Exploring Factors Influencing Supervisor's Behavior on Safety Action

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Abstract

Accident is one of the essential issues in managing construction projects. Many research studies are conducted to solve this problem but the accident rate in construction is still high. Unsafe behavior is claimed as the root cause of accidents. Supervisor is found as the intermediate facilitator to ensure safety practice in construction project. The good safety behavior of supervisor can influence on safety actions that prevent an unexpected accident. Therefore, this paper aims to explore the factors influencing supervisor's behavior on safety action at construction site. The questionnaire was developed from literature related to factors influencing on safety behavior. The survey was performed during March and April 2010 in Vietnam. From the survey, 800 questionnaires were distributed to supervisors who were working at 39 construction sites in Hochiminh city, one of the most developing cities in Vietnam. Finally, 434 respondents are collected and 403 data were used for analyses. Factors analysis technique was applied to group twenty five variables into six main factors. The analysis illustrates the six factors influencing supervisors' behavior. These factors are organizational and managerial influence, project characteristics and work assignment, superiors' pressure and workers influence, safety knowledge and learning, working motivation and supervisor habits.

Keywords: Middle management, Safety behaviors, Safety management, Supervisor behavior.

Needs of Safety Management in Construction

Safety improvement is one of the essential issues in construction projects. Comparing with other industries, construction industry faces with several hazards environment. It also shows the highest accident record due to its characteristics such as decentralization, high mobility, weather condition and uncertainty of work condition (Arditi et al., 2007; Chan and Au, 2007). Moreover, the consequences from construction accident are uncountable. It causes human tragedies, adversely affects other workers and breaks the goals of project such as cost overrun, project delay and low productivity. In addition, it can ruin reputation of the construction company (Mohamed, 1999).

Safety management aims to ensure the construction process performed in safety status. By providing an effective safety regulation and positively workplace environment, safety management can improve spirit of workers. A good safety management system can bring more benefit to company than expected such as increase competitive bidding, improve reputation, raise company profit by saving accident cost and high productivity. From

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these reasons, both developed and developing countries from around the world are showing an interest in the concept of improving safety management.

Factors Influencing Safety in Construction

Based on the benefits of safety implementation, many research studies have been carried out to explore methods for improving the safety in construction site. These topics are very extensive explorations including overall fields in construction safety management such as occupational health, technology application, safety law, organizational safety culture, safety climate, safety performance, training, partner's attitude and behavior. These researches contributed an extra great part in reducing accident in construction. According to Sawacha (1999), organization policy is the most important group influencing safety performance. In addition, by factor analysis result, top five related issues impact to the safety in construction site are management talk on safety, provision of safety booklets, provision of safety equipment, providing of safety environment and appointing a trained safety representative on site.

Impacts of Behaviors on Safety Workplace

Almost construction companies have spent a lot of time, money and effort to set up a safety management system. Over a long period, these efforts tend to reduce dramatically in accident rates. However, these rates are considered too high and caused many unfortunate consequences. Approximately 80 to 95 percent of all accidents are triggered by deeply ingrained unsafe behavior (Cooper, 1998). Consequently, researches about behavior related to safety were carried out.

The safety behavior concept is considered one of the significant causes affect safety performance in construction site. It can be measured and improved to achieve better safety performance at construction site (Duff et al., 1994). Zhou (2008) explored factors influencing safety behaviour and identify strategies to control the factors that have the most impact on safety behavior in complex construction scenarios. There are some other studies about safety behavior were made such as Cox (2004), Prussia et al. (2003), Lingard and Steve (1998), DeJoy (1996), and Duff et al. (1994). But these researches focus on worker level only, they tried to identify the factors can effect the worker behavior to change worker behavior more positive safety as Brown et al. (2000), Langford et al. (2000), and Lingard (1995).

Looking to the construction parties' roles, it could be pointed that supervisor is vital to organizational success. Dan Petersen had pointed that "Safety excellence only occurs when supervisors, managers and executives demonstrate their values through actions, and their credibility by asking hourly workers to improve the system"[3]. The owners, top executives, and middle managers must be committed to safety. However, supervisor is one of management representatives who daily contact with the employees. The supervisor is claimed as the key person for implementing safety program. Even though in construction have a safety engineer or a safety director, the supervisor is still responsible for ensuring that the safety directives are carried out. The supervisor should be assured that employees can perform work safely. In addition, the supervisor should shape the employees' attitude toward safety (Ludden and Capozzoli, 2000). A supervisor behavior

[3] *http://www.asse.org/societyupdate/archive/0505.php*

on safety action is found as important attributes to influence worker, control the hazards and prevent accident at the site. This paper aims to explore the factors influencing supervisor's behavior on safety action at construction site.

