Pergamon

www.elsevier.com/locate/jsr

Journal of Safety Research 37 (2006) 469–477

www.nsc.org

Production supervisor impacts on subordinates' safety outcomes: An investigation of leader-member exchange and safety communication

Judd H. Michael [a,*], Zhen George Guo [b], Janice K. Wiedenbeck [c], Charles D. Ray [d]

[a] *Sustainable Wood-based Enterprises, 211 Forest Resources Building, The Pennsylvania State University, University Park, Pa 16802, USA*
[b] *The Pennsylvania State University, USA*
[c] *USDA Forest Service, USA*
[d] *Wood Operations, School of Forest Resources, The Pennsylvania State University, USA*

Received 28 September 2005; received in revised form 22 March 2006; accepted 26 June 2006
Available online 22 November 2006

Abstract

Problem: Supervisors are increasingly important to the functioning of manufacturing operations, in large part due to their role as leaders. While supervisors' relations and communication with their subordinates are known to be important in influencing subordinates' behavior, little is known about how these two factors will impact subordinates' safety. This study investigated how much each factor contributes to safety-related outcomes for blue-collar production employees. *Method:* Production employees at five Pennsylvania wood manufacturers completed a survey during their work shift. Five hundred and ninety eight employees provided data on leader-member exchange (LMX), safety communication, and safety-related events. Archival data on OSHA recordables were also obtained from the producers' human resources database. *Results:* Analyses found that the influence of LMX was greater than that of safety communication in predicting safety-related events. Neither LMX nor safety communication was significantly related to OSHA recordables. Results also demonstrated that employee job satisfaction and demographic variables such as gender and age have safety implications. *Impact on Industry:* Results from this study further emphasize the importance of production supervisors and illustrate the potential role of leader-member exchange in enhancing workplace safety. Specifically, organizations should foster positive social exchange between their employees and supervisors and enhance the leadership qualities of supervisors to help reduce workplace injuries.

Keywords: Manufacturing supervisors; Leader-member exchange; Communication; Wood products

1. Introduction

Supervisors are an important part of manufacturing organizations, and play an increasingly critical role in delegating job tasks, managing subordinate performance, and juggling competing demands for productivity, quality, and safety. They are also seen as having a key role in communications between management and hourly employees (Therkelsen & Fiebich, 2003). Due to decentralization and other changes associated with organizations (Butz, Dietz, & Konovsky, 2001; Kozlowski, Chao, Smith, & Hedlund., 1993), supervisors' leadership styles and exchange relations with subordinates are becoming more influential in affecting subordinates' performance and outcomes as compared to the influence of the organization itself (Stinglhamber & Vandenberghe, 2003).

Past research suggests that supervisors can impact the attitudes and behaviors of subordinates in a variety of ways. For example, results imply that positive exchange relations and communication between employees and supervisors can lead to increased job performance, job satisfaction, and organizational commitment (Gerstner & Day, 1997; Penley, Alexander, Jernigan, & Henwood, 1991). Exchange relations and communication between employees and supervisors have also been shown to affect specific employee behaviors such as safety performance. Hofmann and Morgeson (1999) found that

* Corresponding author. Tel.: +1 814 863 2976; fax: +1 814 865 3725.
E-mail addresses: jh-michael@psu.edu (J.H. Michael), George.guo@vcf.com (Z.G. Guo), jwiedenbeck@fs.fed.us (J.K. Wiedenbeck), cdr14@psu.edu (C.D. Ray).

0022-4375/$ - see front matter
doi:10.1016/j.jsr.2006.06.004

employees in a manufacturing setting who have higher quality relationships and better communication with their leader are more likely to feel free to raise safety concerns, which can ultimately lead to fewer accidents assuming management acts on those concerns. Their research is one of the few examples of similar work done with a sample of blue-collar employees, and thus is an area that this work sought to expand upon.

Moreover, recent findings have shown that investigating the effects of organizational factors on employees' safety behavior can be a fruitful approach in safety research (Hofmann, Jacobs, & Landy, 1995; Michael, Evans, Jansen, & Haight, 2005; Zacharatos, Barling, & Iverson, 2005). Organizational factors such as climate (Barling, Loughlin, & Kelloway, 2002; Hemingway & Smith, 1999), personnel selection (Jones & Wuebker, 1988), and hiring practices (Vredenburgh, 2002) have been investigated in an effort to increase our understanding of safety-related outcomes. Few researchers, however, have investigated the influence of organizational exchange (e.g., exchange relations between the leader and subordinate) and communication between a leader and a subordinate on workplace safety (Hofmann & Morgeson, 1999; Hofmann, Morgeson, & Gerras, 2003).

We believe that the influence of supervisor-subordinate relationships and communication is an area worthy of further investigation given its potential to enhance safety performance in manufacturing organizations. In part, the dyadic supervisor-subordinate relationships should be given greater consideration since supervisors tend to communicate and interact differently with different subordinates and seem not to use the same style, content, and so forth, with all subordinates as some have proposed (Dienesch & Liden, 1986; Liden & Graen, 1980; Yrle, Hartman, & Galle, 2003). Further, since the practitioner-targeted safety literature often promotes the importance of communication, especially for behavior-based safety programs (e.g., Hidley, 1998), there is even greater need to conduct empirical studies investigating the effects of supervisor-subordinate safety-related communication.

