High-Performance Work Systems and Occupational Safety

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Two studies were conducted investigating the relationship between high-performance work systems (HPWS) and occupational safety. In Study 1, data were obtained from company human resource and safety directors across 138 organizations. LISREL VIII results showed that an HPWS was positively related to occupational safety at the organizational level. Study 2 used data from 189 front-line employees in 2 organizations. Trust in management and perceived safety climate were found to mediate the relationship between an HPWS and safety performance measured in terms of personal-safety orientation (i.e., safety knowledge, safety motivation, safety compliance, and safety initiative) and safety incidents (i.e., injuries requiring first aid and near misses). These 2 studies provide confirmation of the important role organizational factors play in ensuring worker safety.

Most workers in developed countries assume their organizations will take all necessary measures to ensure that they return home safely at the end of the work day, yet work-related injuries and deaths continue to occur at an alarming rate. In the United States, there were 6,026 fatal work injuries and approximately 3.8 million nonfatal injuries in 1998, resulting in an estimated 80 million production days lost for that year and almost 60 million days in future years (Bureau of Labor Statistics, 2000; United States Census Bureau, 2000). In 1999, there were 833 work-related fatalities in Canada, while 379,395 Canadian workers suffered injuries serious enough to be compensated either for wages lost due to time off from work or a permanent disability (Association of Workers' Compensation Boards of Canada, 2000). These data illustrate the enormous cost of occupational injuries and fatalities for organizations in terms of production and for lives altered and lost by these work-related events.

Traditionally, the most frequent method for managing occupational safety has been by taking a control-oriented approach to human resources (Barling & Hutchinson, 2000), one that assumes workers are motivated to exert only as much effort as is necessary for task completion. As such, it is management's responsibility to use its legitimate authority to control employee behavior (Walton, 1985). In terms of occupational safety, the control-oriented approach emphasizes the use of rules to enforce behaviors and the use of punishment to increase rule compliance (Barling & Hutchinson, 2000).

There has been a growing realization that human resources are better managed by high-commitment- (e.g., Walton, 1985) or high-involvement- (e.g., Lawler, 1996) oriented strategies. Wood (1999) noted that these approaches reflect a rejection of the traditional Taylorist model and a heightened focus on job-design theory. Rather than relying on compliance by means of rules, regulations, and monitoring to decrease costs and increase efficiency, high-commitment management creates conditions that encourage employees to identify with the goals of the organization and to exert effort to achieve them (Whitener, 2001). Similarly, high-involvement management concentrates on empowering employees through increased information flows and devolution of decision making power, leading to greater productivity. More recently, the term *high-performance work systems* has been used to characterize these transformed workplaces. Although high-performance work systems encompass the high-commitment and involvement elements, they are also broader in scope by emphasizing the competitive advantage gained by such human resource practices.[1] Way (2002) and Wood and Wall (2002) conceptualized high-performance work systems as a group of separate but interconnected human resource practices that together recruit, select, develop, motivate, and retain employees. Way (2002) suggested that this is achieved by ensuring that employees possess a broad range of superior skills and abilities that are used at work, which ensure that their organizations achieve "superior intermediate indicators of firm performance (i.e., those indicators over which the workforce has direct control) and sustainable competitive advantage" (p. 765).

High-performance work systems assume employees are a primary source of competitive advantage that is difficult for others to imitate and that workers are capable of continuous improvement and will perform at higher levels if they are motivated to do so (Pfeffer, 1998a). This is achieved by encouraging practices such as participative decision making, providing high-quality training, and sharing information. By treating workers with respect and as capable and intelligent individuals, organizations will find that

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[1] Wood, de Menezes, and Lasaosa (2003) noted that researchers continue to use these three forms of management interchangeably.

workers will be more committed to the organization and more trusting of management, which will result in improved performance (Walton, 1985; Wheatley, 1997). Whitener (2001) proposed a social-exchange framework to explain this relationship. Employees view human resource practices and trustworthiness of management as indicative of the organization's commitment to them. In turn, employees reciprocate with appropriate attitudes and behaviors. In the present study, we expected to find greater safety behavior.

Numerous studies now provide empirical support for the superiority of high-performance work systems for employee and organization-level performance (e.g., J. B. Arthur, 1992, 1994; Huselid, 1995; Ichniowski, Shaw, & Prennushi, 1997; MacDuffie, 1995; Patterson, West, & Wall, 2004; Way, 2002). In a study of 30 minimills, J. B. Arthur (1994) found that performance quantity (in terms of labor hours) and performance quality (as measured by scrap rates, turnover rates) were significantly better in minimills operating under a commitment-oriented system than in minimills managed in a control-oriented fashion. Huselid (1995) examined 958 publicly traded companies and reported that high-performance work systems were associated with significantly lower turnover rates, greater employee productivity in terms of sales per employee, and both market-based and accounting-based measures of corporate performance. Similarly, Ichniowski et al. (1997) found that steel output was greater when organizations had in place practices such as incentive pay, flexible job design, elaborate screening of new employees, employment security, problem-solving teams, and off-the-job training. Employees of organizations with more traditional approaches to human resource management produced less than their peers.

We argue that high-performance work systems can be applied to improving workplace safety just as well as firm economic performance. This assertion follows the argument often found in the literature that safety should be considered a performance variable much like production, profits, sales, quality control, or customer complaints (Griffiths, 1985; Kivimäki, Kalimo, & Salminen, 1995). Pfeffer (1998b) stated that it is important for organizations to measure indicators that are important to their particular business and that successful companies often have performance standards that are unique and go beyond typical financial reporting measures. We extend current research and predict that high-performance work systems will also influence occupational safety, and we hypothesize specifically that a high-performance work system will improve workplace safety by increasing employee trust in management and perceived safety climate.

Although there is some debate regarding the number of human resource practices that constitute a high-performance work system, it is generally agreed that they should be multiple and mutually reinforcing (Cappelli & Neumark, 2001; Huselid, 1995; Wood & Wall, 2001). Becker and Huselid (1998) concluded that it is theoretically appropriate to consider a high-performance work system as a single system and that "the overwhelming preference in the literature has been for a unitary index that contains a set (though not always the same set) of theoretically appropriate HRM [human resource management] practices derived from prior work" (p. 63). Therefore, our aim is to develop a system of high-performance work practices, not to replicate and test other high-performance work systems. In addition, although it is beyond the scope of this article to discuss the universalistic, contingency, and con-

figurational approaches of high-performance work systems (see Becker & Huselid, 1998, for a comprehensive review), on the basis of Pfeffer's (1998a) framework, we propose a set of 10 practices that have been theoretically and empirically associated with occupational safety. These include Pfeffer's (1998a) seven factors (employment security, selective hiring, extensive training, teams and decentralized decision making, reduced status distinctions, information sharing, and contingent compensation), as well as three additional practices that we deem to be equally important (transformational leadership, high-quality work, and measurement of management practices) in predicting occupational safety (Barling, Kelloway, & Iverson, 2003; Barling, Loughlin, & Kelloway, 2002). We now describe these practices individually, following which we consider how they together compose a high-performance work system.

Employment Security

Employment security refers to the extent to which an organization provides stable employment for employees. One of the most basic ways in which organizations can improve their performance is by ensuring employment security (Pfeffer, 1998a). Employment security encourages a long-term perspective and represents an investment of time and resources in employees, which would be reciprocated in terms of loyalty to the organization (Tsui, Pearce, Porter, & Tripoli, 1997). Trust in management will also result from employment security, which is desirable to the extent that trust in management is associated with organizational performance (McAllister, 1995).

Empirical data also support a link between employment security and occupational safety. Employment security differentiated high-accident-rate companies from low-accident-rate companies (Smith, Cohen, Cohen, & Cleveland, 1978; Zohar, 1980), and feelings of greater job insecurity were positively associated with the actual number of injuries and days of work missed because of an injury (Grunberg, Moore, & Greenberg, 1996). Likewise, cross-sectional and longitudinal data showed that job insecurity was related to lower safety motivation and safety compliance and greater numbers of workplace injuries in a sample of food-processing-plant employees (Probst & Brubaker, 2001).