Questionnaire Design

The research questions were developed with the intent of exploring factors influencing supervisor' behavior on safety actions. The first list of twenty variables were established from the related literature review (Hofmann and Stetzer, 1996; Cooper, 1998; Neal et al., 2000; Mohamed, 2002; Prussia et al., 2003; Zhou et al., 2008). Questionnaire also based on the Theory of Planned Behavior (Fishbein and Ajzen, 1975; Ajzen, 1991). The pilot survey was conducted to test to questionnaire from 112 respondents at nine construction sites and one Cultivate Professional Supervision in Construction course. Almost respondents agreed the importance of twenty existing items for factor influencing supervisor behavior and also added five more variables. In summary, the questionnaire comprised twenty five variables that affect the supervisor's behavior on safety action. The factors also include personalities, safety attitudes, subjective norms, perceives' behavior control. For each variable, supervisors were required to express their individual perception. Respondents indicated the strength of agreement or disagreement using a five point Likert scale, under categories of 1= strongly disagree, 2= disagree, 3= neither agree nor disagree, 4= agree, and 5= strongly agree.

Data Collection

The main objective of this research was to explore factors influencing supervisors' behavior on safety action at the construction site in Vietnam. The survey was conducted to collect data from 800 supervisors who were currently involving on 39 construction sites and one Cultivate Professional Supervision in Construction course at Hochiminh city. There are 434 respondents who participated in this survey and sufficiently complete to be included in data analysis, producing a usable response rate of 54.25%.

Survey introduction to managers conducted by one of the authors with supporting from company site officer. Of those supervisors responding, the average age was 29.46 years and cover from 20 to 68 years old. All of them were male (100%) and had experience as supervisor at construction site from beginning to 22 years experience, average 3.54 years experience. Almost all responders had acceptable education background (89.2% undergraduate) and at least 1 time attends the Supervisor Course (77.2%). The data showed that 34% of the respondents had little knowledge about safety, 49.4% had necessary safety information and knowledge and only 16.6% satisfied supervisor requirement to control or avoid all potential hazards. The characteristics of respondents covered all possible expected, so they could be representative for supervisor level at construction site.

Factor Analysis

The data collected from the questionnaire surveys were analyzed by using Statistical Package for Social Sciences (SPSS) program. Two statistical techniques were used as Pearson's Correlation Coefficient and the Factor Analysis. Pearson's Correlation analysis was used to describe the strength and direction of the relationship among variables. The

matrix showed that there were cross correlation among variables at a significant level. After that, the Factor Analysis technique was applied to reduce the large amount of variable factors to small groups of factors, showing the factors that has most influence on supervisors' behavior on safety actions.

Factor analysis, a multivariate statistical technique, was used to identify a smaller number of relevant factors than the original number of individual variables. The application of this technique can reduce the data to a representative subset of variables or even create new variables as replacements for the original variables, while still retaining their original characteristics. The twenty five variables of the Positive and Negative Affect scale (PANAS) were subjected to principal components analysis (PCA) using SPSS. Prior to performing PCA the suitability of data for factor analysis was assessed; three assumptions were required to be validated.

Data Validation for Factor Analysis

Prior to performing factor analysis, the suitability of data for the analysis was assessed. In order to do that, the first validation was to measure the adequacy of sample the size. The preferable sample size should be 100 or larger. As a general rule, the minimum should have at least five times as many observations as there are variables to be analyzed (Hair et al., 2010). The sample size of the supervisor was 403, with the ratio of 16.12 cases to 1 variable, which satisfied the specified limit.

The second validation was to assess the factorability of the correlation matrix via the correlation matrix of survey. Inspection of the correlation matrix revealed that more than 20 percent of the correlations were greater than 0.30 at the 0.01 level of significance. This result provided an adequate basis for proceeding to the next level, the empirical examination of the adequacy for factor analysis.

