



## EXPLAINING MODEL FOR SUPERVISOR'S BEHAVIOR ON SAFETY ACTION BASED ON THEIR PERCEPTIONS

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### ABSTRACT

Supervisors play a significant role in controlling safety in construction projects. They provide good advice on safety practices and check the condition of equipment. The carelessness of supervisors may cause several accidents. Therefore, accident prevention is required the encouragement of supervisor to have good behavior on safety action. Although several research studies mention the importance of supervisor behaviors, few research studies are focused on factors influencing supervisor's behavior on safety action. This research aims to develop a model to explain the relationships between factors influencing and supervisor's behavior on safety action based on their perception. The questionnaire is developed from literature related to factors influencing safety behavior and issues represented supervisors' behavior on safety. The survey is performed within two months March and April 2010 in Vietnam. From the survey, 800 questionnaires are distributed to supervisors who are currently working at 39 construction sites and one Cultivate Professional Supervisor course in Hochiminh city, one of the most developing cities in Vietnam. Finally, 434 respondents are collected and 403 data are used for factor analysis, only 214 respondents are used to adopt structural equation modeling (SEM). Factors analysis technique is applied to group twenty-five variables into six main factors that are organizational and managerial influence, project characteristics and work assignment, superiors' pressure and workers influence, safety knowledge and learning, working motivation and supervisor habits. Results from SEM indicated the significant influence of project characteristics, superior pressure and safety knowledge on supervisor intentional behavior. This intentional behavior combined with organizational influence were positive impacts on supervisor behavior.

**Keywords:** middle management, safety behaviors, safety management, supervisor behavior.

### INTRODUCTION

#### Needs of safety management

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 record accident because of its characteristics as decentralization, high mobility, depending on 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. It can ruin reputation of the construction company (Mohamed 1999).

Safety management is the key to ensuring 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 these reasons, both developed and developing countries from around the world are showing an interest in the concept of construction safety management. Many construction organizations attempt to reduce the accident rate and achieve a zero-injury objective.

#### Factors influencing safety in construction

Because of safety's importance, many researches have been carried out to explore the 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, Naoum *et al.* (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

Understanding about safety significant and enormous loss from accidents, almost construction companies have spent much 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 sites. It can be measured and improved to achieve better safety performance at construction sites (Duff *et al.* 1994). Zhou (2008) studied a method by applying the technique to give more insight into the influence of safety climate and personal experience factors on safety behavior, and identifying 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 as Cox (2004), Lingard and Steve (1998), Duff, Robertson *et al.* (1994), Prussia, Brownb *et al.* (2003), DeJoy (1996). However 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 in Lingard (1995), Brown, Willis *et al.* (2000), Langford, Rowlinson *et al.* (2000).

Looking to the construction parties' roles, we can realize 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". The owners, top executives, and middle managers must all are committed to safety. However, because the supervisor is the one representative of management who has daily contact with the employees, the supervisor is the key person of the program. Even though in construction have a safety engineer or a safety director, the supervisor is still responsible for seeing that the safety directives are carried out. It is from the supervisor that employees know what should do in safety status. It is the supervisor who shapes the employees' attitude toward safety (Ludden and Capozzoli 2000). A good behavior in safety supervisor is very important to influence worker, control the hazards and prevent accidents at the site.

### Supervisors' behaviors on safety action

Supervisor is the one representative of management who has daily contact with the employees. Supervisor has the primary role in supporting and ensuring the accomplishment of work (Ludden and Capozzoli 2000). A research done by Rinefort and Fleet (1993) showed that there is a strong correlation between accident rate and the type of safety supervision provided by a company at the supervisor level. Results of these researches suggested that the better the safety supervision provided by a company the lower was the accident rate. The Samelson's work also highlighted some of the most important methods and techniques that affect to safety supervision at the supervisor level. For example, they may handle the new workers differently. They kept stresses off their crews, and their approach to safety is different. To ensure supervisor role on safety, since the late 1980s some countries have begun adopting "Construction Supervisor Scheme", and nowadays developing countries such as Thailand and Vietnam also. Supervisors are responsible for the safety of their employees. So their role is to enhance construction supervision by introducing checks and controls at various construction stages on behalf of the clients. Supervisors' duties are to ensure construction works in compliance with the construction regulations, to supervise execution of the work, to monitor construction safety, to prepare supervision plans and to notify the government in case of any violation of the relevant statutory legislations.