Selective Hiring

Selective hiring focuses on the fit between employees and their work environment. This would suggest that employees who have a poor fit or who are mismatched with their environment display a greater propensity to be injured (Iverson & Erwin, 1997). The way in which hiring is used to achieve occupational safety is usually consistent with a control orientation, with its reliance on the "selective exclusion" of high-risk employees. Typically, personality questionnaires are used to prescreen potential employees on the basis of current or former drug addiction or alcoholism, emotional maturity, and trustworthiness (e.g., Borofsky, Bielema, & Hoffman, 1993; Jones, 1991). Consistent with a control orientation, this approach rests on the assumption that work-related injuries are primarily the fault of employees. Furthermore, causal inference from some of these studies is compromised by statistical and methodological issues such as the use of cross-sectional data and the absence of true control groups.

Organizations committed to occupational safety will attend closely to how they hire new personnel and will incorporate the value of occupational safety into their employee-selection processes to achieve a better fit. Trust in management will also be enhanced because of employees' perceiving the organization as valuing and caring about them (Eisenberger, Fasolo, & Davis-LaMastro, 1990). Involving teams in selecting future members could indirectly serve to improve safety levels and requiring applicants to go through several rounds of interviews in which the organization's values are conveyed might also enhance occupational safety. Although research examining the relationship between selection practices and occupational safety is sparse, both Cohen (1977) and Smith et al. (1978) found that lower injury rate companies had more elaborate selection procedures than organizations with higher injury rates.

Extensive Training

Occupational safety training is likely the most researched issue and practiced technique in safety management, and employees who receive safety training suffer fewer work-related injuries than their untrained counterparts (Colligan & Cohen, 2003). As noted by Barling et al. (2003), training allows employees to acquire greater competencies to control their work, leading to them performing their jobs more safely. This view is consistent with Osterman (1995), who argued from a human-capital perspective that training increases the problem-solving skills of employees. Training also exerts indirect effects on safety, as illustrated by a study of naval trainees that found that the extent to which training was perceived to have met trainees' initial expectations, how satisfied trainees were with the training, and the learning of academic content all predicted subsequent organizational commitment (Tannenbaum, Mathieu, Salas, & Cannon-Bowers, 1991). These results are important because organizational commitment predicts work performance in general (Meyer & Allen, 1997) and safe working in particular (S. K. Parker, Axtell, & Turner, 2001). To be maximally effective, training must extend beyond the mere provision of knowledge related to how to do one's job safely. Employees must also be empowered to use new skills following training (S. K. Parker, Wall, & Jackson, 1997).

Self-Managed Teams and Decentralized Decision Making

There are several reasons why teamwork and decentralized decision making should benefit employee performance and safety performance. First, teamwork and decentralized decision making foster familiarity and demand greater cohesion. Simard and Marchand's (1997) study of 97 manufacturing plants showed that the quality of supervisor–employee relationships, as well as cohesion with the work group, were the best predictors of the propensity to comply with safety rules. Goodman and Garber's (1988) study of safety in underground coal mining found that as the familiarity between members of a working dyad decreased, safety infractions increased. Similarly, employees working in autonomous teams in a mine experienced fewer accidents than did employees who worked individually (Trist, Susman, & Brown, 1977).

Working in teams should also promote safety because it causes individuals to feel more responsible for their own and each others' safety. Geller, Roberts, and Gilmore (1996) found that sense of belongingness to a group and personal control predicted workers' propensity to actively care for coworker safety. Tjosvold (1990) showed that with more cooperative goals, all members of a flight crew felt responsible for safety and handled critical incidences more effectively. Teamwork and decentralized decision making should also enhance occupational safety because it provides those people who are more familiar with the situation greater opportunities for control. Indeed, the safest teams in a chemical plant were those with the most control over varied aspects of their work (Hechanova-Alampay & Beehr, 2001), and manufacturing teams with greater authority over their work experienced fewer work-related injuries (Kaminski, 2001).

Last, teams will enhance occupational safety when they promote the sharing of ideas that result in better solutions. Members of a flight crew performed more effectively as a group in dangerous situations than as a hierarchy with the captain at the top of the chain of command, presumably because team members were motivated to contribute their ideas by the belief that they must work together in achieving their goals (Tjosvold, 1990). Similar results emerged when miners working in autonomous work groups attributed their improved safety performance to their common goals, increased communication between members, and increased sharing of ideas (Trist et al., 1977).

Reduced Status Distinctions

Status distinctions in organizations are ubiquitous, create unwanted barriers between people that breed resentment, and harm motivation and performance (Pfeffer, 1998a). Status distinctions also have the negative effect of reducing the familiarity between top management and shop floor employees. DeJoy (1994) argued that in the case of occupational-safety management, in which placing blame for events is so inherent, there is a tendency for conclusions about injury causation to be biased. In line with attribution theory, it is perceived to be in top management's best interest to blame front-line workers for safety infractions. In contrast, workers may be inclined to hold management responsible for workplace injuries. DeJoy (1994) suggested that one of the ways of confronting this is to reduce the distances between employers and employees through increased exposure to each other. Essentially, when managers and employees see these status barriers being dismantled, they are more likely to see their own safety as being dependent one on the other and to feel an increased responsibility for joint safety.

To study the effects of status distinctions, Milanovich, Driskell, Stout, and Salas (1998) asked 30 recently qualified military aviators to rate their expectations for two aviators. Although each was described identically in terms of age, experience, mental status, and health, one was described as a pilot, the other as a copilot. The researchers showed that this status difference was critical. The participants in their study held higher general and specific expectations for pilots than copilots. A study of injured construction employees illustrates another aspect of status distinctions. Gillen, Baltz, Gassel, Kirch, and Vaccaro (2002) observed that union employees were more likely to perceive their supervisors as caring about their safety compared with nonunion employees. In a high-performance work system, each employee from the shop floor to top management should feel that they can contribute to diverse

aspects of the organization, and, therefore, we argue that reduced status distinctions are critical for occupational safety.

Information Sharing

Just as information sharing across organizational levels is critical for high performance in general, we argue that it is equally critical for optimal safety performance. Indeed, it would not be possible to work safely without full information about all aspects of one's job, and several studies support the role of information sharing in occupational safety. Organizations with better safety programs (Zohar, 1980) and safety records (Cohen, 1977; Smith et al., 1978) were characterized by more open discussion between management and employees. Similarly, when employees felt comfortable discussing safety-related issues with their supervisors, they were more highly committed to following safety procedures and practices, which resulted in the lower occurrence of workplace injuries (Hofmann & Morgeson, 1999).

There are also secondary benefits of information sharing for occupational safety. Where managers do share information, employees will have greater trust in management. Clarke (1999) found that both management and employees underestimated how important safety was to the other group and argued that with greater information sharing, employees would appreciate those instances when management took safety seriously and, in turn, would show more trust in management.

Compensation Contingent on Safe Performance

Well-paid employees feel valued by the organization, and by explicitly choosing which behaviors are to be rewarded, organizations signal unambiguously which behaviors are valued. Arguably, if safety is considered a key performance indicator by an organization, employees should be rewarded for their efforts to improve safety.

There are data showing that paying people contingent on their safety performance (e.g., through token reinforcement) is effective in reducing occupational injuries (e.g., Haynes, Pine, & Fitch, 1982). Nonetheless, several problems emerge with this approach: Its long-term effects are not fully understood, and the behaviors under consideration are typically highly specific, limiting the possibilities that what is learned will generalize across situations (McAfee & Winn, 1989). Furthermore, there is widespread concern that such approaches rely on managerial control (Walker, 1998).

More consistent with Pfeffer's (1998a) proposition is the idea that (a) employees are compensated for safety performance at the group level and (b) compensation be provided for behaviors that extend beyond an individual's personal safety. Fox, Hopkins, and Anger (1987) found support for this notion by studying employees from an open-pit mine. Employees were given tokens redeemable for goods at the end of the month if neither themselves nor a member of their workgroup had been involved in a safety-related incident in the preceding month. Tokens were also provided for making suggestions to improve safety and for taking unusual actions to prevent an injury or an accident. The number of days lost from work because of injuries, the number of lost-time injuries, and the costs of accidents and injuries were substantially reduced. Moreover, these remained lower over several years.