In this study we develop and test a model linking leadership and safety communication with workplace safety. We propose that both positive exchange relations between a leader and a subordinate and their perceived safety-related communication will improve the subordinate's safety practices and thus reduce accidents. Our goal is to gain a better understanding of how exchange relations and safety-related communication between a leader and a subordinate can influence subordinates' safety outcomes. Further, we sought to investigate whether one of the two factors is more valuable in reducing safety-related events for hourly workers in a manufacturing environment. Our research therefore seeks to investigate the function of those factors in production organizations and offer readers with suggestions for improving workplace safety. The term safety-related event here refers to human-related incidents (see Barling et al., 2002), although the terminology has been used in other contexts (e.g., marine vessel accidents) in past research (e.g., Talley, 1995).

1.1. Safety implications of supervisor-subordinate relationships

Supervisor-subordinate relations have become an area of interest to organizational researchers for a variety of reasons. From an overall competitiveness standpoint, supervisors can play an important role in organizations by influencing their subordinates' attitudes, behaviors, and overall job-related performance (Andersson, Shivarajan, & Blau, 2005; Harris, Kacmar, & Witt, 2005; Zohar & Luria, 2003). From a safety perspective, a supervisor's leadership style provides an opportunity for enhancing workplace safety that goes beyond ergonomic design of facilities or implementation of physical changes to meet regulatory standards (Barling et al., 2002) in a manufacturing environment. Employees' safety performance should improve when they have a clear understanding of safe operating procedures and the consequences of unsafe behaviors and when their safety behaviors are supported by their supervisors (Hofmann & Morgeson, 1999). One way to examine the influence of the supervisor on subordinates is to investigate exchange relations between the supervisor and the member (i.e., the subordinate).

As shown in Fig. 1, we propose to investigate the relationships between two supervisor-related variables and subordinates' safety-related outcomes. Specifically, we will explore the roles of two factors, leader-member exchange (LMX) and safety communication between a leader and a subordinate, in enhancing subordinates' safety-related behaviors. The following sections will describe relevant LMX theory and safety-related communication.

1.2. Leader-member exchange theory

Leader-member exchange (LMX) refers to the quality of the exchange relationship that exists between employees and their superiors (Graen & Uhl-Bien, 1995). LMX has become an important leadership concept for management scientists in large part because of its ability to predict desired outcomes at multiple levels (e.g., individual employee level up to organizational; Gerstner & Day, 1997). Unlike other leadership theories seeking to explain leadership based on characteristics of the leader or of the situation, LMX focuses on the dyadic exchange relations between the leader and the follower as the level of analysis (Gerstner & Day, 1997; Graen & Uhl-Bien, 1995). In this study we will measure one half of the dyad by simply asking subordinates about their LMX; not by asking both supervisor and subordinate for perceptions of each other.

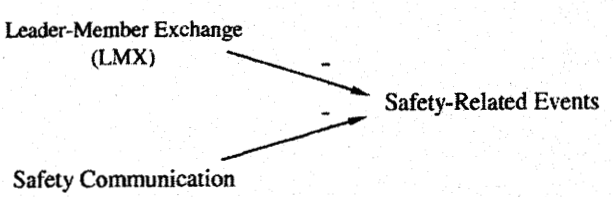

Fig. 1. Proposed relationships with organizational factors and safety-related events.

Social exchange theory (Blau, 1964) and the norm of reciprocity (Gouldner, 1960) have long been used to explain the effects of leaders on positive employee attitudes and behaviors. Social exchange theory suggests that employees develop an exchange relationship with their supervisors; high-quality relationships will create perceived obligations for employees to reciprocate and behave in positive and beneficial ways (Eisenberger, Hunting, Hutchison, & Sowa, 1986; Shore & Wayne, 1993).

Under a positive LMX context, employees may perceive an obligation to reciprocate and perform citizenship role behaviors that will be beneficial for the leader, coworkers, and the organization itself (Setton, Bennett, & Liden, 1996; Wayne & Green, 1993). In a high-quality LMX, subordinates and leaders are engaging in a highly interactive exchange process that should encourage a more open and positive atmosphere. It is therefore reasonable to argue that under a high-quality LMX, employees will engage in both in-role and extra-role behaviors that are perceived as desired by superiors and/or the organization. Desirable changes in member behaviors include job-related performance (Graen, Novak, & Sommerkamp, 1982; Liden, Wayne, & Stilwell, 1993), with similar increases in such attitudes as job satisfaction and commitment (e.g., Graen et al., 1982; Nystrom, 1990).

Even though LMX itself does not focus on a specific role behavior, a positive exchange relationship could be presumed to apply to different outcomes such as safety, productivity, quality, and so forth. Because employees' poor safety practices lead to accidents and high costs for a manufacturer, performing safely should be viewed by the organization and its employees as a valued behavior. Under this scenario, employees having high quality exchange relations with their supervisors should be more likely to reciprocate by greater engagement in safety practices, and may therefore experience fewer safety-related events. Examples of safety-related events may include not only injury accidents, but also first aid incidents and near misses.