From supervisor's activities and roles, there is no doubt about supervisor's importance in successful projects, especially in reducing an accident rate. Supervisor's behavior strongly impacts the safety workplace at a construction site. So if we understand and know how to affect their behavior in safety positively, the accidents in sites can be obvious reduced considerably. Therefore a model to identify the factor that influence supervisor's behavior on safety action is necessary and significant.

This research aims to develop a model to explain the relationships between factors influencing and supervisor's behavior on safety action based on their own perception.

## RESEARCH METHODOLOGY

### Questionnaire design

The research questions were developed with the intent of establishing the model to explain the interior relationship among factors, behavioral intention and behavior. The questionnaire contented three sections.

The first section of variables were set up rely on the related literature review (Cooper 1998; Hofmann and Stetzer 1996; Mohamed 2002; Neal *et al.* 2000; Prussia *et al.* 2003; Zhou *et al.* 2008). Questionnaire also based on the Theory of Planned Behavior (Ajzen 1991; Fishbein



and Ajzen 1975). It comprised twenty five statements, which are considered factors that affect the Supervisor's behavior in safety, dealing with personalities, safety attitudes, subjective norms, perceives behavior control. For each statement, Supervisors were required to express their real responses. 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.

The second section involved ten hazard situations may occur at construction sites to measure behavioral intention. Supposing each situation happened ten times, respondents were asked how many time they "aware worker carefully or stop them working if necessary". This section was designed following the instruction of intention performance method (Francis *et al.* 2004).

The third section of questionnaires was developed with the intent of exploring the current behavior in safety actions of supervisors at construction sites. Following Dan Petersen (1976) guidelines and Gary W. Hobson (1990) behavior measurement, interview questions allow supervisors to describe how often they perform their safety role. Their safety responsibilities are expressed by four main issues which are investigating accidents to determine causes, Inspecting their area to identify hazards, Coaching their people to perform better, and Motivating their people to want to work safely. 12 questions related to main issues of safety are developed to assess current supervisor behavior. They represent important supervisor behaviors that build positive effect to workers. They were asked to responds how often they perform each activity to measure their behavior on safety action in five scales includes "Never", "Rarely", "Sometimes", "Usually", and "Always".

### Data collection

The subject firm for our study was supervisors working on construction sites at Hochiminh city. The survey is conducted to collect data from 800 supervisors who are currently involving 39 construction sites and one Cultivate Professional Supervision in Construction course. There are 434 respondents who are willing to participate 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 office. 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 a supervisor in construction site from beginning to 22 years experience, average 3.54 years experience. Almost all responders have acceptable education background (89.2% undergraduate) and at least one time attends the Supervisor Course (77.2%). The data show that 34% of the respondents have little knowledge about safety, 49.4%

have necessary safety information and knowledge and only 16.6% satisfy supervisor requirement to control or avoid all potential hazards. The characteristics of respondents cover all possible expected, so they can representative for supervisor level at a construction site.

### Factor analysis

Factor analysis, a multivariate statistical technique, is 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 25 items 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 are required to be validated.

An initial capture of factors was made for the data set of factor influencing supervisor behavior on safety actions survey, using the principal component analysis approach with exploratory factor analysis through SPSS. Factor solutions without rotation were computed. The latent root criterion was used with eigenvalues equal to or greater than unity, in order to establish the number of extraction factors (Tabachnick and Fidell 2007). This exercise revealed the presence of six (6) distinct factors. To obtain interpretable results for those factors, a varimax rotation was then performed. Varimax rotation minimizes the number of variables that have high loadings on any one given factor.