Transformational Leadership

There are several reasons why transformational leadership would be an appropriate leadership model for enhancing occupational safety and why it should be considered integral to a high-performance work system. First, the effectiveness of transformational leadership is supported in a number of contexts (Bass, 1998). Second, each of the four transformational-leadership factors lend themselves to the task of enhancing safety performance.

1. Leaders high in idealized influence would convey the value of safety through their personal behaviors.

2. Those high in inspirational motivation would convince their followers that they could attain levels of safety not previously considered possible.

3. Intellectually stimulating leaders help followers think about safety and develop new ways to achieve high safety levels.

4. Individualized consideration would be evident through leaders' real concern about their followers' safety at work (Barling et al., 2002).

Third, research shows that transformational leadership can be taught to managers (Barling, Weber, & Kelloway, 1996). Last, it is the organizational leader who chooses the nature of the system to be implemented who helps to ensure successful implementation (Pfeffer, 1998a) and who helps to choose the outcomes that the organization values. As most organizations do not make use of systems of high-performance work practices (Ichniowski, Kochan, Levine, Olson, & Strauss, 1996), doing so means going against the tide, a task requiring strong leadership.

There are empirical data to support the link between transformational leadership and occupational safety. Transformational leadership is (a) positively associated with safety initiative (O'Dea & Flin, 2000) and the priority assigned to safety (Zohar, 2002), (b) negatively associated with minor injury rate (Zohar, 2002) and microaccidents (Zohar, 2000), and (c) indirectly associated with injuries (Barling et al., 2002). Collectively, these studies support the idea that transformational leadership plays an important role in occupational safety.

High-Quality Work

It would avail little to implement a high-performance work system if employees were left with boring, meaningless work. As such, we argue that high-quality work should be a critical component of a high-performance system. Overall, a well-designed job will ensure that employees are engaged intellectually and emotionally. Although there are numerous conceptualizations of job quality (Hackman & Oldham, 1980; Karasek, 1979; S. K. Parker & Wall, 1998; Warr, 1987) and dimensions of job quality (i.e., task significance, feedback, skill use), we emphasize appropriate workload, role clarity, and employee control (e.g., Barling et al., 2003).

The idea that work overload might be linked to occupational safety is not new. Safety infractions increase during periods of economic growth, presumably because the need for greater production to meet demand results in an increase in work pace

(Conway & Svenson, 1998). When managers feel hindered by an unusually heavy workload, safety is compromised (Baugher & Roberts, 1999; Hofmann & Stetzer, 1996). Less attention has been focused on the effect of work underload on occupational safety, yet it is important because boring tasks lead workers to seek stimulation from other sources (Fisher, 1993). Frone (1998) found that job boredom was associated with adolescents' workplace injuries, and a study of 71 transport drivers showed that attention problems predicted actual involvement in vehicular incidents (W. Arthur, Barrett, & Doverspike, 1990).

Role clarity is a further dimension of job quality that is important for occupational safety. Hemingway and Smith's (1999) study of 252 nurses employed in four different hospitals showed that nurses' role ambiguity was significantly associated with the number of injuries they experienced.

Autonomy (S. K. Parker & Wall, 1998) and job-decision latitude (Karasek & Theorell, 1990) are further elements of a high quality job and are associated consistently with work performance, positive employee attitudes, and physical and psychological well-being. Autonomy at work is also associated with enhanced safety. Job autonomy enhanced employees' commitment to the organization, which in turn affected their safety compliance with procedures (S. K. Parker et al., 2001). Simard and Marchand (1995) demonstrated that participative management predicted (a) the extent to which employees were proactively involved in their own safety (as opposed to compliance with safety regulations) and (b) two other factors that are critical for safety, namely, group cohesion and cooperation. Shannon et al. (1996) reported that lost-time accident rates were lower in workplaces in which workers participated in decision making.

Measurement of Management Practices

The safety behaviors that organizations typically measure—namely, past incidents and injuries, compliance with government regulations, and provisions of collective agreements—are consistent with and foster a control-oriented climate, which Wheatley (1997) argued, "can never spell out the route to perfect safety" (p. 25). Measuring the number of safety incidents provides little insight into near misses or injuries not requiring medical attention that may occur with greater frequency (Hemingway & Smith, 1999; Zohar, 2002) and encourages the under-reporting of safety infractions (Eisenberg & McDonald, 1988; Pransky, Snyder, Dembe, & Himmelstein, 1999). What is needed to enhance safety in the long-term is a measurement approach that focuses on the proximal causes of safety incidents. For instance, measuring management practices that increase employees' levels of trust in management and perceived safety climate would be beneficial to the extent that these factors predict subsequent safety performance.

A System of High-Performance Practices

Describing each practice separately in no way implies their independence. On the contrary, instituting one management practice logically drives the need for the application of other practices (Becker & Gerhart, 1996; Pfeffer, 1998a). For instance, organizations that are averse to providing employment security, relying more on contingent and contract workers, may see little benefit in expending scarce resources on selective hiring or extensive train-

ing and will likely be less willing to share valuable, confidential information with individuals who may subsequently work for the competition. Empirical data from the United States (Wood, 1999) and the United Kingdom (Wood & Albanese, 1995) support the interdependence of the high-performance practices. Kling's (1995) study took the analysis of high-performance systems a step further, showing that human resource management practices are more likely to yield positive effects for the firm when they are introduced as part of a coherent system, rather than as single "best practices." Dyer and Reeves (1995) also concluded that these systems "seem to be superior to any of the individual human resource activities of which they are composed" (p. 668). Accordingly, we created a unitary index for our high-performance work systems (e.g., Becker & Huselid, 1998; Guthrie, 2001; Ramsay, Scholarios, & Harley, 2000; Way, 2002).

Purpose of the Current Research

In the first study, we investigated the relationship between human resource management practices and safety performance at the organization level. The second study focused on the employee level and explored mechanisms that mediate the relationship between the high-performance work system and safety performance.

Study 1

Method

The purpose of this first study was to determine whether a relationship exists between the high-performance work system described and occupational safety at the organizational level. We hypothesized that organizations applying high-performance management practices will experience lower numbers of lost-time injuries after controlling for relevant variables. Given the conceptual overlap between each of the high-performance work practices, a further purpose of this study was to determine the underlying factor structure of the 10 human resource practices.

Participants

Surveys were sent to 1,471 manufacturing organizations that were members of the Industrial Accident Prevention Association of Ontario. Responses were received from the human resource directors of 147 organizations, 138 of whom provided surveys with usable data (response rate = 9.38%). The organizations in the final sample belonged to a wide range of industries, including chemical, automotive, and construction. The organizations had been in existence for an average of 43 years ($SD = 31.88$), with an average of 515 employees ($SD = 828.75$). Approximately 95% of the employees worked full time. The majority of workplaces had nonunionized front-line employees (57%), another 34% had unionized front-line employees, and the remaining 9% of workplaces had both unionized and nonunionized front-line employees. The human resource professionals who responded to the survey had been in their positions an average of 5 years ($SD = 5.32$) and with the organization an average of 8 years ($SD = 8.53$).

Materials

High-performance management practices were measured with 63 items developed for the current study (i.e., 6–7 items per practice). For 35 of the items, participants rated the extent to which they believed the practice existed in their organization (e.g., "providing employment security to our employees is a priority in this organization"; "employees in this organization are involved in the hiring of their peers"). Responses to this type of

Table 1
Descriptive Statistics and Intercorrelations Between Measures of the Ten High-Performance Management Practices in Study 1 (N = 138)

Variable	M	SD	Factor loading	1	2	3	4	5	6	7	8	9	10
1. Employment security	.05	3.08	.35	*.65*									
2. Selective hiring	.17	3.01	.64	.31**	*.57*								
3. Training	.01	3.30	.53	.23**	.35**	*.72*							
4. Teams	−.02	4.23	.91	.26**	.55**	.52**	*.81*						
5. Status distinctions	−.01	2.23	.63	.21*	.44**	.20*	.56**	*.59*					
6. Information sharing	.01	4.07	.76	.28**	.44**	.47**	.67**	.52**	*.78*				
7. Contingent compensation	−.02	2.12	.56	.28**	.42**	.29**	.52**	.41**	.46**	*.52*			
8. Transformational leadership	−.02	4.38	.75	.25**	.48**	.35**	.70**	.50**	.56**	.44**	*.83*		
9. Job quality	.01	4.05	.80	.28**	.58**	.33**	.77**	.51**	.58**	.47**	.58**	*.77*	
10. Measurement	.05	3.97	.76	.30**	.48**	.49**	.69**	.45**	.67**	.43**	.58**	.54**	*.66*

Note. Scale reliabilities can be found on the diagonal, in italics.
* $p < .05$. ** $p < .01$.

question were on a 5-point Likert scale ranging from *strongly disagree* (1) to *strongly agree* (5). For 26 of the remaining questions, respondents estimated the percentage of employees in their organization to which a statement describing a high-commitment management practice applied (e.g., "What percentage of front-line employees received training beyond that mandated by government regulations in the last 12 months?"), a format used previously in this type of research (e.g., J. B. Arthur, 1992; Becker & Huselid, 1998; Guthrie, 2001; Huselid, 1995).[2] Two further items inquired about rounds of layoffs and the number of hours of nonmandatory training received by employees in the past 12 months.