1.3. Safety communication

Effective communication between a leader and subordinate is another important facet of organizations. Regular and direct communication is a valuable characteristic of any organization, and has been promoted as especially important for safety performance (Vredenburgh, 2002). Past research showed that poor communication is a primary reason for substandard behaviors ranging from poor safety performance (Hofmann & Morgeson, 1999) to low productivity and morale (Alexander, Helms, & Wilkins, 1989). Under an open and constructive communication atmosphere, the leader and member would freely converse about routine and non-routine problems and engage in joint problem solving processes, which in the long run should result in behaviors that are mutually beneficial (Fairhurst, 1993; Fairhurst & Chandler, 1989; Fairhurst, Rogers, & Sarr, 1987; Hofmann et al., 2003).

By fostering subordinates' positive safety attitudes and enhancing effective safety-related information sharing, supervisors are cultivating an effective communication atmosphere in the organization. In order to influence safety practices, feedback must be provided to the employees who are capable of using it. A supervisor's feedback needs to be given to those working at a point in the process where their behavior can effectively influence outcomes (Vredenburgh, 2002). In addition, positive safety information exchange between supervisors and their subordinates may also signal that supervisors care about the well being of the subordinates. Employees who positively engage in safety-related communication with their leaders should have a better understanding of safety issues such as safe operating procedures and guidelines, outcomes of unsafe behavior, safety equipment handling, and emergency procedures.

Researchers have used a variety of approaches in an attempt to clarify the relationships between communication and safety-related issues. Hofmann and colleagues (e.g., Hofmann & Stetzer, 1998) have conducted some of the more noteworthy works. For example, Hofmann & Morgeson (1999) showed that better employee-supervisor communication tends to produce employees who are more likely to raise safety concerns. Recently, Laurence (2005) examined communication of safety rules and regulations in a mining environment, and Mullen (2005) attempted to model employee willingness to raise safety issues. Vredenburgh (2002) investigated the effects of communication and feedback on reducing employee injury rates, but her study found no significant relation between communication and injury rates. As the construct of the communication variable used in the Vredenburgh study was mainly at the organizational level and not focused on safety, we will extend her study and examine the role of safety-related communication between a supervisor and an employee on the employee's safety-related behavior.

1.4. Safety in the wood products industry

Safety practices are important to the wood products manufacturing industry in the United States due to its status as one of the most dangerous industries. According to the U.S. Department of Labor, in 2003 the wood products manufacturing industry had 534,000 employees with 10,000 recordable nonfatal injuries and illnesses and 37 fatalities (NAICS code 321). Data showed that the lumber/wood products/furniture and fixtures sector had the most fatalities among all manufacturing sectors from 1997 to 2002.

A variety of costs are associated with accidents in the wood products industry (Michael & Wiedenbeck, 2004). Manufacturers with an elevated accident rate are obliged to pay higher medical premiums and property insurance, and also suffer from the low efficiency of damaged machinery and wasted materials. Moreover, accidents are normally associated with low employee morale, poor job satisfaction, and more withdrawal behaviors and stress (Hemingway & Smith, 1999; Michael et al., 2005; Mohamed, 1999). In order to avoid these problems, wood manufacturers must seek ways to improve safety in the workplace.

2. Research methodology

2.1. Data collection

Data were collected in late 2003 and early 2004 from employees at five large wood products manufacturing facilities in Pennsylvania. In total, 598 hourly workers participated in this survey. Respondents were asked to complete the survey in the presence of the investigators at a neutral place (e.g., lunchroom) in the absence of a supervisor during normal work hours. Respondents were asked to provide their employee number on the survey in order for investigators to match responses with actual injury data, but were assured of confidentiality. At the start of each session employees were verbally informed that they were under no obligation to participate in the survey or to provide their employee number, and were free to skip any questions that they felt uncomfortable with. Twelve persons turned in surveys without identifying numbers; these surveys were excluded from further analyses.

When respondents finished the survey, they were collected by the investigators and secured. The investigators transported the surveys off-site immediately after each location's survey session. The research team had collected previous survey data at each of the facilities, and had built up a degree of trust with the hourly employees.

2.2. Measures

Safety variables such as safety communication, safety-related events, and OSHA recordables were collected. Other individual variables such as leader-member exchange and job satisfaction, and the demographic variables employee gender and age also were obtained. The following section provides details on each of the measures used in this paper; we also provide detailed listings of relevant survey items in the appendix.

Leader-member exchange (LMX): As recommended by Gerstner and Day (1997), we used the seven-item LMX measure (Graen & Uhl-Bien, 1995) with modifications to allow the use of only one set of anchors. A five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) was used such that a higher score represents higher quality exchanges. An example statement is "My supervisor understands my job-related problems and needs."

Safety communication: Safety communication was measured by using six items from the Hofmann and Stetzer (1998) safety communication scale. This scale does not necessarily measure one-way communication from supervisor to subordinate, but instead reflects what might be considered as the "communication atmosphere" related to safety. For example, "To what extent does your supervisor encourage open communication about safety?" and "To what extent do you feel comfortable discussing safety issues with your supervisor?" are items used in this scale. A five-point rating scale was used with anchors from *A very small extent* to *A great extent*; higher values represent more open and constructive communication.

