

THE ROLE OF MANAGEMENT COMMITMENT AND EMPLOYEE INVOLVEMENT IN SAFETY MANAGEMENT

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Abstract

Researchers have recognized safety-related organizational factors have greater influences on safety performance. Little attention, however, has been focused on how these important organizational factors influence safety outcomes. This research explored the relationships among organizational factors (especially management commitment and employee involvement) and safety outcomes through structural equation modeling (SEM) analysis. Data were collected from front-line employees of Taiwanese steel plants. This research postulated that organizational factors would affect safety outcomes through safety management system and work group processes. SEM was used to test the relationships among these factors. Results revealed management commitment and employee involvement demonstrate different effects on safety management system and work group processes, which in turn influence employees' safety awareness and behavior. These findings provide valuable implications for improving safety management programs in other high-risk industries.

KEY WORDS: Safety management; Safety culture; Safety climate; Management commitment, Employee involvement

Introduction

Since the 1980s, a paradigm shift occurred from technical analysis period toward the organizational and management factors period in the research of accident causation theories (Zohar, 2014). All of the studies, either quantitative or qualitative, indicated that organizational factors can be viewed as antecedents of accidents occurrences for large complex systems (Reason, 1997; Seo et al., 2004; Casey et al., 2017) and as effective indicators to assess organizational safety (Flin et al., 2000). In the past thirty years, many studies related to safety management have focused on factorial structure of measurement scales and its predictive validity with regard to a variety of safety outcomes. (Colley et al., 2013; Flin et al., 2000; Glendon & Litherland, 2001; Zohar, 1980). However, much of the work in this field has focused on methodological rather than theoretical or conceptual issues (Zohar, 2010; 2014). To provide more theoretical foundations in this field, safety researchers have recently begun turning their attentions on the roles of organizational factors in relation to safety practices and unsafe behavior (Brown et al., 2000; Casey et al., 2017; Colley et al., 2013; Huang et al. 2014; McFad-

den et al., 2015; Oliver et al., 2002; Seo, 2005; Siu et al., 2004; Tomas et al., 1999). Much of the work has focused on the influences of leadership style on safety outcomes (Barling et al., 2002; Barling & Zacharatos, 1999; Kelloway et al., 2006; McFadden et al., 2015). Other organizational and management factors, such as organizational climate and safety climate, that have been found to be related to safety performance (Brown et al., 2000; Huang et al. 2014; Seo, 2005).

Among these organizational factors related to safety, management commitment and employee involvement have been widely viewed as the important factors influencing organizational safety (Brown & Holmes, 1986; Dedobbeleer & Beland, 1991; Flin et al., 2000; Glendon & Litherland, 2001; Wiegmann et al., 2002; Zohar, 1980). Studies have indicated that management commitment to safety is a critical factor significantly influencing organizational safety behaviors (Cheyne et al., 1998, Wiegmann et al., 2002; Zohar, 1980). In an effective safety program, upper management must demonstrate positive safety attitudes towards safety and their concern for employee well-being. While upper management demonstrates their organizational

commitment to safety, they will identify safety as a core value or guiding principles of an organization (Eiff, 1999). Barling & Zacharatos (1999) pointed out that high levels of management commitment to safety could enhance safety behavior of employees. Hofmann & Morgeson (1999) reached a similar finding, indicating that high-quality management support to safety enhances safety communication and safety commitment of employees, ultimately reducing workplace accidents.

In addition, persistent participation from operations personnel is also a fundamental prerequisite for a total safety culture (Geller, 1994). Employee involvement provides the viable solutions to improve safety problems and reveals their own commitment to safety (OSHA, 2017), which can increase employees' motivation to assume safety responsibility and reduce potentially unsafe behaviors and injuries of organization (Geller, 2001). Organizations with a good safety culture should involve employee suggestions to safety improvement and ensure that employees clearly comprehend their vital responsibilities in facilitating occupational safety. An effective safety management system in an or-

ganization should incorporate employees' concerns and suggestions at different hierarchical level.

Although management commitment and employee involvement are well recognized to significantly influence safety outcomes, exactly how these two safety-related organizational factors are associated with safety outcomes has seldom been addressed.