A varimax solution yields results that make it as easy as possible to identify each variable with a single factor. The six-factor solution accounts for 60 percent of the total variance. The factors are then examined to identify the number of items that loaded on each factor. The rotated pattern matrix for the remaining 25 items is presented in Table-1. The eigenvalues, percentage of variance explained are also displayed in this table. The results correlation matrix of factor in Table-2 show the strength of the relationship among 6 factors is not high; only correlation between factor 1 and factor 3 is -0.326, factor 2 and factor 5 is 0.325 exceed 0.3. So the assumption underlying the use of Varimax rotation is satisfied.

Six factors are identified in Table-1. Each factor is named to represent a list of variables. 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 six 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 emphasizes the organizational role in creating a safety environment in which employers can work safely. This finding adds further support to earlier researches on health and safety about the role of organization and management such as Jannadi (1996), Holt (2001) and Mearns (2003). Holt (2001) pointed out the key elements of successful safety management are policy, organizing, planning and implementing, measuring performance, reviewing performance and auditing. Jannadi (1996) also found that roles and functions of safety management system, or safety management system to control risk can be essential factors. Mearns (2003) emphasized that organization policies and procedures can protect their workers from hazard workplace and reduce hazard in workplace. This research gives additional evidence about the way 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 of 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 reinforced peoples' unsafe behavior. Supervisors sometimes are turning a blind-eye or encouraging employees to take a short-cut to do the job. They also get the pressure to ensuring the project schedule rather than keeping safe workplace. Next are "Project scale" and "Type of project owner". Different scale and project owner caused different interests of supervisor about safety. Real practices at small construction site demonstrate supervisors usually negligent and leave workers unsafe working. In the great scale or main important project in which the safety has a strong influence to their successful, the supervisors are remarked about their safety role. In that

case, their safety behavior is improved. These are normal psychology, but they should be changed. Supervisors' behavior in safety should be fulfilling their obligation in any situations because the damages caused from accidents 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 influenced strongly by the community. Community conception believes that construction site accident is evident truth, there is no-site can get the zero-accident. The most common responses of supervisors to questions on safety practice are "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 have certain influence to them. The last item is an influence from workers. It shows moderately loading 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 to 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. Factors include "Safety knowledge", "Working experience", "Supervisor capability to control workers" and "Education background". It 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 strong perception of supervisor about the important of safety knowledge to their job. The other two items have lower 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 employers 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 construction safety aims to improve knowledge, skills, and awareness in order to ensure supervisor can keep construction site at the basic safety level

#### **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 roles in supervisors' behavior. They should keep safe for themselves and their worker because they are very crucial to their family. This concept is quite often used in the safety training 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 works 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 a co-worker is latent but very dangerous impact on supervisors' behavior in safety action. There is a relationship between age and person's behavior. Younger supervisor in many cases possesses 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 supervisors 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 the younger supervisor to give a command for work safety. Conversely, changing the unsafe behavior of the older supervisor is quite difficult. Lastly, the satisfaction of salary can influence on supervisors' behavior because supervisors who did not satisfy to their salary they may not have organization commitment. Therefore, they may neglect on safety practice while they supervised the construction work task.

#### **Supervisor habits (F6)**

The sixth or the last factor, "Supervisor Habits", combines two items that are "Drinking habit" and "Smoking habit" accounts for 6.311% of the total variance. All of the 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 the respondents can aware the extreme influence of these habits to their behavior on safety actions, they still

keep their habits. This results should be considered in further analyze.

#### **Descriptive factors**

The correlation matrix showing relationships among the various factors, together with the means, standard deviations and the important index is presented in Table-3.

A correlation matrix was used for communicating the pattern of relations among factors. These descriptive statistics were calculated using SPSS Version 18. Level of influence of six factors, Organizational and Managerial Influence, Project Characteristics and Work Assignment, Superiors Pressure and Workers Influence, Safety Knowledge and Learning, Social Influence and Supervisor Habits, on supervisor's behavior were all measured using a 5-point scale. All of the mean responses to these factors were high, exceed 3.0, suggesting that all of these factors considerable impact on 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 first and fourth factor, Organizational and Managerial Influence and Safety Knowledge and Learning, suggests that all of supervisor remarked the strong influence from these factors on their behavior on safety action. Mean responses to 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 correlation matrix indicated that all organizational factors were significantly related to each other 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.