This measurement strategy maximizes several critical factors. First, to address the limitations of previous survey research on high-performance work systems (see Godard, 2001, for a review), we used a multimeasurement approach to identify both the existence and extent of each human resource practice. By focusing on these subjective and objective elements, we could better gauge the usage of each practice. Second, researchers have typically used a time frame of the past 12 months (e.g., Barling et al., 2003), as human resource managers frequently have access to such statistics from organizational records. Third, consistent with our conceptualization of high-performance work systems, we used an additive approach to create a unitary index. Becker and Huselid (1998) noted that this approach is appropriate because it suggests that (a) a unitary human resource system is a strategic asset and (b) there are many ways to increase the organization's value.

Becker and Huselid (1998) further acknowledged that one or a combination of practices that are more heavily emphasized would have the same index value as a wider range of modestly emphasized practices. Therefore, congruent with previous approaches in the literature (e.g., Guthrie, 2001), the basic aim of our research was to assess whether the greater use of a "system" of high-performance management practices would improve workplace safety.

Injury Rates

Respondents reported the number of lost-time injuries and total number of days lost due to each of eight specific types of injuries between January 1 and December 31, 2000: (a) fractures; (b) dislocations, sprains, and strains; (c) bruising and crushing; (d) superficial wounds (i.e., scratches and abrasions); (e) open wounds (i.e., cuts, lacerations, and punctures); (f) burns and scalds; (g) eye injuries; and (h) concussions and other head injuries. Respondents were also asked to report the number of fatalities that occurred in the same time period.

The reliability of the lost-time-injury data was checked by correlating responses from the 32 companies where responses were received from both human resource and safety managers ($r = .86$, $df = 31$, $p < .01$).

Results

To conduct analyses on the varied forms of responses to the items measuring high-performance management practices, we standardized all item scores (Way, 2002). Subsequently, the reliability coefficients for the subscales measuring each of the 10 high-performance management practices were calculated and those items that most negatively impacted the internal consistency of each scale were removed. That was one criterion. The other criterion was that the resulting subscale had to be consistent with our conceptualization of the construct. For each subscale, the sum of scores on each item was calculated and analyses were conducted on these summed scale scores. This allows researchers to address problems such as distribution violations and statistical power issues associated with item-level data (e.g., Comrey, 1978). Sanchez, Kraus, White, and Williams (1999) argued that, "this type of subscale aggregation is likely to provide more reliable indicators than item-level data" (p. 469). Drasgow and Kanfer (1985) have provided empirical support for the subscale aggregation approach. They reported the identical factor solution between item-level data and the corresponding summed subscale data across five hospital samples. Descriptive statistics and intercorrelations between the 10 high-performance management practices appear in Table 1.[3]

To investigate the underlying factor structure of the 10 high-performance management practices, we conducted confirmatory

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[2] This questionnaire, as well as all others used in this research, is available from the authors on request.

[3] As Cortina (1993) noted "alpha is very much a function of the number of items in a scale . . . it must be interpreted with the number of items in mind" (p. 102). Although the scales of employment security, selective hiring, status distinctions, contingent compensation, and measurement displayed alphas lower than .70, they are included in the analysis for several reasons. First, the number of items for each of the five variables was 5, 5, 3, 3, and 7, respectively. Second, factor analysis using principal components established unidimensionality of the factors. Finally, the average item intercorrelations for the five factors were respectively .27, .21, .32, .27, and .22. Accordingly, given the number of items, factor analysis, and item intercorrelations and the fact that the scales were developed by the researchers, these scales are retained in the study (Cortina, 1993).

factor analysis (CFA) using LISREL VIII (Jöreskog & Sörbom, 1992) on the summed scale scores (Sanchez et al., 1999). The hypothesized one-factor model demonstrated a significantly better fit than the null model $\Delta\chi^2(10, N = 138) = 624.59$, $p < .001$ (Bagozzi & Yi, 1988), with a goodness-of-fit index (GFI) of .93, a normed comparative fit index (CFI; Bentler, 1990) of .97, and a root-mean-square error of approximation (RMSEA; Browne & Cudeck, 1993) of .06. Examination of the parameter estimates (factor loadings) of the one-factor model were all significant ($p < .05$) and ranged from .35 to .91. Because the 10 practices consisted of a single factor, we combined all 10 subscales to construct a single index measuring the high-performance work system ($\alpha = .89$).

Descriptive statistics and intercorrelations of all variables are presented in Table 2. Because of the problems associated with the nonnormal sample distribution of total number of lost-time injuries (i.e., skewed and truncated), we censored the variable. The results of the LISREL analysis are presented in Table 3. Because of the potential power problems (i.e., Type II [β] error; Saris & Satorra, 1993) arising from our sample size, a manifest-variables model was used (L. J. Williams & Hazer, 1986). The variance–covariance matrix was used for input, where the latent-to-manifest parameter for high-performance work system was fixed to the square root of the reliability (internal consistency coefficients) and the value of one minus the reliability multiplied by high-performance work systems' variance was used to calculate residuals (Carlson & Perrewè, 1999).

In the analysis, we control for several organizational differences (subsidiary, private/public, age of organization, unionized, and the total number of employees were entered into the equation in Step 1). There is debate as to whether subsidiaries have similar or different human resource practices as their parent organizations (Martell & Carroll, 1995), whereas private and older organizations are argued to be associated with more sophisticated human resource practices (Guthrie, 2001). As unions are a key social mechanism in establishing safety minimums and standards, we would expect a negative association with lost-time injuries (Sprigener & Hodson, 1997). On the other hand, unions may enforce better reporting systems leading to the impression of higher injury rates (Kelloway, 2003). Finally, larger organizations (as measured by the total number of employees) could increase the propensity of injuries because of increased bureaucracy and poorer coordination and communication (Hopkins & Palser, 1987). However, larger firms are also more likely to be under greater scrutiny by health

and safety inspectors, leading to enhanced safety consciousness and lower injuries (Fenn & Ashby, 2004; Genn, 1993).

Of the control variables in Step 1, only subsidiary status and the total number of employees were related to lost-time injuries. The variable measuring high-performance management practices was entered into the equation in Step 2. As predicted, high-performance work systems were related to fewer lost-time injuries, accounting for a significant 8% of the variance above that of the control variables, $F(1, 131) = 15.64$, $p < .001$. A very small proportion of organizations reported occupational fatalities, as a result of which, fatalities were not analyzed further.

Discussion

In this study, three important findings emerged. First, the 10 high-performance management practices composed a single underlying construct—a high-performance work system. This supports earlier findings of other systems of high-performance practices at the organization level (Huselid & Becker, 1996; Wood, 1999; Wood & Albanese, 1995). In addition, because our measure of a high-performance work system follows the recommendations of Becker and Huselid (1998) and includes multi-item measures for each practice, the CFA conducted as part of this study should provide more meaningful results than those of previous studies. Second, the results of this study replicate earlier research showing that high-performance work practices at the organizational level are associated with employee and firm performance and go beyond these traditional outcomes by demonstrating that a high-performance work system also affects occupational safety. Third, high-performance management practices accounted for 8% of the variance in lost-time injuries measured at the organizational level, identifying a substantial predictor of safety performance.