Job Satisfaction: Two items were used to measure an employee's job satisfaction. These items were adapted from Brayfield and Rothe's (1951) satisfaction measure on a five point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Job satisfaction was included as a control since it has been shown to impact job-related outcomes (e.g., Ostroff, 1992).

Safety-related events: Safety-related events have been used by other researchers and were shown to have value for measuring workplace injuries (Barling et al., 2002). Unlike some other variables, there are no proper scales available to measure safety-related events. We generated items with the consultation of safety experts in the wood industry to make sure that our scales were consistent with commonly reported events in this industry. Safety-related events were measured by using eight revised items from the Barling et al. (2002) safety-related events scale that were made relevant to the wood industry (see Table 1). Respondents indicated the frequency that each event had occurred during the previous 12 months on a five-point scale (1=never and 5=more than 5 times).

OSHA recordables: As suggested by past researchers (O'Toole, 1999; Vredenburgh, 2002; Westaby & Lee, 2003), OSHA recordables were also used in our study as a more objective measure of safety-related events (as opposed to the more subjective safety-related events such as a self-reported, non-recordable incident). We asked the respondents to report the number of OSHA recordable injuries they experienced in the previous 12 months on a four-point scale (0=zero and 3=three or more times). These self-reported responses were compared to the organizations' records with near-perfect agreement; but the organizations' archival data were ultimately used in the analyses. This variable was decoded to a dichotomous format (0=0, 1=1 or more incidents).

Demographic variables: We asked the participants to provide their age, gender, race, marital status, and number of

Table 1
Items used with safety-related events measure

In the past 12 months.... ...
- I got some foreign matter (e.g., wood chip, sawdust, chemical) in one of my eyes.
- I tripped over something on the plant floor.
- an object got stuck in my hand (e.g., splinter, nail, staple, etc.) while working.
- my clothes got caught in something (e.g., a piece of machinery) while working.
- I slipped on sawdust, scrap wood, liquid substances, or other objects on the plant floor.
- I came in contact with dangerous equipment (e.g., saw blade, heavy equipment, etc.) that almost caused an injury.
- I developed joint, tendon, or muscle pain from work activities that require repetitive motions.
- I dropped a heavy object (e.g., board) on body part (e.g., foot).

Note: anchors used were "Never", "Once", and so on up to "More than 5 times".

Table 2
Means, standard deviations, and intercorrelations among variables

Variable	M	SD	1	2	3	4	5	6	7
1. Leader-member exchange	3.30	0.72	(0.88)						
2. Safety Communication	3.76	0.85	.543**	(0.80)					
3. Job Satisfaction	3.10	0.95	.520**	.393**	(0.83)				
4. Safety-Related Events	2.41	0.73	−.259**	−.139**	−.271**	(0.76)			
5. OSHA Recordable	0.20	0.40	−.087*	.104*	−.086*	.126**	(N/A)		
6. Age	38.31	11.26	.025	−.042	.023	−.167**	.020	(N/A)	
7. Gender	0.20	0.40	.126**	.113**	.143**	.022	−.024	.069	(N/A)

Note: Where appropriate, internal consistency reliability coefficients (Cronbach's alpha) are in included in parentheses on the diagonal of the correlation matrix.
* $p<.05$ ** $p<.001$.

dependents in the survey. These variables were given a dummy code for the analysis.

3. Results

Table 2 presents the means, standard deviations, and intercorrelations of the variables used in the survey. All constructs had a Cronbach's alpha above 0.70 as recommended by Nunnally and Bernstein (1994). As can be seen, the demographic variables (gender and age) are not significantly related to the OSHA recordable result. Neither is gender significantly related to safety-related events. Notably, however, age is significantly related to safety-related events; employees who are older have fewer safety-related events (r=−.167). This might be explained in that employees who are older should have more experience and knowledge about safety, and how to safely work in their specific environment. This accumulated knowledge could help them avoid accidents and injuries (whether caused by themselves or by their coworkers). Unfortunately, however, our research could not provide a definitive reason why accident rates should decline with employee age.

Two separate hierarchical regression analyses were conducted to test the unique variance in safety-related events that was accounted for by LMX and safety communication (Table 3). Job satisfaction, age, and gender were entered as control variables (covariates) into block 1 of these two linear regression templates. LMX and safety communication were then entered separately as independent variables into block 2. In the first regression, the covariates explained 11% of the variance in safety-related events. After removing the effects of the covariates, LMX accounted for 2.3% of the variance in the safety-related events. Thus, controlling for age, gender, and job satisfaction, LMX was negatively and significantly related to safety-related events ($p=.001$). In the second regression, covariates again explained 11% of the variance in the safety-related events. Adjusting for age, gender, and job satisfaction, safety communication accounted for only 0.4% of the variance in the safety-related events. Safety communication was negatively and non-significantly related with safety-related events ($p=.127$).