#### **STRUCTURAL EQUATION MODELING (SEM)**

Structural equation modeling (SEM) using AMOS 16.0 software was performed to test the research model and interrelationships between factors. Amos is short for Analysis of MOment Structures. It implements the general approach to data analysis known as structural equation modeling, also known as analysis of covariance structures, or causal modeling. Six independent variables - Organizational and Managerial Influence, Project Characteristics and Work Assignment, Superiors Pressure and Workers Influence, Safety Knowledge and Learning, Social Influence, and Supervisor Habits were explored their influence on intentional behavior and behavior. SEM enables researchers to answer a set of interrelated research questions in a single, systematic and comprehensive analysis by modeling the relationships among multiple and dependent constructs simultaneously. This capability for simultaneous analysis differs greatly from many generation regression models such as linear regression,



ANOVA, and MANOVA, which can analyze only one layer of linkages between independent and dependent variable at a time.

Since factor analysis reduced the number of variables to six factors, combined with intentional behavior and behavior measured variable, a satisfactory ratio of 30:1 cases per measured variable was achieved. For the purpose of this study, SEM was employed for the main task determining significant structural model between measured variables.

The structural model was undertaken using the SEM technique to uncover the significant

interrelationships between the factors retained from EFA. The conceptual model was described in Figure-1. Six constructs related to factor influencing supervisors' behavior that was explored from EFA, one construct represented for intentional behavior and one construct represented for current behavior were in this model. In order to achieve a higher Goodness-of-Fit model, some links between errors were sequentially added based on the result from Modification Indices (MI). The final model that was described in Figure-2 was the optimum model that achieved almost criteria for several fit indexes without too complex relationships.

**Table-1.** Pattern matrix, eigenvalues, percentage of variance explained for factor influencing supervisor's behavior on safety actions (N = 403).

Items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
<b>Factor 1. Organizational and managerial influence</b> (Cronbach's Alpha = 0.867)						
Safety management system	.816					
Safety regulations and procedures	.796					
Company vision about safety	.777					
Company financial supports for safety issue	.740					
Workplace environment	.660					
Providing of safety training programs	.648					
<b>Factor 2. Project characteristics and work assignment</b> (Cronbach's Alpha = 0.796)						
Project schedule		.804				
Amount of work responsibility		.766				
Project scale		.752				
Kind of project owner		.678				
Weather conditions at construction site		.484				
<b>Factor 3. Superiors pressure and workers influence</b> (Cronbach's Alpha = 0.794)						
Project owner			.832			
Top manager			.804			
Community pressure (government, law, neighbors)			.665			
Workers			.507			
<b>Factor 4. Safety knowledge and learning</b> (Cronbach's Alpha = 0.643)						
Safety knowledge				.706		
Working experience				.674		
Supervisor capability to control workers				.594		



Education background				.518		
<b>Factor 5. Social influence</b> (Cronbach's Alpha = 0.604)						
Family members					.720	
Coworkers					.629	
Supervisor's age					.580	
Salary satisfaction					.495	
<b>Factor 6. Supervisor habits</b> (Cronbach's Alpha = 0.708)						
Smoking						.874
Drinking						.849
Eigenvalues	3.707	2.914	2.679	2.128	1.953	1.578
Percentage of Variance Explained	14.827	11.656	10.714	8.513	7.813	6.311
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization						

**Table-2.** Component correlation matrix (N=403).

Factor	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
<b>Factor 1</b>	<b>1.000</b>					
Factor 2	-.205	1.000				
Factor 3	-.326	.280	1.000			
Factor 4	.000	-.134	-.112	1.000		
Factor 5	-.040	.325	.182	-.116	1.000	
Factor 6	.216	-.118	-.269	.097	-.201	1.000