Nevertheless, several limitations of this study need to be confronted. First, the cross-sectional nature of the data makes any inferences about causality somewhat risky. Second, the single-source nature of the data introduces the possibility of measurement error (Wright et al. 2001). Third, an organizational representative provided the data regarding the existence of human resource practices in each respective company as well as the firm's overall safety performance. Fourth, the reliability of our survey instrument would be improved by better psychometric measures of our human resource practices of employment security, selective hiring, status distinctions, contingent

Table 2

Descriptive Statistics and Intercorrelations Between Measures in Study 1 (N = 138)

Variable	M	SD	1	2	3	4	5	6	7
1. Subsidiary[a]	0.63	0.49	—						
2. Private–public[b]	1.12	0.33	−.08	—					
3. Age of organization	43.00	31.88	.01	−.14	—				
4. Unionized[c]	1.75	0.61	−.15	−.01	−.04	—			
5. No. of employees	515.54	828.75	−.12	−.10	.35**	−.03	—		
6. High-performance work system	0.22	25.14	.09	−.02	.01	.05	.07	—	
7. Total lost-time injuries	17.68	41.59	−.21	−.05	.20*	.11	.45**	−.26**	—

[a] 1 = subsidiary; 2 = not a subsidiary. [b] 1 = private; 2 = public. [c] 1 = unionized; 2 = nonunionized.
* $p < .05$. ** $p < .01$.

Table 3
Study 1: LISREL Results Predicting Total Lost-Time Injuries

	β	
Predictor variable	Step 1	Step 2
Step 1		
Subsidiary[a]	−.17*	−.14*
Private–public[b]	−.03	−.03
Age of organization	.07	.06
Unionized[c]	.10	.09
Total no. of employees	.40**	.43**
Step 2		
High-performance work system		−.28**
Total R^2	.25**	.33**
ΔR^2		.08*

Note. Standardized LISREL coefficients are reported.
[a] 1 = subsidiary; 2 = not a subsidiary. [b] 1 = private; 2 = public. [c] 1 = unionized; 2 = nonunionized.
* $p < .05$. ** $p < .01$.

compensation, and measurement (Wright et al. 2001). Fifth, the response rate (9.57%) warrants comment. Although low, Becker and Huselid (1998) reported response rates for similar studies to be between 6 and 28%. Although some caution needs to be expressed in terms of the implications, recent research suggests that low response rates may indeed not lead to biased findings. In a meta-analysis of 86 articles in the occupational-health-psychology literature, Schalm and Kelloway (2001) found a weighted average correlation between effect size and response rate in self-report survey research ($N = 177$) to be .15, with a nonsignificant population variance estimate of .02. They concluded, "nonresponse is not likely to result in substantial bias in the results" (p. 163). Sixth, safety performance was only measured in terms of total lost-time injuries, yet such measures may underestimate the number of actual injuries (Eisenberg & McDonald, 1988; Pransky et al., 1999). Seventh, even though we supported the reliability of the lost-time-injury data, the correlation ($r = .86$) may be spuriously high owing to the possibility that companies who have systems of high-performance practices had both human resource and safety managers respond. As we are unable to test this, some caution needs to be noted with the measure. Last, no indication is provided as to how high-performance work systems influence occupational safety.

Study 2

In the second study, we addressed some of these issues by investigating the link between the high-performance work system and occupational safety at the employee level. In doing so, we extended Study 1 in several ways. First and foremost, the results of this first study show that high-performance work systems are associated with occupational safety, but they do not address the question of how such an effect occurs. Several elements of the high-performance work system result in trust in management. For example, management systems that promote employment security (Cascio, 1993) and information sharing (Fitz-Enz, 1997) are likely to heighten employees' trust in management, especially during turbulent and unstable times in

the organization. In addition, trust in management mediates the relationship between transformational leadership and employee well-being (Sivanathan, Barling, Loughlin, & Kelloway, 2003) and transformational leadership and follower performance (e.g., Jung & Avolio, 2000).

Although there does not appear to be any research on the effects of trust on safety performance, more general evidence for the relationship exists. In a review of the trust literature, Kramer (1999) reported that trust results in spontaneous sociability, which includes cooperation between individuals, acts that go beyond employee roles, work toward common goals, and information-sharing. If extended to the realm of safety, employees who are trusting of management may be more inclined to work in a safe manner, to look out for the safety of fellow employees, and to take greater initiative in safety-related matters.

Employees' perceptions of safety climate have been of interest for some time (see Keenan, Kerr, & Sherman, 1951; Zohar, 1980) and comprise the perceptions employees have of their work environments with respect to safety policies, procedures, and rewards (Griffin & Neal, 2000; Zohar, 1980, 2000). Many of the practices associated with high-performance work systems are hypothesized to result in an individual's positive perceptions of safety climate. For example, when management is seen to offer extensive training because it is committed to employee safety, rather than simply to comply with external standards, perceived safety climate is enhanced. Similarly, perceptions of safety climate will be more positive when workload is considered appropriate by employees (Zohar, 1980).

In turn, perceived safety climate is a proximal predictor of safety behaviors. Individuals whose supervisors displayed safety-specific transformational leadership exhibited more positive perceptions of the safety climate and were less likely to engage in unsafe behavior (Barling et al., 2002). Safety climate has also been related to safety compliance and employees' participation in safety-related activities (Neal, Griffin, & Hart, 2000), and perceived safety climate has predicted fewer injuries in production, restaurant, and young workers (Barling et al., 2002; Zohar, 2000). Thus, we hypothesize that the relationship between human resource management practices and safety performance will be mediated by trust in management and safety climate.

Second, although much of the prior research on high-performance practices has asked one person in each organization to provide the data on the practices, with that person typically being a human resource director or other company official, we focus on employee perceptions of high-performance practices in this study. Third, we hypothesize that any such effects are indirect and will be mediated by perceived safety climate and trust in management (see Figure 1).

Last, we extend the measurement of occupational safety. In the prior study, we accessed organizational records for the outcome measure. Because organizational records can be of questionable validity (see Eisenberg & McDonald, 1988; Pransky et al., 1999) and are invariably nonnormally distributed, we looked to different safety outcomes as measures of safety performance. We assessed three aspects of safety incidents, namely, (a) microaccidents—those injuries that require a visit to the infirmary but do not require time off of work (e.g., Zohar, 2000, 2002), (b) near misses—incidents at work that involve
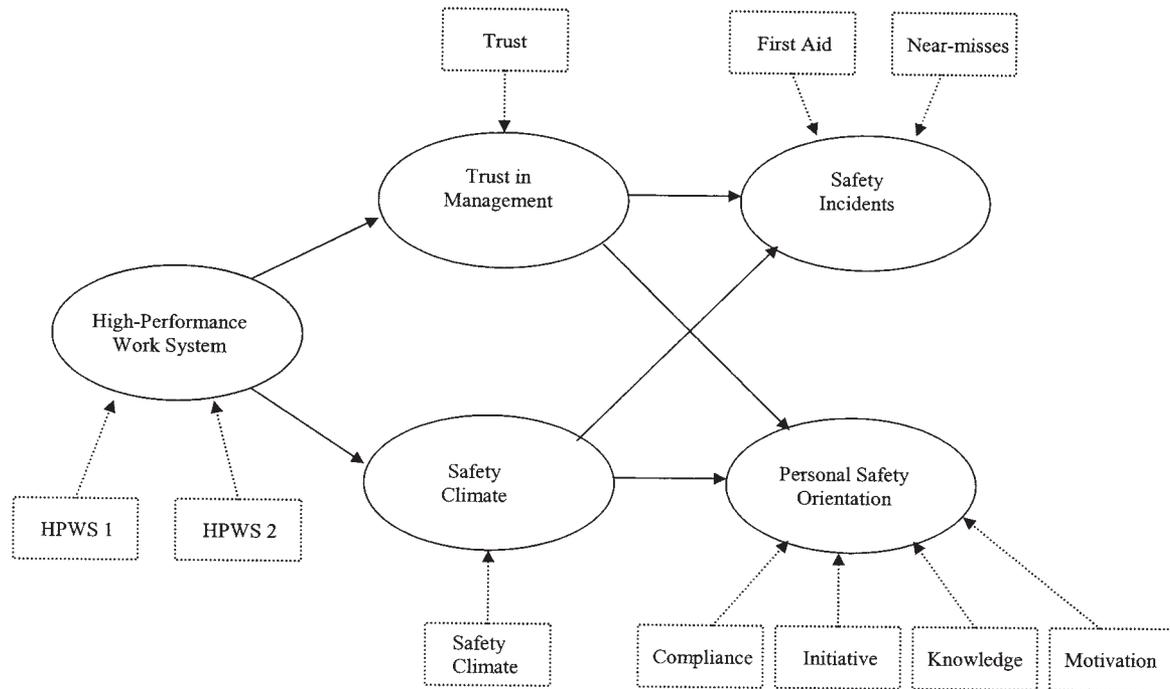
Figure 1. Proposed model: Effects of a high-performance work system on occupational safety at the employee level. HPWS = high-performance work system.