Therefore, this study attempts to elucidate the relationships between the two factors and safety outcomes. We adopt the perspectives of how an organization functions to develop the conceptual structural framework (Hsu et al., 2008; Zohar, 2000). According to the hierarchy of organizational operation, upper management sets organizational goals in response to the fluctuations of external environment. They also make policies and devise organizational strategies to achieve the established goals. Middle level management formulates operating procedures and provides tactical action guidelines based on upper management policies and strategies. Line managers at work group level execute policies and procedures from upper and middle management, provide instructions to frontline workers, and monitor the work progress to ensure the operating performance (Zohar & Luria, 2005). Based on above concepts, we

develop a safety management model, which postulates that organizational factors affect safety awareness and behavior through safety management system and work group processes.

Linkages Between Management Commitment And Safety Outcomes

Zohar & Luria (2005) has indicated that the safety policies of upper management may influence the tactical action plans of frontline supervisors at the work group level. Once demonstrating an organizational commitment to safety, upper management prioritizes safety as a core organizational value. Upper managers also become personally involved in daily safety-related activities critical and decision-making meetings on safety to provide guiding organizational principles, which will facilitate frontline supervisors to play a more active supervisory role (i.e. more task instructions and progress monitoring) to comply with the expectations and requirements of upper management. Thus, increased supervisory involvement might make employees more aware of safety risks in the workplace and more receptive to comply with safety procedures and regulations. Simard & Marchand (1994) indicated that supervisory involvement in safety activities is ef-

fective in reducing accident rate. Therefore, we hypothesize the following.

Hypothesis 1a: In an organization with higher management commitment to safety will be positively related to the supervision of line managers. Additionally, increased supervision of line managers will be positively related to safety awareness and behavior of employees.

While demonstrating a persistent and positive attitude towards safety, management becomes intimately involved in critical safety activities within the organization (Wiegmann et al., 2002). They often improve organizational safety performance through holding safety related activities. Safety activities refer to how an organization promulgates safety policies and promotes safety management practices. Safety training and safety campaigns are the most common methods among safety-related activities. Safety training can upgrade knowledge expertise of employees towards safety operations. Safety campaigns can raise safety awareness among employees towards risk and safety-related capabilities. Holding safety training and campaigns will provide helps to

promote safety awareness and safety behavior of employees. We thus hypothesize the following.

Hypothesis 1b: In an organization with higher management commitment to safety will be positively related to safety activities. Additional safety activity efforts will be positively related to safety awareness and behavior of employees.

Furthermore, upper management with a high level of management commitment to safety provides adequate resources and methods to nurture and promote proactive system management. Here, proactive safety management refers to the perceived quality and effectiveness of a safety management system, including formalization of safety policies, formulation of safety procedures, as well as investigation of safety incidents/accidents, risk assessment and solutions. In an effective safety management system, upper management highly prioritizes proactive risk management of safety (Geller, 2001; Santos-Reyes & Beard, 2002). A proactive safety management within an organization might increase the safety risk awareness of employees in the workplace and encourage employ-

ees to actively participate in and comply with safety procedures and regulations. We thus hypothesize the following.

Hypothesis 1c: In an organization with higher management commitment to safety will be positively related to proactive safety management. A proactive safety management system will have positively related to safety awareness and behavior among employees.

Linkages between employee involvement and safety outcomes

As mentioned in earlier paragraph, employee involvement can increase a sense of responsibility among employees and hold accountable ownership for their safety actions, enabling them to concentrate on continuously elevating proactive safety management. That is, employees can participate in decision making, including formulation of safety policies, procedures and practices, as well as investigation and evaluation of safety incidents/accidents. Employees with incentives to offer their ideas and whose contributions are taken seriously are more satisfied and productive on the job (OSHA, 2009). Management that adopts em-

employee suggestions will increase employees' motivation to make a difference and go beyond in ensuring organizational safety (Wiegmann et al., 2002; Geller, 1994), and in complying with safety records of organizations. Consequently, employees become proactive in safety management, which in turn increases their awareness of safety risks in the workplace and actively comply with safety procedures and regulations. We thus hypothesize the following.

Hypothesis 2a: In an organization with higher employee involvement will be positively related to proactive safety management. A proactive safety management will be positively related to safety awareness and behavior among employees.