**Table-3.** Summary statistics and correlations for all factors (N = 403).

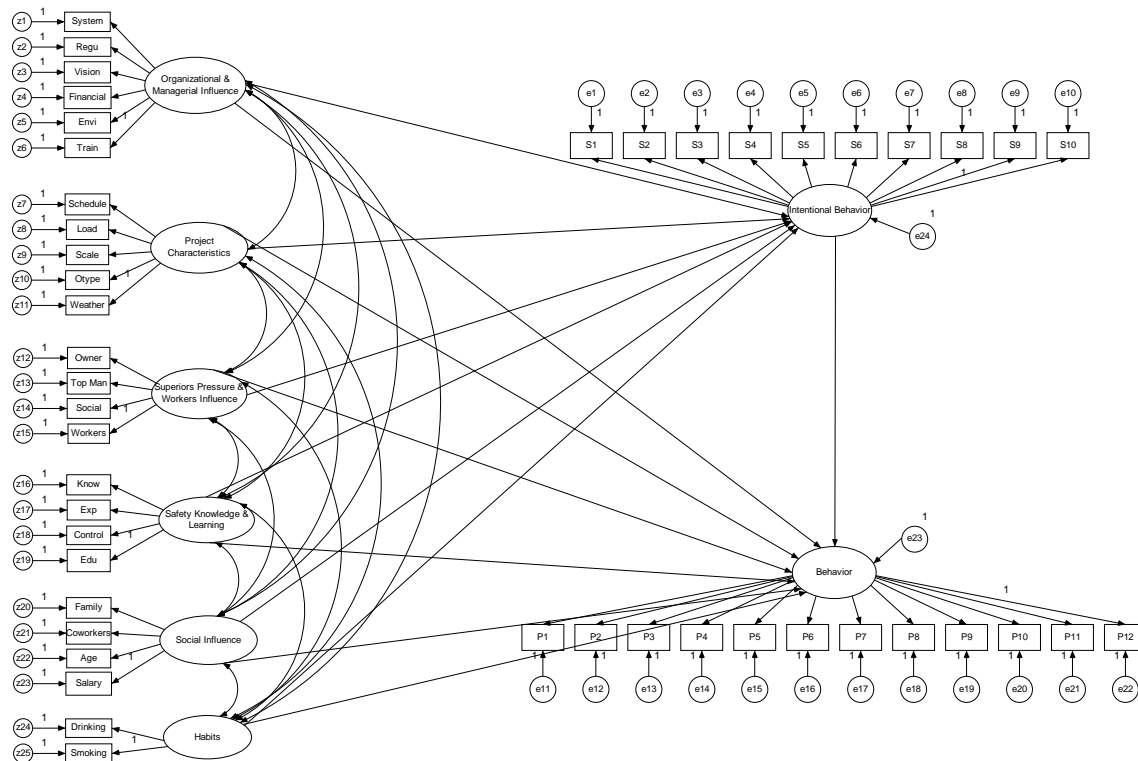
Factor	Mean	SD.	Index	F1	F2	F3	F4	F5	F6
<b>F1</b>	<b>4.249</b>	<b>.725</b>	<b>5.864</b>	<b>1</b>					
F2	3.654	.877	4.167	.334**	1				
F3	3.798	.894	4.250	.286**	.506**	1			
F4	4.211	.703	5.993	.516**	.296**	.298**	1		
F5	3.294	.869	3.789	.215**	.372**	.470**	.345**	1	
F6	3.676	1.261	2.916	.180**	.152**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