safety infractions but do not result in injury—and (c) lost-time injuries—the number of days of work lost because of injuries. We also obtained data on personal-safety orientation, a variable that comprised safety knowledge, safety motivation, compliance with safety rules and regulations, and safety initiative. Reason, Parker, and Lawton (1998) suggested that these broader measures are particularly important because they provide the organization with continuous feedback—injuries requiring time away from work and fatalities are rare events whereas the personal-safety orientations of employees and the less severe safety incidents they experience are always present, and they provide useful information regarding the actual state of safety in the organization.

Method

Participants

Participants in this study were 196 employees of two Canadian organizations from the petroleum and telecommunications industries. Eighty-three participants worked in the petroleum company as plant and field operators, while 113 worked in the telecommunications company as field technicians at two different sites. It was not possible to calculate the overall response rate in the petrochemical plant and one of the two telecommunications plant: Managers were responsible for distributing the surveys, and we cannot know how many were distributed. In the other telecommunications site, 123 surveys were distributed and 33 returned, with a response rate of 26.83%.

Of the questionnaires that were completed, 191 contained usable data; 2 respondents were female, and their surveys were removed to eliminate any effects that gender may have had on responses. Participants (n = 189 men) had a mean age of 39.12 years (SD = 7.92) and had completed 13.84 years

of schooling (SD = 2.26). Most (84%) worked full-time for an average of 41.68 hr per week (SD = 8.04). The average number of hours of overtime worked was 3.22 per week (SD = 4.02). Participants had worked in their respective organizations an average of 12.38 years (SD = 9.18) and had been in their positions an average of 7.22 years (SD = 7.25). The majority were permanent employees (89.60%).

Materials

High-performance work systems. We conducted a pilot study in which a pool of 81 items were developed and tested. Between 8 and 10 items were generated for each of the 10 practices. Items measuring employment security were adopted from Kuhnert and Vance (1992) whereas items measuring transformational leadership were adopted from Bass and Avolio's (1995) Multifactor Leadership Questionnaire. Responses were on a 5-point Likert scale ranging from *strongly disagree* (1) to *strongly agree* (5). The items used to measure the high-performance work system in Study 2 differ somewhat from those used in Study 1 in two ways. First, the items used for this second study emphasized employees' perceptions of the extent to which the organization had adopted the human resource practices. Second, in Study 2, item responses were all on Likert-type scales. Many items were similar between the two studies; other items were adapted to better suit the individual-level focus of Study 2. Surveys were distributed via email to a sample of convenience of 349 individuals who were either recent graduates of an executive MBA program or their peers (n = 225) or employees of a university's Physical Plant Services Department (n = 94); 142 responses were received (70 women; 72 men; M age = 32.39 years, SD = 9.33; M years in current position = 3.29, SD = 5.77). Items were discarded on the basis of low item-total correlations and nonnormal distributions, resulting in 51 items. All scales had five items with the exception of information sharing which had six. Descriptive statistics and intercorrelations for the 10 practices appear in Table 4.

Table 4
Descriptive Statistics, Intercorrelations, and Factor Loadings for the Pilot Study (N = 142)

Variable	M	SD	1	2	3	4	5	6	7	8	9	10	Factor loading
1. Employment security	29.15	4.85	.70										.55
2. Selective hiring	29.41	5.48	.31**	.78									.65
3. Training	31.66	6.35	.49**	.55**	.86								.73
4. Teams	26.04	4.79	.43**	.46**	.58**	.78							.82
5. Status distinctions	26.28	5.31	.38**	.54**	.50**	.69**	.79						.80
6. Information sharing	27.23	5.04	.51**	.49**	.67**	.71**	.66**	.75					.84
7. Contingent compensation	21.53	3.91	.19*	.51**	.43**	.29**	.30**	.45**	.68				.47
8. Transformational leadership	28.74	5.82	.36**	.46**	.51**	.65**	.64**	.61**	.27**	.89			.74
9. Job quality	28.20	4.56	.39**	.44**	.54**	.64**	.74**	.71**	.28**	.61**	.76		.78
10. Measurement	34.23	6.70	.42**	.47**	.56**	.60**	.54**	.60**	.29**	.60**	.47**	.82	.71

Note. Scale reliabilities (α) can be found on the diagonal, in italics.
* $p < .05$. ** $p < .01$.

The CFA using LISREL VIII (Jöreskog & Sörbom, 1992) supported the aggregation of the summed scale scores of 10 practices. The hypothesized one-factor model was a significantly better fit to the data than the null model, $\Delta\chi^2(10, N = 189) = 718.62, p < .001$ (Bagozzi & Yi, 1988). The measurement model displayed acceptable fit: GFI = .89, CFI = .93, RMSEA = .10.[4] Factor loadings (all significant and ranging from .47 to .84) are presented in Table 4. As a result, all 10 subscales were combined to form a single variable reflecting a high-performance work system ($\alpha = .92$). In relation to construct validity, as high-performance work systems are associated with high-commitment management, we carried out an additional analysis with affective commitment (i.e., six items from the revised Meyer & Allen, 1997, scale). The convergent validity (i.e., the degree of association between measures of a construct) of high-performance work system (10-item measure) and affective commitment was supported, as the two-factor model was found to fit the data significantly better than both the null, $\Delta\chi^2(17, N = 189) = 1,299.88, p < .001$, and one–factor, $\Delta\chi^2(1, N = 189) = 93.96, p < .001$, models. In terms of the discriminant validity (i.e., the degree to which measures of constructs are distinct), we calculated the difference between one model, which allowed the correlations between high-performance work systems and affective commitment to be constrained to unity (i.e., perfectly correlated) and the other, which allowed the correlations between the constructs to be free. The chi-square difference test between the two models, $\Delta\chi^2_{\text{difference}}(1, N = 189) = 17.5, p < .001$, affirmed the discriminant validity of the high-performance work systems measure.[5]

Mediators. Six items from Cook and Wall's (1980) measure of interpersonal trust at work measured *trust in management*. A further, general item was also added to the scale. Responses were measured on a 7-point Likert-type scale ranging from *strongly disagree* (1) to *strongly agree* (7).

Sixteen items were used to measure four dimensions of individuals' *perceived safety climate*: management values (4 items), communication (5 items), training (4 items), and systems and procedures (3 items; Neal et al., 2000). Responses were on a 5-point Likert-type scale ranging from *strongly disagree* (1) to *strongly agree* (5).[6]

Personal-safety orientation. Seven items derived from Neal et al. (2000) and H. Williams, Turner, and Parker (2000) measured *safety compliance*. *Safety initiative* was measured with eight items from Turner and Parker (2004). *Safety knowledge* was measured with four items from Neal et al. Last, *safety motivation* was measured with four items from Neal et al. Responses to all four measures of personal-safety orientation took place on a 5-point Likert-type scale ranging from *strongly disagree* (1) to *strongly agree* (5).