We also put safety communication and LMX together into a third regression model to test the effects of these two variables on safety-related events (Table 4). Job satisfaction, age, and gender were entered as control variables into block 1 of the linear regression template. The covariates explained 12% of the variance in employee's self-reported safety-related events ($F=22.53$, $p<.001$). Employee's safety communication was entered into block 2. After removing the effects of the covariates, safety communication accounted for only an additional 0.3% of the variance in employee self-reported safety-related events. Adjusting for age, gender, and job satisfaction, safety communication was negatively and non-significantly related with safety-related events ($p=.154$).

Table 3
Hierarchical regression coefficients for analysis predicting safety-related events in separate models

	Depedent Variable=Safety-Related Events			
	Model		Model	
	1	2	1	2
Control Variables				
Employee Gender	2.14*	2.41*	2.23*	2.34*
Employee Age	−3.96**	−4.01**	−3.44**	−3.53**
Job Satisfaction	−7.00**	−4.26**	−7.07**	−5.96**
Independent Variables				
LMX		−3.76**		
Safety Communication				−1.53
Model F	22.16**	20.54**	21.42**	16.69**
R^2	.112	.136	.111	.115
R^2 change		.023**		.004

Note: LMX was entered as the independent variable in the first regression equation to test its relationship with safety-related events. The second regression equation used safety communication as the independent variable.
* $p<.05$ ** $p<.001$.

Table 4
Hierarchical regression coefficients for analysis predicting safety-related events in full model

	Dependent Variable		
	Safety-Related Events		
	t	Partial Coeffecient	R^2
Control Variables			
Employee Gender	2.501*	0.111	
Employee Age	−3.689**	−0.162	0.12
Job Satisfaction	−4.416**	−0.193	
Independent Variables			
Safety Communication	0.084	0.004	0.003
LMX	−3.365**	−0.148	0.02

* $p<.05$ ** $p<.001$.

Table 5
Logistic regression of LMX and safety communication on OSHA recordable

Independent variable	Final Model		
	Wald	p	EXP(B)
Leader member exchange	0.53	0.467	0.883
Safety Communication	3.32	0.069	0.765

LMX was entered into block 3 in the model. After removing the effects of the covariates and safety communication, LMX added another 2% of the variance in employee's self-reported safety-related events. Adjusting for the other variables, LMX was significantly and negatively related to safety-related events ($p=.001$). In sum, the combined effects of all the independent variables accounted for 14% of the total variance in safety-related events.

Due to the subjective nature of the safety-related events variable, we also used OSHA recordables as a dependent variable to test whether our proposed relations still exist in a new regression equation. We used logistic regression to test the effects of age, gender, job satisfaction, LMX, and safety communication on OSHA recordables. First, we recoded the number of OSHA recordable accidents to a binary variable to measure whether an employee had an accident or not in the previous 12 months. Then we put age, gender, and job satisfaction into block 1, safety communication into block 2, and LMX into block 3. Our results showed that none of the descriptive variables were significantly related with OSHA recordables. Table 5 presents the results of LMX and safety communication regressed on OSHA recordables in the logistic regression model.

4. Discussion

The purpose of this project was to investigate how supervisors' leadership style and safety-related communication can impact subordinates' safety-related outcomes. The results of this study suggest that exchange relations between a supervisor and a subordinate are related to the number of safety-related events experienced by the subordinate; subordinates in our sample who had a high quality relationship with their supervisors were less likely to be injured or involved in a near-miss accident.

While LMX was significantly related to safety-related events, it was not significantly related to actual OSHA recordable injuries. One possible explanation for this is that safety-related events is a subjective variable, whereas an OSHA recordable is more of an objective variable. A recent review of LMX theory (Gerstner & Day, 1997) showed that high-quality exchange relationships are more predictive of subjective outcomes (i.e., performance rating and intention to quit) than objective outcomes (i.e., turnover). Because safety-related events was a subjective variable and OSHA recordables are more objective, our results are consistent with previous findings and at the same time expand the findings to a workplace safety environment.

Results also suggest that our measure of safety-related communication between supervisors and subordinates has little direct effect on the subordinate's safety-related events. This finding generally mirrors similar results by Vredenburgh (2002). Upon initial review of the results, it seems as if safety communication is highly related to employees' safety-related events (using the bivariate coding). However, with further analysis, the effect of safety communication disappears when adding other variables (covariates) into the model.

Male employees also reported fewer safety-related events than female employees. It could be that male employees have less trouble in dealing with machines, are generally stronger than female employees, and can therefore better handle heavy objects without injury. Results also show that older employees had fewer safety-related events. Older workers normally have more knowledge and consciousness related to safety, with their accumulated knowledge and experiences helping them to perform more safely. On the other hand, they may be physically somewhat weaker than younger employees.

Our results showed that neither LMX nor safety communication was predictive of whether an employee experienced an OSHA recordable injury. This result is consistent with the finding of Gerstner and Day (1997) that there are often weaker correlations between LMX and objective outcomes. The causes of injury accidents in a manufacturing setting are very diverse and some of them (e.g., unpredicted machine break down) are not attributable to the attitude or performance of the employee.