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

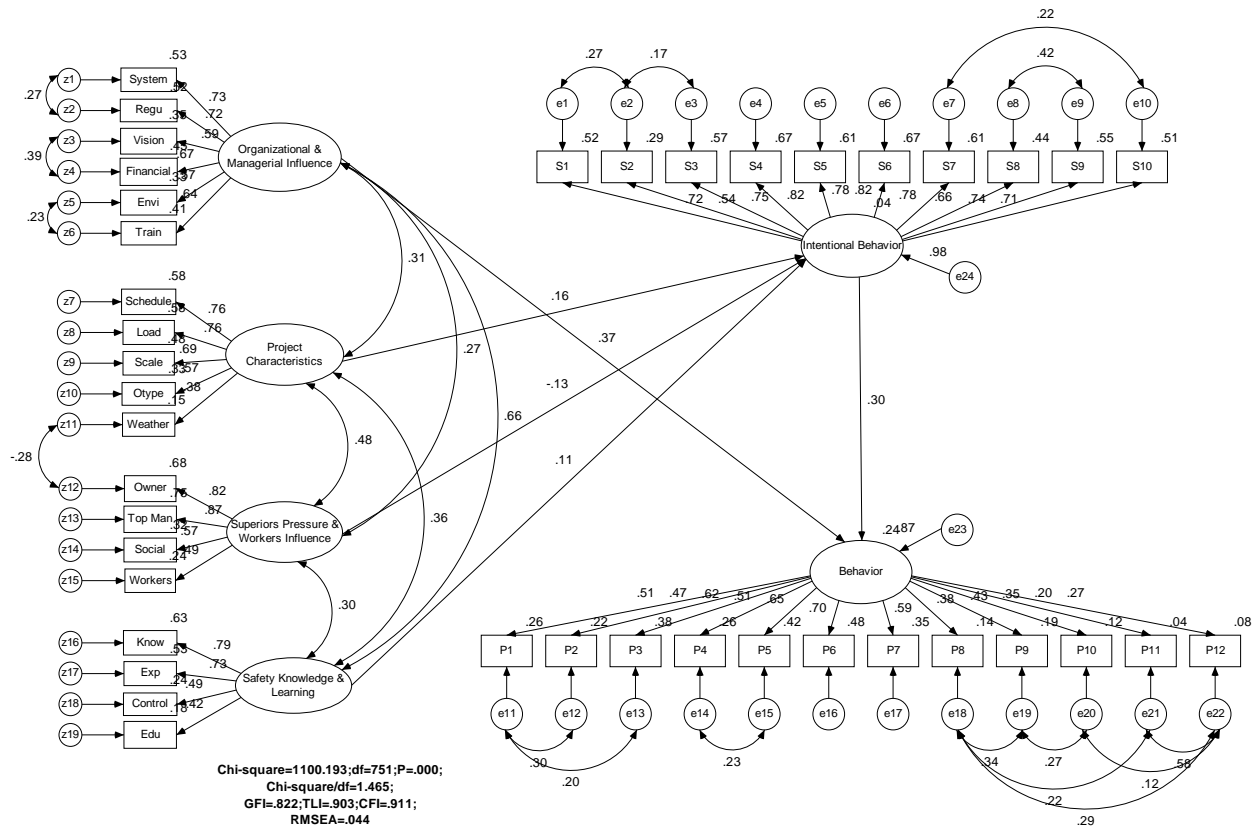
\* . Correlation is significant at the 0.05 level (2-tailed).

**Table-4.** Path coefficients and structural equations.

Path	Estimate un-stand	Estimate standardized	S.E.	C.R.	P
Safety Knowledge and Learning - Intentional Behavior	.465	.106	.373	2.447	.013
Project Characteristics - Intentional Behavior	.800	.158	.490	1.422	.103
Superiors Pressure and Workers Influence - Intentional Behavior	-.484	-.127	.337	-1.435	.101
Intentional Behavior - Behavior	.037	.303	.013	2.888	.004
Organizational and Managerial Influence - Behavior	.163	.366	.054	2.995	.003

**Figure-1.** Conceptual model for explaining Supervisors' Behavior based on their opinion.





**Figure-2.** Final model for explaining Supervisors' Behavior based on their opinion.

## RESULTS

From the analysis, it was determined that social influence and habits influence did not appear in the final model. It was not contradicted with the result of EFA and was not difficult to understand. Although these two factors existed as important factors but their percentage of variance explained were low than 8%. SEM results indicated the non-significant from Social and Habit Influence on both intentional behavior and behavior. The remaining factors were as significant influence on intentional behavior or behavior as shown in Figure-5.3. Additionally, scatter plots between the four retained factors were conducted to ensure that a linear trend best represented (i.e. highest R<sup>2</sup> fit) their relationship. This model has the following fit coefficients: CMIN/DF = 1.465; RMSEA = 0.044; GFI = 0.822; AGFI = 0.796; NFI = 0.769; CFI = 0.911; and TLI = 0.903, comparing with the critical value. The final model satisfied more than 50% of critical standards and above the threshold of most important standards. So, we can thus safely conclude that the model is valid and can continue to analyze the outcome of the causal effects.

