

A Quantitative Model for Safety Working Behaviors of Employees in Construction Projects Based on the Theory of Planned Behavior: A Case Study of Twin Towers Project by Telecommunication Company of Iran

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ABSTRACT

This study examined the influential factors of safety working behavior. Accordingly, the variables of attitude, subjective norm, and perceived behavior control in the theory of planned behavior were studied. This cross-sectional and descriptive-analytic study was conducted on 240 employees working in the construction workshop of the Central Twin Towers Project by Telecommunication Company of Iran (TCI) from February 2017 to September 2017. The required information was collected using a researcher-made questionnaire. The collected data were analyzed using SPSS v. 23 and LISREL v. 8.8. According to the Pearson correlation, there was a significant correlation between the five variables of the questionnaire. In order to determine the validity of the confirmatory factor analysis and assess the reliability of the questionnaire, Cronbach's alpha was used. Then, the research hypotheses were tested by a structural equation model. The results showed that the effect of attitude (with the intensity of 0.49) and subjective norm (with the intensity of 0.46) on the behavioral intention was more than the perceived behavioral control (with the intensity coefficient of 0.19). According to the findings of this research, in order to improve safety-working behavior, corrective measures should be on the agenda to improve the attitudes and subjective norms of employees.

KEYWORDS: *Safety, Attitude, Construction, Planned behavior*

INTRODUCTION

The occurrence of accidents in construction projects as one of the most important economic sectors is common in all countries of the world because the industry is highly prone to accidents. The rate of accidents in construction projects in the world is higher than the average in other industries [1]. Due to the growth and development of Iran's infrastructure, development of the construction industry, and implementation of

civil projects in the country, the rate of incidents and occupational accidents in this industry is not favorable compared to the other countries so that thousands die each year from work-related accidents. The industry is also of paramount importance due to the changing nature of construction works that are associated with risks and a high number of accidents, most of which lead to death. In addition, construction activities are linked to all aspects of human life, such as industry, business, information technology, and even

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traditional human activities and are one of the indicators for the development of communities. For this reason, it can be said that many human resources are involved in this industry.

Given the upward trend in labor costs in Iran, production in this country seems to be very costly in terms of workforce. Occupational accidents impose direct and indirect costs on workshops, organizations, and the whole community, which in turn, increases the cost of goods and services as well as the total costs at the national level; though these costs are usually overlooked. The direct costs of work-related accidents, such as pension payments to retirees and disables, are difficult to calculate in some cases. When an accident occurs at a workshop, depending on the dimensions of the accident, it usually disrupts and interrupts the work process, and causes an adverse effect on employees' morale. Relying on the role of safety in reducing work-related accidents, national costs can be reduced annually and many of the material, mental, and psychological injuries resulting from occupational accidents can be prevented. So far, the occupational safety and health performance in developing countries have been quite poor. Identifying key barriers and effective interventions to improve the safety performance of organizations and build robust safety management systems in the construction industry would be of the utmost importance [2]. One of the most important goals of health and safety management is the management of accidents, which should be given adequate attention.

Nowadays, events are considered the most important cost driver in any organization and need to be managed. Over the past years, safety experts have been trying to discover how events happen. The findings of the initial investigations into how the events happen were very simplistic. Later, as further research was conducted and after major industrial accidents, safety experts found that this initial attitude could not explain the nature of accidents and how they occurred. Investigations have shown that, in general, accidents have no single cause and there are usually several factors contributing to the occurrence of an accident.

Safety at work, especially in construction projects, still needs attention [1]. The construction is one of the most sensitive industries in terms of occupational injuries and illnesses [3]. Employees are one of the most important assets of organizations because of their critical role in the success of organizations. The success of an organization depends heavily on its performance and productivity. Therefore, the issue of job performance and productivity, due to its importance to organizations, has been extensively studied in industrial and organizational psychology literature. Productivity is the optimal use of

resources to produce the goods and services that consumers or users need to use. The emphasis here is on the optimal use of the most important source of commodity production, that is, human resources. In order to improve productivity, the potential of human resources must be optimized to promote national productivity and have a decent presence in a globally competitive market that requires better quality products and cheaper prices.