Finally, these results suggest that safety communication alone is not sufficient to ensure a low incident rate. Communication would seem to be part of a much larger picture, including variables such as safety climate, culture, and management commitment to safety, that have been shown to interact to affect accident rates (e.g., Coyle, Sleeman, & Adams, 1995; DeJoy, Schaffer, Wilson, Vandenberg, & Butts, 2004; Zohar, 1980). For example, upper managers can communicate often about the importance of safety but hourly employees may see this as simply "lip service" if there is a low level of actual commitment on the part of management. Our experience with hourly production employees shows that they are very much in tune with how they are treated by supervisors and management. It would be unwise for managers to think that the average production employee will not see through insincerity related to commitment to safety or true caring for the well being of the employee.

4.1. Implications

The findings of this paper reveal several important implications for organizations and safety professionals. The linkage between LMX and safety outcomes suggests that supervisors' leadership styles may play an important role in enhancing workplace safety. It is our experience that production supervisors are often promoted into that position without any formal training in leadership, communication, and so forth. Considering these results it would seem that a

greater need for such training is warranted. A transformational leadership training intervention was designed and used by Graen et al. (1982) to help leaders maintain higher quality exchange relations with their subordinates; its key components provide a valuable outline for organizations seeking to upgrade the skills of their supervisors. Their keys to increasing the quality of supervisor-subordinate relations included training the supervisors to: increase the time spent talking with subordinate's about problems, concerns, and expectations; becoming a better "active" listener and learning not to impose their own frame of reference when talking to subordinates; and relating expectations regarding the member's job and their working relationship.

The results of this study might also appear to have implications for safety communication since it was not predictive of safety outcomes (i.e., safety-related events and OSHA recordables). We would not, however, want practitioners to take from our results that safety communication is a useless endeavor. It is noteworthy that the scale used in our research did not measure the levels of traditional one-way, downward communication that many persons may associate with safety-related communication. Other research (e.g., Hofmann & Morgeson, 1999) has suggested that employees who engaged in more safety-related communication were more likely to be perceived as having greater commitment to safety and were involved in fewer accidents. Though our study didn't provide sufficient evidence to support strong correlations between safety communication and safety outcomes, we believe that this relationship is worthy of further examination. Future research should be conducted by looking for variables that mediate or moderate this process (e.g., as seen with DeJoy et al., 2004). Given our results, it is perhaps rational to propose that safety communication affects accidents via other variables such as safety climate (Barling et al., 2002; Hemingway & Smith, 1999) and safety commitment (Hofmann & Morgeson, 1999).

4.2. Limitations

There are several limitations to the current study. First, data were collected in the format of a survey. Even though this survey was implemented in a neutral place and designed for completion by hourly production workers, the results could be biased due to social desirability effects and other factors such as poor reading comprehension ability. Second, data were collected in only five wood products manufacturing operations in Pennsylvania. The scope of the data was limited as it only represents situations in a certain industry and a certain geographic area within the United States. Third, all the variables used in this study except the OSHA recordable were self-reported, and same source bias may therefore inflate the results in this study. Finally, these analyses did not include any variables related to safety climate or culture, and thus we cannot conclusively state the effect they may have on relationships between communication, LMX, and safety outcomes. Anecdotally, however, we did have evidence that the levels of management commitment to safety were similar at each of the five firms (based on extensive interviews with management at each organization prior to data collection and on previous employee surveys conducted at the locations). Future research should investigate relationships between these organization– or plant–level variables and the variables used in this project.

4.3. Conclusions

Previous research has illustrated the value of supervisors' favorable treatment toward and positive interpersonal exchange relations with their subordinates for enhancing subordinates' behavior. The findings of this study help researchers and safety practitioners to understand the importance of supervisors' exchange relations with their subordinates in improving safety performance in a manufacturing organization. Our findings suggest that positive leader-member exchange will not only affect general employee behaviors (Gerstner & Day, 1997), but also perhaps specific behaviors such as those related to safety. As related to safety management systems, our findings show that the nature of dyadic relations between the leader and member can offer another approach to understanding workplace safety.

This study examined blue-collar production workers and thus serves as an important supplement to the previous research with white-collar or service industry employees. Production supervisors are often the "face of the organization" for hourly employees, and our results suggest that lower level supervisors can complement the role of a firm's upper management (e.g., commitment to safety) in influencing safety performance. Top management teams at manufacturers should therefore strongly consider how to integrate supervisors into the firm's overall safety program.

Acknowledgements

This project was funded in part by a grant from the USDA National Research Initiative Competitive Grants Program, and a Cooperative Research Agreement with the U.S. Forest Service (#11242343-066), Northeastern Research Station, Princeton, WV.

References

Alexander, E. R., Helms, M. M., & Wilkins, R. D. (1989). The relationship between supervisory communication and subordinate performance and satisfaction among professionals. *Public Personnel Management, 18*(4), 415–429.

Andersson, L., Shivarajan, S., & Blau, G. (2005). Enacting ecological sustainability in the MNC: A test of an adapted value–belief–norm framework. *Journal of Business Ethics, 59*, 295–305.

Barling, J., Loughlin, C., & Kelloway, E. K. (2002). Development and test of a model linking safety-specific transformational leadership and occupational safety. *Journal of Applied Psychology, 87*(3), 488–496.

Blau, P. M. (1964). *Exchange and power in social life.* New York: Wiley.

Brayfield, A. H., & Rothe, H. F. (1951). An index of job satisfaction. *Journal of Applied Psychology, 35*, 307–311.