Figure-2 provides the results of testing the structural links of the proposed research model using AMOS program. The estimated path coefficients

(standardized) are given. All path coefficients can be considered significant at the 90% significance level providing support for five relationships. These results represent was explaining supervisor behavior towards intention and other factors. The effects of the intentional behavior and four remained factors (Organizational and Managerial Influence, Project Characteristics, Superiors Pressure and Worker Influence, Safety Knowledge and Learning) accounted for over 24% of the variance in behavior variable. This is an indication of the good explanatory power of the model for supervisor behavior.

In total, structural equations explained the five causal relationships (paths) which exist between the four retained enabling and outcome factors. A summary of the developed structural equations, path coefficients, and significance levels is provided in Table-4. The following section discusses the practical implications of each structural equation and its' associated predictor variables.

Supervisors' behavior on safety actions at construction site are positively affected by their intentional behavior ( $\beta = 0.30$ ,  $P < 0.01$ ) and organizational influence ( $\beta = 0.37$ ,  $P < 0.01$ ). This result appropriates with some previous theory of behavior that individual behavior can be changed through intention positively. However, this result indicates, behavior can be positive influenced strongly by



organizations in which they are working for. These findings stressed the important role of organization in improving supervisors' behavior on safety.

Results from SEM also indicated the influence of project characteristics, superior pressure and safety knowledge on supervisor intentional behavior. Project features and safety knowledge are the positive influence in changing intentional behavior as our expected but the significant very weak ( $\beta = 0.16$ ,  $P = 0.1$ ;  $\beta = 0.11$ ,  $P = 0.01$ ). In generally, the statistical report is seldom expressing the results less than 95% significant. However in this results explanation, authors expect to show some results in 90% confident in extending the outcome. It helps to achieve comprehensive understand about factors affect supervisor behavior. The unexpected result is negative affected by superior pressure on intention. Normally, we expect that supervisor may constantly concern with safety if they received higher aware from superiors levels such as top manager, project manager, community, and worker. However, the output is the reverse direction. The pressure may influence intentional behavior in the negative direction ( $\beta = -0.13$ ,  $P = 0.1$ ). This result is an interesting outcome. The negative relationship indicates the way that superior impact to improving supervisor on safety is counterproductive.

## 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 a construction site. The results of this research indicate high significant levels of variable influencing supervisors' behavior in safety action such as "Organizational and Managerial Influence", "Project Characteristics and Work Assignment", "Superiors Pressure and Workers Influence", "Safety Knowledge and Learning", "Social Influence" and "Supervisor Habits". As a result, Supervisor's behavior can be influenced by several levels of factors that are organizational level, project level, individual level and especially social level. Some issues related to a 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 of 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.

Until SEM, the relationships of these factors and behavior are explored carefully. There is no doubt about the positive influence of organization and intentional on supervisors' behavior while intentional behavior can be changed by project characteristics and safety knowledge. The unexpected and interesting outcome is the negative

influence of superior pressure on intention. It is hoped that the current study can contribute to the improvement safety approach at construction sites. By understanding the factors, the manager can change and improve the supervisor behavior. The changing supervisors' behavior can directly influence on to the safety culture and workers because supervisors are the key people who work in between senior managers and workers.

It is hoped that the current study can contribute to the improvement safety approach at a construction site. By understanding the group of factors, managers can change and improve the supervisor behavior. The changing supervisors' behavior can directly influence on to the safety culture and workers because supervisors are the key persons who works in between senior managers and workers. However, it should to notice that, all of responses in this paper based on supervisor perception only. It is significant for further studies to establish a model base on practical parameters.

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