Human behavior is a reflection of various factors and recognition of this network, with the aim of influencing behavioral factors, is one of the most important issues that has been the focus of many behavioral science experts over the years [4]. The scope of this network is so wide that it varies from person to person and from group to group. Human behavior plays an important role in the prevention, control, treatment, and recovery of many health problems.

Job performance is defined as a set of activities, behaviors, and outcomes that employees perform to achieve organizational goals [5]. Unsafe work behaviors have many economic, social, and psychological costs to organizations. In addition to the costs mentioned, these behaviors have a negative impact on the mental and physical health of employees, cause demoralization, and increase stress. According to a study, the incidence rate is related to the level of managerial commitment and employees' perception of safety [6]. There are also many safety hazards in the construction industry due to the lack of proper safety culture in organizations and projects. The culture of safety in an organization is influenced by the attitude and normative discretion of its employees [7]. Because most health problems link closely to human behaviors, behavioral theories and patterns can be used to understand how to prevent health problems.

Nowadays the issue of safety in civil engineering projects, like any other industry, is considered, not merely as a post-incident management issue, but also as a structural issue. The psychosocial factors are among the important determinants of occupational safety and health. Social psychology seeks to explain how and why different factors influence behavior, and how and why individuals' beliefs and behaviors change. The theory of planned behavior (TPB) is useful in the development of models that can be used to describe the conflicts in different aspects of safe behavior [8]. One's attitude toward a behavior indicates his/her positive or negative attitude toward the characteristics of that behavior. Mental arts represent social norms that are characterized by the approval or disapproval of a particular

behavior by others [9]. A person's intention to perform or not to perform a particular behavior determines that person's behavior. Beliefs about behavior are believed to be based on the individual's belief on "how much that certain behavior will benefit him". Normative beliefs also represent a perception of behavior that is influenced by the assessment of other people who are important to the individual. Behavioral tendencies are predictive of actual behavior [10]. Attitudes are made up of beliefs about the consequences of behaviors a person has acquired throughout his/her life, though only certain beliefs, in reality, will affect attitudes. These beliefs are called prominent beliefs and they are the immediate determinants of one's attitude [9]. Strong prominent beliefs lead to positive attitudes toward a particular behavior and vice versa.

The TPB states that doing a behavior relates to two factors of motivation (the intention to behavior) and ability (behavioral control). A person, who has a high degree of control over his/her behavior and intends to do that behavior, is likely to do so. The TPB provides a conceptual framework for dealing with the complexities of human social behaviors [9]. The present study, by investigating the constructs of TPB and structural equations, aims to provide a management model for employees' safe working behaviors in the construction projects. In the conceptual model of the present study, mental structures, subjective norm, and perceived behavioral control were considered as independent variables, the structure of behavioral tendencies as the mediator variable, and safe behaviors as a dependent variable.

This cross-sectional and descriptive-analytic study was carried out on 240 employees working in the construction workshop of the Twin Towers project by Telecommunication Company of Iran in District 6 of Tehran City from February 2017 to September 2017. Despite the growing trend in the use of safety equipment and the availability of the equipment, we still face a lack of appropriate feedback from the staff and reduced levels of safety in construction projects. In other words, attitudes about behavior and subjective norms determine behavioral tendencies, and behavioral tendencies determine the actual behavior. The TPB suggests that three types of beliefs affect three types of perceptions [9]:

1. Behavioral beliefs affect the attitude toward behavior.
2. Normative beliefs determine subjective norms.
3. Control beliefs affect perceived control behavior.

In short, attitudes to behavior, subjective norms, and perceived controlled behavior all lead to the formation of behavioral tendencies that determine behavior. The TPB is a useful tool for understanding the psychological background in defective procedures, which are often associated with accidents [8] and have potential application to many safety-related behaviors [11].

The assumptions of TPB are as follows (Fig 1):

H1: The employees' behavioral attitudes have a positive and significant effect on their behavioral intention.

