMS suggests that there is a distinction between groups of individuals that all share similar interpretations of the organization's H&S policies, practices, procedures, goals, and behavioral expectations (e.g., a strong safety climate) and groups of individuals who do not share similar interpretations (e.g., a weak safety climate). As strength increases, the heterogeneity in individual responses can be used to form the basis of hypotheses related to individual and collective outcomes. For example, strong perceptions of the HSMS within a group that has a high 'level' (or average score) should hypothetically lead to uniform safety behaviors and increased group safety performance. Because HSMS are designed to mitigate all risk an organization is exposed to (including both human and hardware factors), perceptions of the HSMS serve as one of the many metrics that can be used by H&S executives and top-managers to determine how effective the HSMS is performing.

4. Conclusion and suggestions for future research

Throughout this manuscript, a detailed discussion of the application of multilevel and strategic management theory and methods to relevant issues within occupational H&S theory and research was presented—the primary goal being to provide an operational definition of a strategic HSMS and to discuss the sources of measurement error and construct validation issues relevant to HSMS for research purposes. Because both measurement error and construct validity are critical components to the validity of inferences made for any empirical study, the methodological processes advocated within the multilevel framework arguably provide the prospect for more accurate empirical estimates of effect. Thus, based on the findings and recommendations of Robson et al. (2007) this article may serve to bring the H&S academic community one step closer to a homogeneous approach to empirical measurement of an HSMS and provide insight to the

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[2] As demonstrated through satisfactory levels of within group agreement and reliability using statistical indexes such as the r_{WG}, a_{WG}, AD_M, AD_{md}, and intraclass correlations-ICC(1) and ICC(2). For a complete review of these measures and their suggested cutoff values see LeBreton and Senter (2008).

[3] Where the difference between consensus and referent shift models is reflected in the reference for the items used to capture worker perceptions. Consensus models are evaluated at the individual level using measurement items that refer to the individual in question (e.g., 'Safety is my priority at work'). Referent shift models shift the referent to the collective level prior to measurement (e.g., 'Safety is a priority in my work group').

potential measurement biases and limitations to the approach chosen. Through the operational definition, and by distinguishing between the strategic and implementation aspects of an HSMS, contingencies important to the success of the overall system were also discussed. The potential benefits of these arguments, and the corresponding conceptual model presented, include stronger H&S theory development opportunities and a broader range of hypotheses that can be generated.

The conceptual model enables research questions to be developed regarding which aspects of the strategic HSMS may be important to its success and worthy of future theoretical development and empirical investigation. The conceptual HSMS model presented suggests that the strategically designed organizational HSMS must pass through several 'barriers' prior to its implementation. Therefore, characteristics related to the content and communication of it can be important determinants of its success. Based on a review of the broader strategic management literature (Bowen and Ostroff, 2004; Delery and Shaw, 2001; Way, 2002), the potential effectiveness of an HSMS may depend on: (1) the consistency among the strategically developed practices; (2) the representativeness and relevance of the practices to the actual workplace risk; and (3) the visibility and understandability of the organizational HSMS.

Advancement of the conceptual HSMS model and empirical attempts to answer the future research questions noted above are encouraged. Obtaining answers to these important research questions not only requires that the content of the HSMS be accurately assessed, but it also requires that creative and innovative research designs be utilized. Appropriate research designs include well thought out quantitative and/or qualitative, cross sectional or longitudinal, field observations within or across organizational units (e.g., Arocena and Nunez, 2010; Hale et al., 2010; Vinodkumar and Bhasi, 2010; Yorio and Wachter, 2014) as well as innovative field experiments where interventions can be manipulated across experimental and control units (Grant and Hofmann, 2011; Zohar, 2002b; Zohar and Polachek, 2014). It is hoped, through this fundamental effort to better understand an organizational HSMS as an independent construct within the H&S discipline, we will begin to more fully understand the important role it can serve in injury and illness prevention.

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References

Arboleda, A., Morrow, P.C., Crum, M.R., Shelley, M.C., 2003. Management practices as antecedents of safety culture within the trucking industry: similarities and differences by hierarchical level. J. Safety Res. 34, 189–197.

Arocena, P., Nunez, I., 2010. An empirical analysis of the effectiveness of occupational health and safety management systems in SMEs. Int. Small Bus. J. 28, 398–419.

Bagozzi, R.P., Yi, Y., Phillips, L.W., 1991. Assessing construct validity in organizational research. Admin. Sci. Quart. 36 (3), 421–458.

Becker, B.E., Huselid, M.A., 2006. Strategic human resources management: where do we go from here? J. Manage. 32 (6), 898–925.

Bliese, P.D., Jex, S.M., 2002. Incorporating a multilevel perspective into occupational stress research: theoretical, methodological, and practical implications. J. Occup. Health Psych. 7 (3), 265–276.

Bowen, D.E., Ostroff, C., 2004. Understanding HRM-Firm performance linkages: the role of the 'strength' of the HRM system. Acad. Manag. Rev. 29 (2), 203–221.