The third validation was to examine the anti-image correlation matrix; the diagonals on that specific matrix should have an overall Measure of Sampling Adequacy (MSA) of 0.50 or above (Hair et al., 2010). The same criterion of MSA applies to the values of individual variables; which should be considered for elimination from further analysis if they were low on this measure (Hair et al., 2010). After omitting the above variables, the MSA test was conducted again, to check the revised values for overall and individual MSA. The set of variables exhibited satisfactory values above 0.50 and therefore were deemed fit for further analysis. The checked data set of 25 variables resulted in a Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy of 0.845, which is considered as meritorious. Another mode of determining the appropriateness of factor analysis, the Bartlett test of sphericity, reached statistical significance with chi-square 3807.97, degree of freedom 300 and significance level of 0.000. Therefore factor analysis technique was deemed appropriate.

Research Findings

Factor analysis was used to explore factors influencing supervisor behavior on safety actions. The initial captures of these factors were extracted by using principal component analysis. The factor solution without rotation presented six (6) distinct factors with eigenvalues equal to or greater than unity (Tabachnick and Fidell, 2007). Lastly, varimax rotation was performed for interpreting the factors structure and naming the factors.

A varimax solution make as easy as possible to identify each variable with a single factor. The six-factor solution accounted for 60 percent of the total variance. The factors were then examined to identify the number of items that were loaded on each factor. The rotated factor loading of 25 items was presented in Table 1.

Table 1. Factors Influencing Supervisor's Behavior on Safety Actions (N = 403)

Factors	Factor Loading	Mean	SD.	IMP Index	Influence Ranking
Factor 1. Organizational and Management Influence. (Cronbach's Alpha = 0.867; Eigenvalues = 3.707)		**4.249**	**.725**	**5.864**	**II**
Safety management system	.816	4.397	0.865	5.086	2
Safety regulations and procedures	.796	4.298	0.898	4.785	3
Company vision about safety	.777	4.248	0.950	4.469	5
Financial supports for safety	.740	4.206	0.972	4.327	7
Workplace environment	.660	4.104	0.959	4.280	8
Providing of safety training programs	.648	4.241	0.962	4.410	6
Factor 2. Project Characteristics and Work Assignment. (0.796; 2.914)		**3.654**	**.877**	**4.167**	**IV**
Project schedule	.804	3.918	1.124	3.484	11
Amount of work responsibility	.766	3.692	1.199	3.080	16
Project scale	.752	3.660	1.218	3.005	18
Type of project owner	.678	3.382	1.211	2.794	20
Weather conditions	.484	3.615	1.156	3.127	15
Factor 3. Project Stakeholder Influence. (0.794; 2.679)		**3.798**	**.894**	**4.250**	**III**
Project owner	.832	3.893	1.131	3.442	12
Top manager	.804	3.940	1.084	3.634	10
Community pressure (government, law, ...)	.665	3.742	1.147	3.261	13
Workers	.507	3.618	1.181	3.062	17
Factor 4. Personal Background and Safety Knowledge. (0.643; 2.128)		**4.211**	**.703**	**5.993**	**I**
Safety knowledge	.706	4.591	0.837	5.486	1
Working experience	.674	4.290	0.934	4.591	4
Supervisor capability to control workers	.594	4.032	1.003	4.019	9
Education background	.518	3.931	1.228	3.201	14
Factor 5. Social Influence. (0.604; 1.953)		**3.294**	**.869**	**3.789**	**V**
Family	.720	3.258	1.292	2.522	23
Coworkers	.629	3.387	1.143	2.962	19
Age	.580	3.166	1.419	2.231	25
Salary satisfaction	.495	3.365	1.275	2.639	22
Factor 6. Supervisor Habits. (0.708; 1.578)		**3.676**	**1.261**	**2.916**	**VI**
Smoking	.874	3.355	1.357	2.472	24
Drinking	.849	3.998	1.505	2.655	21

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization

Discussion of Research Findings

Discussion of the research findings is based on the results of the correlation and factor analysis technique which are shown in Table 1 and Table 2. Six factors are identified in Table 1. Each factor is named to represent list of variable. To ensure that the items comprising the factors produced reliable scales, Cronbach's alpha coefficient of internal consistency is calculated for each scale. Cronbach's alpha values range from 0.604 to 0.867, higher than standard value 0.600 (Tabachnick and Fidell, 2007), indicating adequate internal consistency.