Safety incidents were assessed in three ways. First, the incidence of workplace injuries requiring first aid was assessed by asking individuals to think back over the past 6 months and to report how often (*never* = 1 to *frequently* = 5) they had sustained injuries requiring first aid at work in

each of the same eight injury categories used in Study 1. Second, following Hemingway and Smith (1999), the incidence of *near misses* was also measured using the same eight categories of injuries and the same response scale. Employees were asked to report how frequently they had almost sustained the particular type of injury over the past 6 months. Six months

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[4] Although the root-mean-square error of approximation (RMSEA) of .10 may not be considered a good fit by some (e.g., MacCallum, Browne, & Sugawara, 1996), current research (e.g., Curran, Bollen, Paxton, Kirby, & Chen, 2002; Hayduk & Glaser, 2000; Nevitt & Hancock, 2000) has raised concerns over RMSEA criterion and sample size sensitivity. Hu and Bentler (1999) recommended that for samples below 250, RMSEA be used with caution. In addition, in a Monte Carlo simulation, Tanguma (2001) reported the CFI to be stable and less affected by sample size than other fit indices. Hu and Bentler (1999) also preferred that the CFI be used for small sample sizes ($N \leq 250$). Hence, on the basis of sample-size considerations, as well as the general agreement that values for CFI exceeding .90 indicate a good fit of the data (Byrne, 1998; Kelloway, 1998), we aggregated the data.

[5] We also observed that the measure of high-performance work systems displayed convergent and discriminant validity with the mediator variable of trust in management as well.

[6] There is some debate in the literature as to whether "climate" should be considered an individual difference (e.g., Barling et al., 2002; Griffin & Neal, 2000; Neal et al., 2000; C. P. Parker, Baltes, Young, Huff, Altmann, Lacost, & Roberts, 2003) or group/organizational variable (e.g., Burke, Finkelstein, & Dusig, 1999; Hofmann, Morgeson, & Gerras, 2003; Zohar, 2003a, 2003b). We argue that perceived safety climate is an individual variable that encompasses an individual's perception of the management value, communication, training, and safety systems. Therefore, we conceptualize perceived safety climate at the individual level. To affirm our decision to operationalize safety climate as an individual difference variable, we undertook additional analyses (i.e., within and between analysis; see Bliese, 2000; Castro, 2002; Dansereau, Alutto, & Yammarino, 1984, for procedures). Using one-way analysis of variance (ANOVA), we examined whether there were significant differences between the three research sites. Because the eta (η) value for within sites was .97 as compared with .56 for between sites, we inversed the traditional F test (Dansereau et al., 1984; Yammarino & Markham, 1992). The corrected F test was nonsignificant, $F(2, 171) = .09, p > .05$, suggesting that there is not a significant difference in variation within and between the sites. Conversely, the E test (η_B/η_W) of .58 was practically significant (30° test), indicating that the variation within the sites was greater than the variation between the sites. Given these results, it is appropriate to consider safety climate as an individual-difference variable (Yammarino & Markham, 1992).

is the recommended maximum time over which employees should be asked to recall injuries they have sustained with any accuracy (Veazie, Landen, Bender, & Amandus, 1994). As workplace injuries requiring first aid and near misses were averages of the eight injury categories and were considered cause and not effect indicators, it was not appropriate to estimate coefficient alpha (Frone, 1998). Employees were also asked to report lost-time injuries and resulting days lost. The number of lost-time injuries reported were few in number (2.8% of employees sampled reported experiencing a single lost-time injury in the previous 6 months) and, therefore, this last variable was dropped from further analyses.

Results

Descriptive statistics and intercorrelations of all variables in this study are presented in Table 5. All analyses were based on the covariance matrix and were estimated using maximum-likelihood estimation as implemented in LISREL VIII (Jöreskog & Sörbom, 1992). Anderson and Gerbing's (1988) two-stage modeling approach was followed. Latent variables were created to reflect two types of safety outcomes. In the first case, safety compliance, safety initiative, safety knowledge, and safety motivation were indicators of a single latent variable—personal-safety orientation. Second, the incidence of actual injuries and near misses was used as an indicator of a single latent variable, namely, safety incidents. Latent variables were also created to reflect the high-performance work system and safety-climate variables. This was accomplished by conducting an odd–even split on the scales (e.g., Zacharatos, Barling, & Kelloway, 2000). These two subscales were then used as observed variables reflecting the latent factor of high-performance work system. Trust in management was treated as a single-indicator latent variable (e.g., Barling, Kelloway, & Bremermann, 1991).

The proposed measurement model, specifying five latent variables (i.e., high-performance work system, trust in management, safety climate, personal-safety orientation, and safety incidents) provided an acceptable fit to the data: $\chi^2(27, N = 189) = 35.16$, ns; GFI = .96, CFI = .99, and RMSEA = .04. Standardized parameter estimates for the measurement model are presented in Table 6. The measurement structure was then used to estimate the structural relations of interest. To demonstrate mediation, we found it necessary to estimate three nested structural models (Kelloway, 1998): (a) the fully mediated model (Figure 1), (b) a partially mediated model in which there are additional paths be-tween the high-performance work system and the outcome variables, personal-safety orientation, and safety incidents, and (c) a third nonmediated model that consists of the partially mediated model with the paths from trust in management and safety climate removed. To establish mediation, the fully mediated model must provide a better fit to the data than the nonmediated model and a more parsimonious fit to the data than the partially mediated model (Kelloway, 1998).

Because of the high correlation between the trust and safety-climate variables ($r = .54$, $p < .01$), the model was further modified to allow these two single-indicator variables to covary. The proposed mediational model provided an excellent fit to the data, $\chi^2(30, N = 189) = 43.70$, ns; GFI = .96, adjusted goodness-of-fit (AGFI) = .92, normed fit index (NFI) = .96, CFI = .99, RMSEA = .05, and parsimony normed fit index (PNFI) = .64. The partially mediated model also provided an excellent fit to the data, $\chi^2(28, N = 189) = 36.84$, ns; GFI = .96, AGFI = .93, NFI = .96, CFI = .99, RMSEA = .05, and PNFI = .60. The nonmediated model did not provide a good fit to the data, $\chi^2(32, N = 189) = 103.53$, $p < .001$; GFI = .90, AGFI = .83, NFI = .89, CFI = .92, RMSEA = .11, and PNFI = .64.

The mediated model clearly provided a better fit to the data than the nonmediated model. To determine whether the fully or partially mediated model provided a substantially better fit to the data, we examined measures of comparative fit (NFI, CFI, and the chi-square-difference test) and the overall parsimony (PNFI) of each of the two models (Kelloway, 1998). In terms of comparative fit, both models provided acceptable fits to the data. The result of the chi-square-difference test, however, demonstrates that the partially mediated model was a significantly better fit than the fully mediated model, $\chi^2_{\text{difference}}(2, N = 189) = 6.86$, $p < .05$. Although the path between the high-performance work system and personal-safety orientation was significant, the original path between trust in management and safety incidents became nonsignificant, whereas the path between trust in management and personal-safety orientation became significant, but in the opposite direction than expected. These findings indicate a potential problem of overfitting the model (Kelloway, 1998). To address this problem, we examined two partially mediated models. In the first model, we only added the path between high-performance work system and personal-safety orientation, $\chi^2(29, N = 189) = 40.40$, ns, and in

Table 5

Descriptive Statistics and Intercorrelations Between Measures in Study 2 (N = 189)

Variable	M	SD	1	2	3	4	5	6	7	8	9	10
1. HPWS	153.18	21.12	.92									
2. Trust in management	32.42	9.16	.70**	.91								
3. Safety climate	64.04	9.27	.54**	.52**	.95							
4. Affective commitment	34.64	6.86	.69**	.53**	.34**	.78						
5. Safety compliance	29.34	3.59	.35**	.27**	.63**	.27**	.88					
6. Safety initiative	29.57	4.04	.28**	.22**	.42**	.22**	.48**	.83				
7. Safety knowledge	16.70	1.90	.37**	.27**	.59*	.31**	.72**	.47**	.84			
8. Safety motivation	17.78	1.88	.14	.16*	.37**	.16*	.55**	.38**	.48**	.89		
9. First aid	10.38	2.10	−.31*	−.30**	−.21	−.05	−.11	−.13	.08	.11	—	
10. Near miss	11.68	3.53	−.33**	−.28**	−.26*	−.15	−.30**	−.13	−.13	.03	.70**	—

Note. Scale reliabilities (α) can be found on the diagonal, in italics. HPWS = high-performance work system.
* $p < .05$.   ** $p < .01$.