An organization with a good safety climate thus encourages employees to report safety problems without fear of retribution, as well as provides timely and valuable feedback to all employees (Wiegmann et al., 2002). Increased employee participation motivates them to constantly provide safety suggestions in the workplace, thus encouraging them to actively report safety concerns and share their knowledge expertise with colleagues (Geller,

1994). A reporting system can function as an effective feedback loop that enables management to understand safety problems in the workplace. This system also acts as an information sharing and organizational learning venue for incidents in the workplace, ultimately preventing future incidents proactively (IAEA, 2002; Reason, 1997). Employees who demonstrate free and uninhibited reporting of safety issues increase their safety awareness and willingness to comply with safety practices. We thus hypothesize the following.

Hypothesis 2b: In an organization with higher employee involvement will be positively related to safety reporting among employees. A sound safety reporting climate will be positively related to safety awareness and behavior among employees.

In addition, several accidents in high-risk systems are related to teamwork failure (Helmreich & Merritt, 1998). Teamwork, which comprises communication, coordination, and collaboration among team members, profoundly impacts safe operation. Employee involvement increases interaction and autonomy of team members, leading to a sense of

responsibility for safety among team members (Parker & Turner, 2002). A strong feeling of responsibility and ownership for safety can encourage workplace safety, subsequently increase group communication and collaboration and reduce monotony (Cohen & Ledford, 1994). Through safety reminders and knowledge sharing among team members, employee awareness of workplace risks can be enhanced. Additionally, cohesion and collaborative relations among work group members and supervisors are positively associated with safety compliance (Simard & Marchand, 1995, 1997). Hofmann & Stetzer (1996) indicated that group processes such as planning and coordinating approaches prevent team members from engaging in unsafe acts, subsequently resulting in fewer injuries and less unsafe behavior. In sum, with higher quality teamwork atmosphere in an organization will be help to increase the safety awareness and behavior. We thus hypothesize the following.

Hypothesis 2c: In an organization with higher employee involvement will be positively related to teamwork climate among employees. With higher quality teamwork climate will be positively related to safety aware-

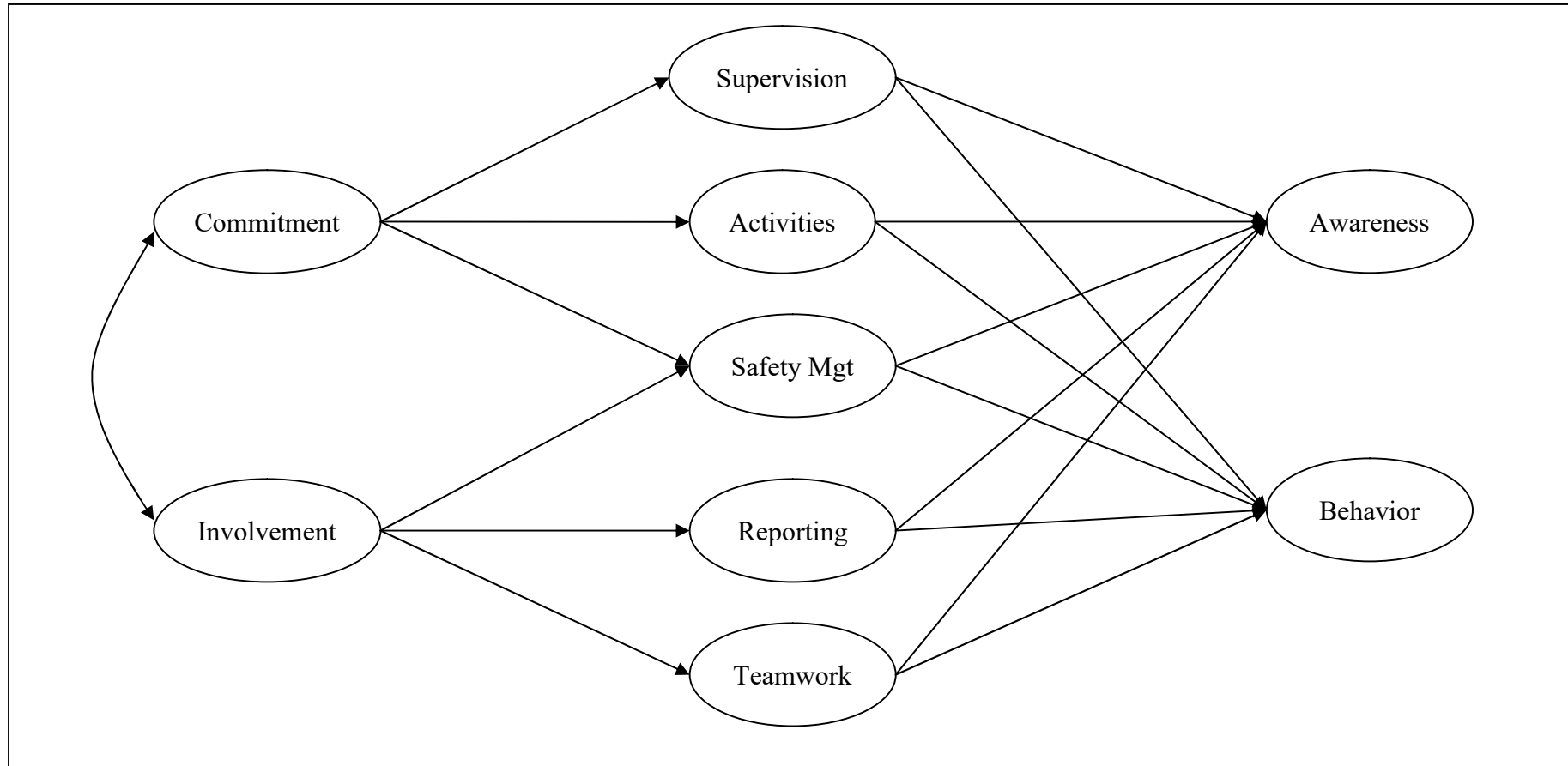
ness and behavior among employees.