Organizational and Managerial Influence (F1)

The first factor, "Organizational and Managerial Influence", accounts for 14.827% of the total variance and comprises 6 items. It includes Safety Practice, Safety Regulation, Financial Supporting, Control Capacity, and Commitment of Top Managers. It indicates the degree of supervisor's belief about organization role. Organizational management's safety responsibilities strongly influence their safety behavior. The majority of items present relatively high factor loadings (>0.65). However, "Providing of safety training programs" shows moderate value of factor loading. The highest factor loading item is "Safety management system" indicating the important role of management system. They recognize management as a safety associate. This result emphases the organizational role in creating a safety environment in which employers perform work safely. This finding adds further support to earlier researches on health and safety about the role of organization and management. For example, Mearns (2003) emphasized that organization policies and procedures can protect their workers from hazard workplace and reduce hazard in workplace. Jannadi (1996) also found that roles and functions of safety management system, or safety management system to control risk can be essential factors. This research gives additional evidence that organization can impact on the worker safety through the middle level, supervisors who direct influence on workers daily.

Project Characteristics and Work Assignment (F2)

The second factor, "Project Characteristics and Work Assignment", contains five items and accounts for 11.656% of the total variance. This factor includes five items relating to properties of project, and the other to the weather influence. Collectively, this group of items demonstrates the supervisors' perception of the influence from project properties to their behavior in safety actions. The majority of items enjoy relatively large factor loadings (>0.65), except item "Weather conditions". The first and the second are "Project schedule" and "Amount of work responsibility". The actual workflow process may be reinforces peoples' unsafe behavior. Supervisors sometimes turn a blind-eye or encouraging employees to take a short-cut to do the job. They also work under pressure to finish project on time rather than keep safe workplace. Next are "Project scale" and "Type of project owner". Different scale and project owner causes different interest of supervisor about safety. Real practices at small construction site demonstrate supervisors usually negligent and leave workers unsafe working. In the large scale project, supervisors are remarked about their safety role. In that case, their safety behavior is well embedded in their workplace. However, supervisors' behavior in safety should be fulfilling their obligation in any situations because the damages caused from accident are not different no matter how project size are. The last item, weather conditions in which

project was placed, weakly associated with this factor with the factor loading low. However, it also expresses the influence to supervisor behavior.

Superiors Pressure and Workers Influence (F3)

The third factor, "Superiors Pressure and Workers Influence", has four items and accounts for 10.714% of the total variance. Three of four items in this group factor are related to supervisors' pressure, namely project owner, top manager and community, impact supervisor behavior. Supervisors' behavior is strongly influenced by the community. Community conception believes that construction site accident is evident truth, there is no-site can get the zero-accident. The common responses of supervisors on safety practice was "Construction work is dangerous, so people have to look out for themselves" (Holt, 2001). This concept not only impacts on supervisors' behavior but also creates a fulcrum for unsafe behavior. Supervisor perception indicated project owner and top manager also has been influence to them. The last item is an influence from workers. The result shows moderately factor loading because workers normally have less influence on supervisors' behavior in term of command line. But workers can influence supervisors' behavior through their commitment on work safety.

Safety Knowledge and Learning (F4)

The fourth factor, "Safety Knowledge and Learning", includes four items and accounts for 8.513% of the total variance. Factor includes "Safety knowledge", "Working experience", "Supervisor capability to control workers" and "Education background". This is one of the most important influences on construction site safety. According to Anderson and John (1999), lack of education and training is one of seven factors that attributes the non-improvement in the construction industry accident rate. Among four items of this factor, "Safety knowledge" and "Working experience" have high factor loading. It demonstrates a high perception of supervisor about the important of safety knowledge to their job. The other two items have less factor loading. All of the respondents did not highly appreciate the influence of education background. Therefore, three levels of training are needed to improve safety in construction industry such as craft and skills training, training by employer to new employees upon joining, and training on-site induction process. It is also found that three conditions for successful safety training are the active commitment, support and interest of management, necessary finance and organization provide the opportunities to learn. Training about safety aims to improve supervisor about knowledge, skills and awareness of safety practice and regulation.