Butz, R. M., Dietz, J., Konovsky, M. A. (2001). *Top management and immediate supervisors as distinct targets of trust*. Paper presented at the 16th Annual Conference of the Society for Industrial and Organizational Psychology, San Diego, CA. April 2001.

Coyle, I. R., Sleeman, S. D., & Adams, N. (1995). Safety climate. *Journal of Safety Research, 26*, 247–254.

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. *Journal of Safety Research, 35*, 81–90.

Dienesch, R. M., & Liden, R. C. (1986). Leader-member exchange model of leadership: A critique and further development. *Academy of Management Review, 11*, 618–634.

Eisenberger, R., Hunting, R., Hutchison, S., & Sowa, D. (1986). Perceived organizational support. *Journal of Applied Psychology, 71*, 500–507.

Fairhurst, G. T. (1993). The leader-member exchange patterns of women leaders in industry: A discourse analysis. *Communication Monographs, 60*, 321–351.

Fairhurst, G. T., & Chandler, T. A. (1989). Social structure in leader-member exchange interaction. *Communication Monographs, 56*, 216–239.

Fairhurst, G. T., Rogers, L. E., & Sarr, R. A. (1987). Manager-subordinate control patterns and judgments about the relationship. *Communication Yearbook, 10*, 395–415.

Gerstner, C. R., & Day, D. V. (1997). Meta-analytic review of leader-member exchange theory: Correlates and construct issues. *Journal of Applied Psychology, 82*(6), 827–844.

Gouldner, A. W. (1960). The norm of reciprocity: A preliminary statement. *American Sociological Review, 25*, 161–178.

Graen, G. B., Novak, M. A., & Sommerkamp, P. (1982). The effects of leader-member exchange and job design on productivity and satisfaction: testing a dual attachment model. *Organizational Behavior and Human Performance, 30*, 109–131.

Graen, G. B., & Uhl-Bien, M. (1995). Relationship-based approach to leadership: Development of leader-member exchange (LMX) theory over 25 years: Applying a multi-level multi-domain perspective. *Leadership Quarterly, 6*, 219–247.

Harris, K. J., Kacmar, K. M., & Witt, L. A. (2005). An examination of the curvilinear relationship between leader-member exchange and intent to turnover. *Journal of Organizational Behavior, 26*, 363–378.

Hemingway, M. A., & Smith, C. S. (1999). Organizational climate and occupational stressors as predictors of withdrawal behaviours and injuries in nurses. *Journal of Occupational and Organizational Psychology, 72*, 285–299.

Hidley, J. H. (1998). Critical success factors for behavior-based safety: Avoiding common pitfalls and achieving real gains. *Professional Safety, 43*(7), 30–34.

Hofmann, D. A., Jacobs, R., & Landy, F. L. (1995). High reliability process industries: Individual, micro, and macro organizational influences on safety. *Journal of Safety Research, 26*, 131–149.

Hofmann, D. A., & Morgeson, F. P. (1999). Safety-related behavior as a social exchange: The role of perceived organizational support and leader-member exchange. *Journal of Applied Psychology, 84*(2), 286–296.

Hofmann, D. A., Morgeson, F. P., & Gerras, S. J. (2003). Climate as a moderator of the relationship between leader-member exchange and content specific citizenship: Safety climate as an exemplar. *Journal of Applied Psychology, 88*(1), 170–178.

Hofmann, D. A., & Stetzer, A. (1998). The role of safety climate and communication in accident interpretation: Implication from negative events. *Academy of Management Journal, 41*, 644–657.

Jones, J. W., & Wuebker, L. J. (1988). Accident prevention through personnel selection. *Journal of Business and Psychology, 3*(2), 187–198.

Kozlowski, S. W. J., Chao, G. T., Smith, E., & Hedlund, J. (1993). Organizational downsizing: Strategies, interventions, and research implications. In C. L. Cooper & I.T. Robertson (Eds.), *International review of industrial and organizational psychology* (pp. 263–332).

Laurence, D. (2005). Safety rules and regulations on mine sites: The problem and a solution. *Journal of Safety Research, 36*(1), 39–50.

Liden, R. C., & Graen, G. (1980). Generalizability of the vertical dyad linkage model of leadership. *Academy of Management Journal, 23*(3), 451–463.

Liden, R., Wayne, S. J., & Stilwell, D. (1993). A longitudinal study on the early development of leader-member exchange. *Journal of Applied Psychology, 78*, 662–674.

Michael, J. H., Evans, D. D., Jansen, K. J., & Haight, J. M. (2005). Management commitment to safety as organizational support: Relationships with non-safety outcomes in wood manufacturing employees. *Journal of Safety Research, 36*, 171–179.

Michael, J. H., & Wiedenbeck, J. K. (2004). Safety in the Wood Products Industry. *Forest Products Journal, 54*(10), 8–18.

Mohamed, S. (1999). Empirical Investigation of Construction Safety Management Activities and Performance in Australia. *Safety Science, 33*, 129–142.

Mullen, J. (2005). Testing a model of employee willingness to raise safety issues. *Canadian Journal of Behavioural Sciences, 37*(4), 273–282.