Based on those relationships between organizational factors (management commitment and employment involvement) and safety performance (safety awareness and safety practices), a fully integrated structural model is developed. Figure 1 graphically depicts the relationships specified in the above hypotheses.

Methods

Participants

Survey questionnaires of this study were distributed to 350 front-line workers from steel plants of two steel companies in Taiwan. The participants were selected using a stratified random sampling method. Thus, the number of samples selected from a department was proportional to the relative size of the department in one company. The questionnaires were administered during working hours. The investigators described the procedures of the study, and promised confidentiality. The process was supervised by members of research team. Participants were asked to fill out the questionnaire anonymously and collected immediately by



Note. Commitment=Management commitment; involvement=Employee involvement; Activities=Safety activities; Safety Mgt= Proactive safety management; Reporting= Safety reporting; Awareness=Safety awareness; Behavior=Safety behavior

Figure 1. The hypothetical model of the present research

Table 1. Profile of respondents from frontline employees (N=323)

Demographic variable	Respondents	
	Frequency	(%)
Gender		
Male	304	94%
Female	19	6%
Age		
21-30	23	7%
31-40	58	18%
41-50	123	38%
51-60	113	35%
>61	6	2%
Job categories		
Plant services	36	11%
Shop floor	264	82%
Other	23	7%
Work experience		
< 5 years	23	7%
6-10	39	12%
11-15	61	19%
16-20	68	21%
21-25	71	22%
>25	61	19%

investigators. The response rate was 92% (n=323). Respondent characteristics are shown in Table 1 above.

Materials and Measures

The survey questionnaire items were adopted from a safety assessment system questionnaire, as developed by the Central Research Institute of Electric Power Industry (CRIEPI) in Japan (Takano et al., 2001). Each questionnaire item uses a 5-point Likert-type scale, with an-

swers ranging from 1 (strongly disagree) to 5 (strongly agree), indicating the extent to which the respondent agreed with items. The reliability and validity of the Taiwanese-version questionnaire has been demonstrated in earlier studies (Hsu, 2005; Hsu et al., 2008). To fulfill the objectives of this study, questionnaire items were selected in the above-mentioned factors from four categories: organizational factors, including management commitment and employee involvement; safety

management factors, including safety activities, proactive safety management and safety reporting; work group process factors, including supervision and teamwork; and safety outcome factors, including safety awareness and behavior. Table 2 lists the definition, item number, and an example item of each factor.