Social Influence (F5)

The fifth factor, "Social Influence", includes four items and accounts for 7.813% of the total variance. This factor includes the influence from family members, coworker, age and salary satisfaction. From the factor loading, the important from family members remind them working safely is pointed out. There is no doubt about family role in supervisors' behavior. They should keep safe for themselves and their worker because they are very important to their family. This concept is quite often used in the safety training in order to improve supervisors and workers behaviors. Another response of supervisors is "I don't want to become unpopular by going on about safety – I'd always be complaining and we wouldn't get the job done" (Holt, 2001). Despite the violation of organization's safety policy, supervisors became socialized and accepted the unsafe

practice as "normal" work behavior. They let worker perform work unsafely to avoid being teased or made fun of their co-worker, avoid to be a wimp in workers' eyes when he always remind about safety. Influence from co-worker is latent but very dangerous impact to supervisors' behavior in safety action. There is a relationship between age and person' behavior. Younger supervisor in many cases possess certain capabilities over older workers including increased strength, speed, and precision. However, they may lack to aware the hazard. Different from age will influence directly to their experience. Older supervisor may have some advantages in realizing and controlling hazards at the site through their experience. Under construction site environment, the older supervisor may present more competence than younger supervisor to give a command for work safety. Conversely, changing the unsafe behaviour of older supervisor is quite difficult. Lastly the satisfaction of salary can influence on supervisors' behaviour because supervisors who did not satisfy to their salary they may not have organizational commitment. Thus, they may neglect on safety practice while they supervised the construction task.

Supervisor Habits (F6)

The sixth or the last factor, "Supervisor Habits", combines two items which are "Drinking habit" and "Smoking habit" accounts for 6.311% of the total variance. All of items enjoy relatively large factor loadings (>0.80). Among 403 respondents were asked, more than 66% person respond have a habit of drinking and more than 24% have a habit of smoking. Although all of respondents can aware the extremely influence of these habits to their behavior on safety actions, they still keep their habits. This results should be consider in further analyze.

The correlation matrix showing relationships among the various factors, together with the means, standard deviations and important index is presented in Table 2.

Table 2. Summary statistics and correlations for all factors (N = 403)

Factor	Mean	SD.	Index	F1	F2	F3	F4	F5	F6
Factor 1	4.249	.725	5.864	1					
Factor 2	3.654	.877	4.167	.334**	1				
Factor 3	3.798	.894	4.250	.286**	.506**	1			
Factor 4	4.211	.703	5.993	.516**	.296**	.298**	1		
Factor 5	3.294	.869	3.789	.215**	.372**	.470**	.345**	1	
Factor 6	3.676	1.261	2.916	.180**	.152**	.084	.188**	.125*	1

**. Correlation is significant at the 0.01 level; *. Correlation is significant at the 0.05 level (2-tailed).

All of mean responses to these factors were high, exceed 3.0, suggesting that all of these factor considerable impact to supervisor's behavior. However, the variance was high for all of these factors, all of them above 0.70, showing that the same portion numbers of respondents either agree or disagree. The highest responses pertained to the fourth and first factors which are "Safety Knowledge and Learning" and "Organizational and Managerial Influence". It was found that most supervisors remarked the strong influence from these factors on their safety action. Mean responses of four remaining factor were not too high but above threshold of average 3.0. It proved that these four factors also affected supervisor behavior from themselves opinion. The influence

rankings of each item in each factor are also presented in Table 1. In the item point of view, supervisors' behavior is affected from their safety knowledge, safety management system, safety regulations and procedures, their experience, and company safety vision. These five items are the highest ranking within twenty items which studied in this research. The correlation matrix indicated that all organizational factors were significantly related to each other with the exception of Superiors Pressure and Workers Influence and Supervisor Habits. Coefficients ranged from 0.125 to 0.516. All these coefficients were positive and significant at the .01 level.

Conclusions

The serious losses and damages in construction industry require more research to improve safety performance. Understanding key factors influencing supervisor's behavior can encourage safety implementation at construction site. As a result, Supervisor's behavior can be influenced by several levels of factor which are organizational level, project level, individual level and especially social level. Some issues related to social level were discovered and highlight as family awareness about safety, influence from coworkers and salary satisfaction. Besides, the research outputs pointed out the influence from learning and knowledge factor as an important factor in changing supervisor behavior. Additionally, it was interesting from the results of factor analysis that supervisor behavior may be influenced by some of their habits such as drinking and smoking.

By understanding the factors and their important level of influencing supervisor's behavior, manager can change and improve the supervisor behavior to achieve better safety approach. The changing supervisors' behavior can directly influence on safety performance and worker's behavior because supervisors are the key persons who works in between senior managers and workers. However, this research has just explored the factors which may impact supervisor behavior. The intensity and direction of these impacts on changing supervisor behavior were not considered in this study. It is significant for further studies to identify the relationships of these factors influencing the supervisors' behavior. This can help the top manager has a good orientation in selecting and training their supervisors.

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