Chen, G., Mathieu, J.E., Bliese, P.D., 2004. A framework for conducting multilevel construct validation. In: Dansereau, F.J., Yamarino, F. (Eds.), Research in Multilevel Issues: Multilevel Issues in Organizational Behavior and Processes, vol. 3. Elsevier, Oxford UK, pp. 273–303.

Christian, M.S., Bradley, J.C., Wallace, J.C., Burke, M.J., 2009. Workplace safety: a meta-analysis of the roles of person and situation factors. J. Appl. Psych. 94 (5), 1103.

Colley, S.K., Lincolne, J., Neal, A., 2013. An examination of the relationship amongst profiles of perceived organizational values, safety climate and safety outcomes. Saf. Sci. 51, 69–76.

Cooper, M.D., 2000. Towards a model of safety culture. Safety Sci. 36, 111–136.

Dejoy, D.M., Schaffer, B.S., Wilson, M.G., Vandenberg, R.J., Butts, M.M., 2004. Creating safer workplaces: assessing the determinants and role of safety climate. J. Safety Res. 35, 81–90.

Delery, J.E., Shaw, J.D., 2001. The strategic management of people in work organizations: Review, synthesis, and extension. In: Ferris, G.R. (Ed.), Research in Personnel and Human Resources Management, vol. 20. JAI, Greenwich, CT, pp. 165–197.

Denison, D., 1996. What is the difference between organizational culture and organizational climate? A native's point of view on a decade of paradigm wars. Acad. Manag. Rev. 21 (3), 619–654.

Edwards, J.R.D., Davey, J., Armstrong, K., 2013. Returning to the roots of culture: a review and re-conceptualization of safety culture. Safety Sci. 55, 70–80.

Evans, W.R., Davis, W.D., 2005. High-performance work systems and organizational performance: the mediating role of internal social structure. J. Manage. 31, 758–775.

Fang, D., Wu, H., 2013. Development of a safety culture interaction (SCI) model for construction projects. Safety Sci. 57, 138–149.

Fernandez-Muniz, B., Montes-Peon, J.M., Vazquez-Ordas, C.J., 2009. Relation between occupational safety management and firm performance. Safety Sci. 47 (7), 980–991.

Finegan, J.E., 2000. The impact of person and organizational values on organizational commitment. J. Occupat. Org. Psychol. 73, 149–169.

Frazier, C.B., Ludwig, T.D., Whitaker, B., Roberts, D.S., 2013. A hierarchical factor analysis of a safety culture survey. J. Safety Res. 45, 15–28.

Gerhart, B., Wright, P.M., McMahan, G.C., Snell, S.A., 2000. Measurement error in research on human resources and firm performance: how much error is there and how does it influence effect size estimates? Personnel. Psych. 53 (4), 803–834.

Gonalez-Roma, V., Peiro, J.M., Tordera, N., 2002. An examination of the antecedents and moderator influences of climate strength. J. Appl. Psych. 87 (3), 465–473.

Graen, G.B., Uhl-Bien, M., 1995. Relationship-based approach to leadership: development of LMX theory of leadership over 25 years. Leadersh. Quart. 6, 219–247.

Grant, A., Hofmann, D.A., 2011. It's not all about me: motivating hand hygiene among health care professionals by focusing on patients. Psych. Sci. 22 (12), 1494–1499.

Guldenmund, F.W., 2007. The use of questionnaires in safety culture research – an evaluation. Safety Sci. 45, 723–743.

Guldenmund, F.W., 2010. (Mis)understanding safety culture and its relationship to safety management. Risk Anal. 30 (1), 1466–1480.

Hale, A.R., Guldenmund, F.W., Van Loenhout, P.L.C.H., Oh, J.I.H., 2010. Evaluating safety management and culture interventions to improve safety: Effective intervention strategies. Saf. Sci. 48 (8), 1026–1035.

Hitt, M.A., Beamish, P.W., Jackson, S.E., Mathieu, J.E., 2007. Building theoretical and empirical bridges across levels: multilevel research in management. Acad. Manag. J. 50 (6), 1385–1399.

Hofmann, D.A., Morgeson, F.P., 1999. Safety-related behavior as social exchange: the role of perceived organizational support and leader-member exchange. J. Appl. Psych. 84, 286–296.

Hoyt, W.T., 2000. Rater bias in psychological research: when is it a problem and what can we do about it? Psych. Meth. 5 (1), 64–86.

Huselid, M.A., Becker, B.E., 2000. Comment on "Measurment error in research on human resources and firm performance: how much error is there and how does it influence effectsize estimates?" by Gerhart, Wright, McMahan, and Snell. Pers. Psych. 53 (4), 835–854.

Johns, G., 2006. The essential impact of context on organizational behavior. Acad. Manag. Rev. 31 (2), 386–408.

Judge, T.A., Bono, J.E., 2000. Five-factor model of personality and transformational leadership. J. Appl. Psych. 85 (5), 751–765.

Klein, K.J., Kozlowski, S.W.J., 2000. From micro to meso: critical steps in conceptualizing and conducting multilevel research. Org. Res. Meth. 3, 211–235.