Data Analysis Procedures

Questionnaire items were analyzed to confirm the construct validity of the factor measurement model using confirmatory factor analysis (CFA), as conducted by LISREL version 8.54. The internal consistency reliability of each factor was examined using Cronbach's alpha coefficient (Churchill, 1991; Nunnally, 1978). The factor variables were analyzed using descriptive statistics and intercorrelations. Hypothetical structural relationships among organizational factors were examined using structural equation modeling (SEM), also conducted by LISREL version 8.54.

Measurement adequacy of CFA and SEM was evaluated using several goodness-of-fit indices, as recommended by researchers (Bentler, 1992; Bentler & Bonett, 1980; Joreskog & Sorbom, 1993; Maruyama,

1998): chi-square (χ^2), normed fit index (NFI); non-normed fit index (NNFI); comparative fit index (CFI); incremental fit index (IFI); root-mean-squared error of approximation (RMSEA). Bentler (1992) recommended NNFI, CFI, IFI scores of .90 or more indicate an acceptable data fit. A RMSEA value up to .05 indicates a good-model fit; a value of .08 or lower indicates an acceptable model fit; a value exceeding .10 indicates poor model fit (Joreskog & Sorbom, 1993).

Results

Measurement Model Testing

The overall measurement model fit was evaluated by χ^2 (557) =1614.95, $p < 0.01$. Since χ^2 is affected by sample size, we recommend using other fit indices. RMSEA values of 0.077 (i.e. lower than 0.08) indicate that the measurement model is an acceptable model fit. Others indices exceeding or near 0.9 indicate that the measurement model is acceptable (i.e. the NFI was 0.92; the NNFI was 0.94; the CFI was 0.95; the IFI is 0.95). In sum, test results indicate that the construct validity of factors is adequate. The Cronbach's alpha value of