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory* (pp. 264–265)., 3rd Ed. New York: McGraw-Hill Publisher.

Nystrom, P. C. (1990). Vertical exchanges and organizational commitments of American business managers. *Group and Organization Studies, 15*, 296–312.

Ostroff, C. (1992). The relationship between satisfaction, attitudes, and performance: An organizational level analysis. *Journal of Applied Psychology, 77*, 963–974.

O'Toole, M. F. (1999). Successful Safety Committees: Participation Not Legislation. *Journal of Safety Research, 30*(1), 39–65.

Penley, L. E., Alexander, E. R., Jernigan, I. E., & Henwood, C. I. (1991). Communication abilities of managers: The relationship to performance. *Journal of Management, 17*(1), 57–76.

Setton, R. P., Bennett, N., & Liden, R. C. (1996). Social exchange in organizations: Perceived organizational support, leader-member exchange, and employee reciprocity. *Journal of Applied Psychology, 81*, 219–227.

Shore, L. M., & Wayne, S. J. (1993). Commitment and employee behavior: Comparison of affective organizational commitment and continuance commitment with perceived organizational support. *Journal of Applied Psychology, 78*, 774–780.

Stinglhamber, F., & Vandenberghe, C. (2003). Organizations and supervisors as sources of support and targets of commitment: A longitudinal study. *Journal of Organizational Behavior, 24*(3), 251–270.

Talley, W. K. (1995). Safety investments and operating conditions: Determinants of accident passenger-vessel damage cost. *Southern Economic Journal, 61*(3), 819–829.

Therkelsen, D. J., & Fiebich, C. L. (2003). The supervisor: The linchpin of employee relations. *Journal of Communication Management, 8*(2), 120–129.

Vredenburgh, A. G. (2002). Organizational safety: Which management practices are most effective in reducing employee injury rates? *Journal of Safety Research, 33*, 259–276.

Wayne, S. J., & Green, S. A. (1993). The effects of leader-member exchange on employee citizenship and impression management behavior. *Human Relations, 4*, 1431–1440.

Westaby, J. D., & Lee, B. C. (2003). Antecedents of Injury among Youth in Agricultural Settings: A Longitudinal Examination of Safety Consciousness, Dangerous Risk Taking and Safety Knowledge. *Journal of Safety Research, 34*, 227–240.

Yrle, A. C., Hartman, S. J., & Galle, W. P., Jr. (2003). Examining communication style and leader-member exchange: Considerations and concerns for managers. *International Journal of Management, 20*(1), 92–100.

Zacharatos, A., Barling, J., & Iverson, R. D. (2005). High-performance work systems and occupational safety. *Journal of Applied Psychology, 90*(1), 77–93.

Zohar, D. (1980). Safety climate in industrial organizations: Theoretical and applied implications. *Journal of Applied Psychology, 65*, 96–102.

Zohar, D., & Luria, G. (2003). The use of supervisory practices as leverage to improve safety behavior: A cross-cultural intervention model. *Journal of Safety Research, 34*(5), 567–577.

Appendix A. Items used in employee survey

Safety Communication - Scale was 1=A very small extent, 3=Some extent, and 5=A great extent. (α=0.80) (adapted from Hofmann & Stetzer, 1998)

1. Do you feel comfortable discussing safety issues with your supervisor?
2. Do you generally try to avoid talking about safety-related issues with your supervisor?
3. Do you feel free to discuss safety-related issues with your supervisor?
4. Does your supervisor encourage open communication about safety?
5. Does your supervisor openly accept ideas for improving safety?
6. Are you reluctant to discuss safety-related problems with your supervisor?

Leader-member exchange - Scale was from 1=Strongly Disagree to 5=Strongly Agree. (α=0.88) (Graen & Uhl-Bien, 1995)

1. My supervisor understands my job-related problems and needs.
2. I know where I stand with my supervisor.
3. My supervisor recognizes my potential.
4. My supervisor would use his/her power to help me solve work related problems.
5. My supervisor would "bail me out" at his/her expense.
6. I defend and justify my supervisor's decisions when he/she is not present to do so.
7. I have an effective working relationship with my supervisor.

Job satisfaction - Scale was from 1=Strongly Disagree to 5=Strongly Agree.(α=0.83) (Brayfield & Rothe, 1951)

1. I find real enjoyment in this work environment.
2. I consider this work environment rather unpleasant.

Judd H. Michael is Associate Professor of Sustainable Wood-based Enterprises at The Pennsylvania State University, and conducts research related to safety and competitiveness of the wood products industry. He received an MBA from Texas A&M University and a PhD from Penn State.

Zhen George Guo was a Graduate Research Assistant at Penn State (currently Director of International Sourcing, American Signature Furniture) where he received his M.S. in Wood Products Business Management.

Janice K. Wiedenbeck is Project Leader and Research Scientist with the USDA Forest Service located in Princeton, WV. She is also Adjunct Professor at both Penn State and North Carolina State University. She received a PhD in Wood Science from Virginia Tech.

Charles D. Ray is Assistant Professor of Wood Products Operations at Penn State. He has nearly 20 years of industry experience with such large forest products companies as Louisiana-Pacific. He received a PhD from Texas A&M University in Forest Science.