Klein, K.J., Dansereau, F., Hall, R.J., 1994. Levels issues in theory and development, data collection, and analysis. Acad. Manag. Rev. 19 (2), 195–229.

Kozlowski, S.W.J., Klein, K.J., 2000. A multilevel approach to theory and research in organizations. In: Klein, K.J., Kozlowski, S.W.J. (Eds.), Multilevel Theory, Research and Methods in Organizations. Jossey-Bass, San Francisco, pp. 3–90.

LeBreton, J.M., Senter, J.L., 2008. Answers to 20 questions about interrater reliability and interrater agreement. Org. Res. Meth. 11 (4), 815–852.

MacDonald, N., Corrigan, S., Daly, C., Cromie, S., 2000. Safety management systems and safety culture in aircraft maintenance organizations. Saf. Sci., 151–176.

Makin, A.M., Winder, C., 2008. A new conceptual framework to improve the application of occupational health and safety management systems. Safety Sci. 46, 935–948.

Mearns, K.J., Flin, R., 1999. Assessing the state of organizational safety – culture or climate? Curr. Psychol.: Dev. Learn. Personal. Soc. 18 (1), 5–17.

Mearns, K., Whitaker, S.M., Flin, R., 2003. Safety climate, safety management practice and safety performance in offshore environments. Saf. Sci., 641–680.

Mischel, W., 1973. Toward a cognitive social learning reconceptualization of personality. Psych. Rev. 80, 252–283.

Naumann, S.E., Bennett, N., 2000. A case for procedural justice climate: development and test of a multi-level model. Acad. Manage J. 43 (5), 881–889.

Neal, A., Griffin, M.A., 2002. Safety climate and safety behaviour. Aust. J. Manage. 27 (Suppl. 1), 67–75.

Podsakoff, P.M., MacKenzie, S.B., Lee, J.Y., 2003. Common method biases in behavioral research: a critical review of the literature and recommended remedies. J. Appl. Psych. 8 (5), 879–903.

Reiman, T., Rollenhagen, C., 2014. Does the concept of safety culture help or hinder systems thinking? Accid. Anal. and Prev. 68, 5–15.

Robson, L.S., Clarke, J.A., Cullen, K., Bielecky, A., Severin, C., Bigelow, P.L., Irvin, E., Culyer, A., Mahood, Q., 2007. The effectiveness of occupational HSMS interventions: a systematic review. Saf. Sci. 45, 329–353.

Rousseau, D.M., 1985. Issues of level in organizational research: multi-level and cross-level perspectives. In: Cummings, L.L., Staw, B.M. (Eds.), Research in Organizational Behavior 7. JAI Press, Greenwich, CT, pp. 1–37.

Schneider, B., 2006. The people make the place. Pers. Psychol. 40 (3), 437–453.

Vinodkumar, M.N., Bhasi, M., 2010. Safety management practices and safety behavior: assessing the mediating role of safety knowledge and motivation. Accid. Anal. Prev. 42, 2082–2093.

Way, S., 2002. High performance work systems and intermediate indicators of firm performance within the US small business sector. J. Manage. 28, 765–785.

Wright, P.M., Gardner, T.M., Moynihan, L.M., Park, H.J., Gerhart, B., Delery, J., 2000. Measurement error in research on human resources and firm performance: additional data and suggestions for future research. Center for Advanced Human Resource Studies, Cornell University, Working Paper Series. Working Paper 00-21.

Yorio, P.L., Wachter, J., 2014. The impact of human performance focused safety and health practices on injury and illness rates: do size and industry matter? Safety Sci. 62, 157–167.

Zacharatos, A., Barling, J., Iverson, R.D., 2005. High-performance work systems and occupational safety. J. Appl. Psych. 90 (1), 77–93.

Zammuto, Raymond F., Gifford, Blair, Goodman, Eric A., 2000. Managerial ideologies, organization culture and the outcomes of innovation: a competing values perspective. In: Ashkanasy, Neal M., Wilderom, Celeste, Peterson, Mark F. (Eds.), The handbook of organizational culture and climate. Sage Publications, Thousand Oaks, CA, pp. 263–280.

Zohar, D., 2002a. The effects of leadership dimensions, safety climate, and assigned priorities on minor injuries in work groups. J. Org. Behav. 23 (1), 75–92.

Zohar, D., 2002b. Modifying supervisory practices to improve subunit safety: a leadership-based intervention model. J. Appl. Psych. 87 (1), 156–163.

Zohar, D., 2008. Safety climate and beyond: a multi-level multi-climate framework. Safety Sci. 46, 376–387.

Zohar, D., Luria, G., 2005. A multilevel model of safety climate: cross-level relationships between organizational and group-level climates. J. Appl. Psych. 90 (4), 616–628.

Zohar, D., Polachek, T., 2014. Discourse-based intervention for modifying supervisory communication as leverage for safety climate and performance improvement: a randomized field study. J. Appl. Psych. 99 (1), 113–124.

Zohar, D., Tenne-Gazit, O., 2008. Transformational leadership and group interaction as climate antecedents: a social network analysis. J. Appl. Psych. 93 (4), 744–757.