Table 2. The definition, item number, example item for all constructs

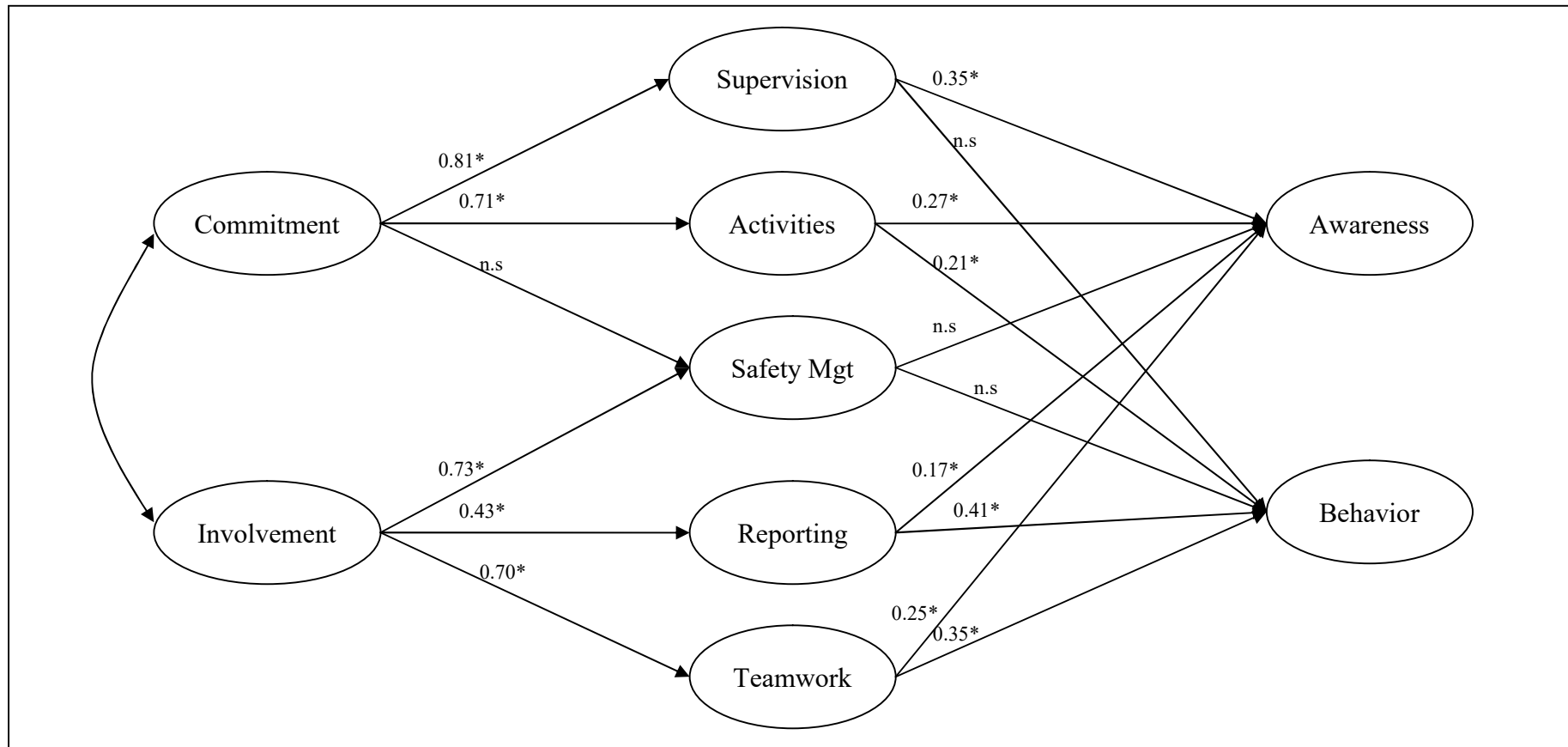
	Constructs (# of items)	Definition	Example item
1	Management commitment (4)	Top management identifies safety as a core value and demonstrates positive and supportive safety attitudes	Management places a high priority on safety operations in company
2	Employment involvement (4)	Employees are involved in safety meetings and safety decision-making processes.	Employees were involved in safety decision meetings in the workplaces
3	Safety activities (4)	The ways how an organization implements safety policies, and promotes safety management practices	Safety activities are frequently held at workplace.
4	Proactive safety management (4)	Perceived quality and effectiveness of proactive safety management system in an organization	The company modifies safety procedures in response to incident occurrence
5	Safety reporting (4)	Employees are willing to report safety problems of mistakes in the workplace	Coworkers are willing to making reports to upper management regarding safety mistakes
6	Supervision (4)	Supervisor's efforts spent in instructing and monitoring employee safety	Supervisors frequently go around inspecting the workplace.
7	Teamwork (4)	Communication, coordination, and collaboration among team members	Team members help each other finish their work.
8	Safety awareness (4)	Employees' risk perception to workplace	When in doubt about safety is in question, I proceed with great caution.
9	Safety behavior (5)	Employees' risk-taking behavior and compliance to safety rules and procedures	I comply with safety rules and procedures.

Table 3. Descriptive Statistics and Intercorrelations for all constructs in present study (N=323)

Constructs	M	SD	1	2	3	4	5	6	7	8	9
1 Management commitment	3.96	0.59	0.85								
2 Employment involvement	3.84	0.61	0.71**	0.83							
3 Safety activities	4.00	0.60	0.77**	0.68**	0.87						
4 Proactive safety management	3.85	0.64	0.61**	0.75**	0.77**	0.79					
5 Safety reporting	3.64	0.49	0.20**	0.45**	0.27**	0.23**	0.67				
6 Supervision	3.83	0.61	0.68**	0.74**	0.63**	0.71**	0.17**	0.81			
7 Teamwork	3.74	0.53	0.55**	0.45**	0.44**	0.44**	0.26**	0.48**	0.75		
8 Safety awareness	3.95	0.54	0.59**	0.62**	0.60**	0.58**	0.20**	0.67**	0.45**	0.80	
9 Safety behavior	4.06	0.46	0.57**	0.51**	0.59**	0.55**	0.37**	0.50**	0.41**	0.57**	0.77

Element in the diagonal are the values of Cronbach's alpha for each construct

* $p < 0.05$. ** $p < 0.01$.