Table 6
Standardized Parameter Estimates for the Measurement Model
(N = 189)

Variable	HPWS	Trust	Safety climate	Personal safety orientation	Safety incidents
1. HPWS 1	.87				
2. HPWS 2	.98				
3. Trust		.95			
4. Safety climate			.97		
5. Compliance				.88	
6. Initiative				.59	
7. Knowledge				.82	
8. Motivation				.59	
9. First aid					.73
10. Near miss					.90

Note. HPWS = high-performance work system.

the other, we added the path between high-performance work system and safety incidents, $\chi^2(29, N = 189) = 41.84$, *ns.* These models failed to show a significantly better fit than the fully mediated model: that is, $\chi^2_{\text{difference}}(1, N = 189) = 3.30$, *ns,* and $\chi^2_{\text{difference}}(1, N = 189) = 1.86$, *ns,* respectively. In addition, examination of the PNFI indicated that the fully mediated model was more parsimonious than the original partially mediated model (.64 versus .60) and displayed a practical improvement in fit (Widaman, 1985). Therefore, because of (a) potential problems of overfitting, (b) the additional analyses, and (c) the better parsimony fit, the fully mediated model was retained. The standardized parameter estimates for the model are presented in Figure 2. As shown, safety incidents were predicted by both trust in management ($\alpha = .19$, $p < .05$) and safety climate ($\alpha = .35$, $p < .01$). Personal-safety orientation was predicted by safety climate ($\alpha = .76$, $p < .01$) but not by trust in management ($\alpha = .10$, *ns*). Trust in management was predicted by high-performance work practices ($\alpha = .77$, $p < .01$) as was safety climate ($\alpha = .62$, $p < .01$).

Discussion

The results make several contributions to our understanding of the link between high-performance work systems and occupational

safety. First, the results of this second study again extend our understanding of the conceptualization of a high-performance work system. The construct validity of the measure was affirmed by CFA and provided further support that the 10 high-performance work practices are highly interrelated and form a single underlying factor. This result is particularly noteworthy given that (a) the scales were reliable (Wright et al., 2001) and (b) the high-performance work practices were measured by a number of items each (Becker & Huselid, 1998) and are, therefore, more meaningful than those of previous studies. Second, these results replicate the widespread effects of high-performance work systems on critical organizational outcomes.

Third, these results extend our understanding of *how* high-performance work systems affect employee attitudes and behaviors. Our results suggest differential mediational effects for perceived safety climate and trust in management. Perceived safety climate mediated the relationships between the high-performance work system and both personal-safety orientation ($\alpha = .76$) and safety incidents ($\alpha = .35$). In contrast, trust in management mediated the effects of the high-performance work system on safety incidents ($\alpha = .19$) but not on personal-safety orientation, and at least two factors may explain this discrepancy. It is possible that trust in management is relatively less important in this context. A more plausible explanation, however, is that this is an unfair comparison (Cooper & Richardson, 1986): The context-specific nature of perceived safety climate, as opposed to the context-free nature of trust in management in this study, could account for these differential findings. Future research might focus on whether safety-specific trust in management serves a more substantial mediating role.

This second study is not without limitations, however. First, this study relied exclusively on self-report data. Although it is difficult to demonstrate conclusively that monomethod bias is absent from our results, the possibility is minimized by the significantly better incremental fit of the five latent variables (i.e., high-performance work system, trust in management, safety climate, personal-safety orientation, and safety incidents; Korsgaard & Roberson, 1995; Podsakoff & Organ, 1986) and by the nonsignificant link between personal-safety orientation and trust in management. In addition, our focus on self-report data is justified, given that (a) organizational level measures of injuries may themselves be methodolog-
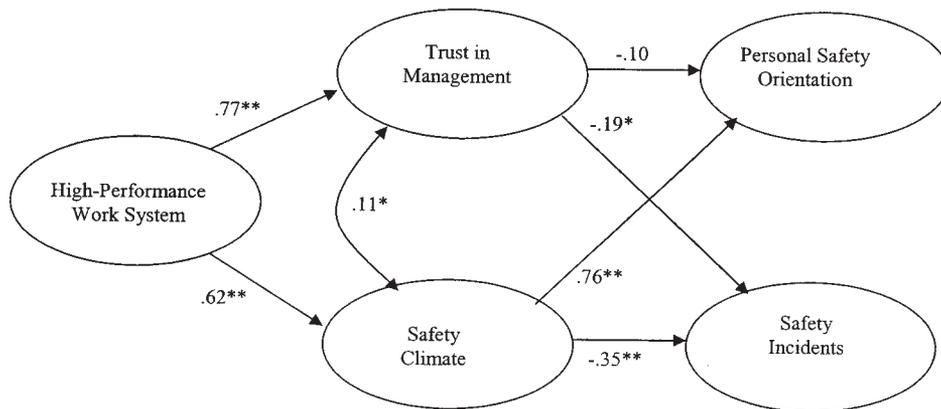

Figure 2.   Standardized parameters for the fully mediated model. *$p < .05$. **$p < .01$.

ically flawed (e.g., Eisenberg & McDonald, 1988; Pransky et al., 1999) and (b) findings from our two studies using organizational records and self-report measures both demonstrate the role of high-performance work systems in occupational safety. Second, causal inference is not justified from the results of this study, and longitudinal data are required to allow such inferences.

General Discussion

Several general issues emerge from these two studies that have conceptual, methodological, or practical implications. First, these two studies have shown that (a) high-performance work systems affect occupational safety and (b) this relationship is mediated by trust in management and perceived safety climate. In addition, (c) high-performance work systems formed a unidimensional construct in three separate samples.

Second, a further examination of other human resource practices that affect workplace safety would be timely. An extension of the current findings in which control-oriented practices were also measured would allow researchers to make a direct comparison between the commitment-oriented and control-oriented practices and their impact on workplace safety. The mediational roles of job satisfaction and perceptions of organizational justice might also be examined as mediators in the high-performance work system–performance link, especially given Barling et al.'s (2003) findings showing that job satisfaction mediates the relationship between high-quality work and occupational safety. A further avenue for future research would be to examine these types of issues using a cross-level analysis to unravel individual and group-level factors that affect occupational safety (e.g., Hofmann, Morgeson, & Gerras, 2003; Zohar, 2003a, 2003b).

Third, the findings from these studies have important implications for the management of occupational safety. Given the findings of these two studies, we can no longer assume that occupational safety is the primary prerogative of individual workers, ergonomic design, and government regulations of collective agreements. Rather, our data demonstrate that a high-performance work system is significantly associated with occupational safety. These findings are consistent with Kaminski's (2001) findings, which showed that many of the management practices that are frequently applied to improve organizational performance (e.g., pay-based performance, teams) may have equal or greater effects on occupational injuries. Taken together, these findings have strong implications for interventions designed to enhance occupational safety.

Fourth, the consistency and reliability of reports of the high-performance work system warrant comment. Wright et al. (2001) have noted concerns about potential measurement problems in research on the effects of high-performance work systems. Our analyses of three separate samples support the view that the measurement error of human resource practices is an important issue, and researchers need to be attentive to the issue of within-group consistency of these practices.

One remaining issue that deserves attention is the construct validity of the high-performance work system measure. Conceptually, we considered it to comprise several subdimensions, which could be differentiated from other constructs (e.g., trust in management). Empirically, through the use of CFA, we attempted to demonstrate this construct validity. Nevertheless, some caution

needs to be expressed given the current concern regarding the causation between constructs and measures (i.e., formative vs. reflective; Edwards & Bagozzi, 2000). In our analysis in Study 1, we found that the 10 human resource practices formed a single factor, and we therefore aggregated them into a single index measuring the high-performance work system. However, in Study 2, the factor loadings of the subdimensions ranged from .47 to .84 (see Table 4), whereas the composite measure of our high-performance work system was correlated at .70 and .69 with trust in management and affective commitment, respectively (see Table 5). Therefore, the latter two constructs were more strongly related to the high-performance work system than some of its indicators (in 3 out of 10 cases). This highlights the difficulty and limitations of using multifaceted constructs such as high-performance work systems within a psychological model.

Research interest in the area of high-performance work systems continues to develop as does interest in the impact that management can have on workplace safety. Nevertheless, to date, very little research has attempted to bring together these two distinct areas of study. The contribution of this work to our understanding in both these areas is significant. Our findings show the extensive benefits of high-performance work systems. With respect to occupational safety, this study confirms the role of organizational, rather than individual, factors in promoting safety, and supports the need to take a broader look at the understanding and management of occupational safety.

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