Note. Commitment=Management commitment; involvement=Employee involvement; Activities=Safety activities; Safety Mgt=Proactive safety management; Reporting= Safety reporting; Awareness=Safety awareness; Behavior=Safety behavior. * $p < .05$

Figure 2. The modified structural model with standardized path coefficients

each factor exceeds 0.6, demonstrating the adequacy of the internal consistency reliability of the questionnaire (Churchill, 1991; Nunnally, 1978). Table 3 lists the descriptive statistics and inter-correlations among the factors in different levels.

Structural Model Testing

The hypotheses of structural model depicted in Figure 1 were validated by performing structural equation modeling (SEM). The overall fit of the structural model was evaluated by $\chi^2 (577) = 1760.07, p < 0.01$. Since χ^2 tends to be affected by sample size, other fit indices are used in this study. The values of RMSEA were 0.080 (near 0.08), indicating that the measurement model has a reasonable model fit. Others indices (the NFI was 0.91; the NNFI was 0.93; the CFI was 0.94; the IFI was 0.94) exceeded or approached 0.9, indicating that the structural model is acceptable. In sum, test results indicate that the structural model is adequate. According to model testing results, most paths in the structural model were statistically significant except four paths from management commitment to safety management, from safety management to safety awareness and behavior, and from supervision to safety behavior. Fig-

ure 2 presents the standardized path coefficients in the modified model.

Discussion

This study explores the relationships between management commitment and employee involvement and safety outcomes by performing structural model analysis. The results of the structural models revealed these two important organizational factors (management commitment and employee involvement) related significantly affect safety awareness and behavior of employees, which are consistent with previous studies, indicating that management commitment and employee involvement are essential to safety performance (Brown & Holmes, 1986; Dedobbeleer & Beland, 1991; Flin et al., 2000; Zohar, 1980). The findings of this research have several theoretical and practical implications for safety and organizational studies, which will be discussed as follows.

First, our results demonstrate that management commitment significantly affects the supervision of line managers. However, increased supervision has significant effects on employee safety awareness than employee safety behavior. This finding can be explained by that Taiwanese

line managers tend to be involved in daily safety activities and demonstrate their safety supervisory capability. Continuous work instructions and process monitoring from a line manager only increase risk awareness and safety knowledge of employees at the cognitive level, and the improvement of safety behavior is not significant. To promote safety behavior of employees, Taiwanese upper management and line management should emphasize on the importance of behavioral safety. They should provide visible management and become actively involved in implementing safety programs. Doing so would help all organizational members to understand clearly management commitment to safety, performance required and the measures achieving goals. Additionally, management should stress the importance of accountability to avoid employees from over relying on line managers. Employees should be held accountable for safety responsibilities, and their performance should also be evaluated in relation to standards or goals that yield positive consequences (OSHA, 2009).

Second, we find upper management commitment to safety has significant effects on safety activities, and however, the effect on pro-

active safety management is not significant. This result reveals management of Taiwanese steel industry tends to adopt an activity-based reactive approach to respond to safety problems. This finding is consistent with the research conducted by Hsu et al. (2008). In the workplace, the performance of holding safety activities and safety campaigns is apparent and attainable. Conversely, enhancement of proactive safety management practices requires additional efforts, and safety management performance is not apparent. Therefore, Taiwanese management should shift their style of safety management system from reactive approach to proactive approaches (Geller, 2001; Hsu et al., 2008, 2002). Although our research indicates holding safety-related activities such as training and campaigns are very important in promoting safety awareness and behavior, they should more heavily emphasize establishing the importance of proactive safety management system, especially with respect to preventing and controlling potential hazards at workplace. Establishing safe work practices and using personal protective equipment (PPE) can significantly reduce employee exposure to potential hazards. Companies should also computerize their hazard monitoring systems, which

can easily search hazards and accidents investigation reports and track their corrections. Moreover, management must be aware of possible emergency contingencies and plan the most effective means of controlling or preventing hazards during emergencies (Geller, 2001; Santos-Reyes & Beard, 2002; OSHA, 2009). In addition, we also find that employee involvement significantly affects proactive safety management in Taiwanese steel plants, which is consistent with the findings of Geller (1994), who stated employee involvement can improve safety management programs from reactive to proactive. It is a good way to increase proactive safety management through employee involvement. Employee involvement can provide an effective means of continuously solving safety problems and expressing their own commitment to safety, subsequently causing employees to more heavily emphasize the importance of proactive safety management (Wiegmann et al., 2002). To ensure their greater satisfaction and productivity on the job, employees should be invited to participate in management or specific purpose decision-making committees. They should be encouraged to provide recommendations and presentations at safety meetings, especially those

employees who offer their ideas and whose contributions should also be taken seriously. Additionally, employees should be regularly involved in developing and modifying the site safety rules. They should also be authorized to conduct site inspections and participate in accident/incident investigations. Analyzing hazards in the work process and preparing safe work practices would help to eliminate or reduce workplace hazards. Taiwanese management should shift their thinking from top-down directive to bottom-up involvement (Geller, 2001).

Third, our results indicate that employee involvement significantly affects safety reporting among employees. An effective safety reporting system is the keystone of preventing accidents (Eiff, 1999, Reason, 1997). Employee involvement can also help to establish a good reporting culture, ultimately enhancing employees' safety awareness and behavior, which are consistent with the previous studies (Brown & Holmes, 1986; Dedobbeleer & Beland, 1991; Reason, 1997; Zohar, 1980). To establish a sound reporting culture, management should incorporate the employee suggestions in safety-related decisions for the safety reporting system. Employees should be encouraged to freely and uninhibitedly

report safety issues during daily activities (Wiegmann et al, 2002). Management should also avoid blaming an individual or group for mistakes of injury-producing incidents in the workplace. Mistakes or injuries provide an opportunity to accumulate facts from a system (Geller, 2001). For a successful safety program, employees must draw attention to safety mistakes without fear of retribution; otherwise, knowledge expertise is suppressed (Reason, 1997). Additionally, management should establish a structural feedback system to inform employees that their recommendations or concerns to occupational safety have been reviewed and what improvement actions are taken (Wiegmann et al., 2002).

Finally, our results indicate that employee involvement significantly can help to facilitate high quality of teamwork among employees, ultimately enhancing employees' safety awareness and behavior. This finding is consistent with the previous studies (Parker & Turner, 2002). Teamwork issues in the workplace have been increasingly paid more attention. To achieve the goals of operations in an organization, employees must be able to collaborate with others effectively. Employee involvement can enhance communication, coordination and collaboration of team members, and in-

crease group cohesiveness. Therefore, management should stress the importance of teamwork building while involving employees into safety meetings or activities. To facilitate the high quality of teamwork, an organizational incentive system should be designed based on the team performance. Management should continuously encourage open information sharing among employees. Employees should also be invited to support team members by providing feedback on risks and assisting them to eliminate hazards. Additionally, management should establish an organizational learning culture. Through sharing knowledge expertise within an organization, teamwork quality increases, which will help to promote the safety awareness and behavior of employees.

Despite the above contributions, this study has certain limitations. First, this study was only one cross-sectional research, making it impossible for us to investigate how these two factors influence safety outcomes over time. This clearly limits the extent to which we can make a causal inference. To further clarify the efficacy of this study, future studies should perform a longitudinal study. Second, the samples in this study are limited to Taiwanese front-line workers in the steel industry.

Results of this study clearly limit the extent to which we can make inferences for various high risk industries, thus necessitating further safety studies in different high risk industries. Third, according to previous studies (Barling & Zacharatos, 1999; Barling et al., 2002; Hofmann & Morgeson, 1999; Kelloway et al., 2006), management leadership styles significantly affect safety outcomes. Future research should attempt to incorporate the role that leadership styles play in current studies. Fourth, previous studies indicated that these two safety-related organizational factors have cross-cultural characteristics. However, exactly how these two safety-related organizational factors influence safety management may differ across different cultures, thereby necessitating further comparative studies in other cultures.

Conclusion

As is widely recognized, management commitment and employee involvement significantly influence safety performance. However, exactly how these safety-related organizational factors influence safety outcomes has seldom been addressed. By performing structural model analysis, this study explores how management commitment and em-

ployee involvement and safety outcomes are related. Analytical results support our hypotheses, in which we postulate that management commitment and employee involvement significantly influence the safety awareness and behavior through a safety management system and work group processes. Results of this study have valuable implications for upgrading safety management programs in other high-risk industries.

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