H2: The employees' mental norms have a positive and significant effect on their behavioral intention.

H3: The employees' perceived behavioral control has a positive and significant effect on their behavioral intention.

H4: The employees' perceived behavioral control has a positive and significant effect on their behavior.

H5: The employees' behavioral intentions have a positive and significant impact on their behavior.

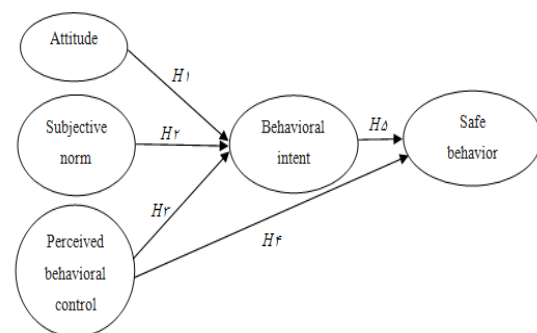


Fig. 1. Theory of Planned Behavior (TPB)

When behavioral intention is sufficient to do something or if voluntary control over the behavior is high, the third factor (perceived behavioral control) is weakened and the constructs of logical action theory, attitude, and subjective norms gain power.

MATERIALS AND METHODS

The purpose of this research was to provide a model for managerial safety working behaviors. The data were gathered based on library and field studies. The data collection tools for the field survey was a researcher-made questionnaire and the interviews with the staff of the Central Telecommunication Tower project in Tehran. The relevant articles and books published in the prestigious journals were also studied. The statistical population in this research included all the employees working at the workshop of the Twin Towers project (240 employees).

The Cochran formula was used to determine the sample size. In this study, 148 questionnaires were distributed among the staff. From the population under study, a total number of 140 workers were men and 8 were women. In addition, 46 subjects were working in the office and 102 subjects (including workers and contractors) were in the executive units. In terms of the frequency of the age groups, 46 subjects were under 30 years old, 64 subjects between 31 and 40 years old, and 38 subjects between 41 and 50 years old. In terms of education level, 76 participants had an associate's degree, 54 bachelors of science, and 18 masters of science. The work experience of 66 participants was less than 10 years, 48 subjects between 11-21 years, and 34 subjects more than 21 years. The salary of 70 subjects was below average, 56 subjects was average, and 22 subjects was more than average. To analyze the collected data, SPSS and Lisrel software were used. The reliability of the variables and questionnaires was assessed by Cronbach's alpha coefficient (Table 1).

The normal distribution of the data was checked by Kolmogorov-Smirnov test and the indices of Skewness and Kurtosis (Table 2). According to the results of the Kolmogorov-Smirnov test, all of the variables have a normal distribution (Table 2). After ensuring the normal distribution of the data, confirmatory factor analysis, Pearson correlation test, and structural equation modeling (SEM) were used to investigate the relationships between the variables and research hypotheses. The confirmatory factor analysis was used to examine the validity of the questionnaire

structure. The validity of each of the questions was evaluated by factor loading pattern in LISREL software. In addition to Cronbach's alpha, a reliability test was used to measure reliability of the questionnaire. The combined reliability of the indices was calculated by statistical methods. The average amount of variance (AVE) was used to examine the convergent validity.

The results show that the reliability and validity of the variables were appropriate and safety working behavior has a significant relationship with attitude, subjective norm, and perceived behavioral control. Using Pearson correlation test, the correlation between the variables was also investigated (Table 3). As Table 3 suggests, there is a significant correlation between the dependent variable, i.e. safety working behavior, and all of the research variables at the confidence level of 99% ($P < 0.01$).

The developed conceptual model was tested using SEM technique in LISREL software. The technique estimates the magnitude and intensity of hypothetical relationships among variables in a theoretical model. The SEM was used to show the model is in the mode of standardized path coefficients (Fig 2). After estimating the model parameters, the question was that to what extent the model is consistent with the relevant data. The answer to this question was only possible by examining the fitting of the model. The fitting indices, as listed in Table 4, showed acceptable fit of data to the model.

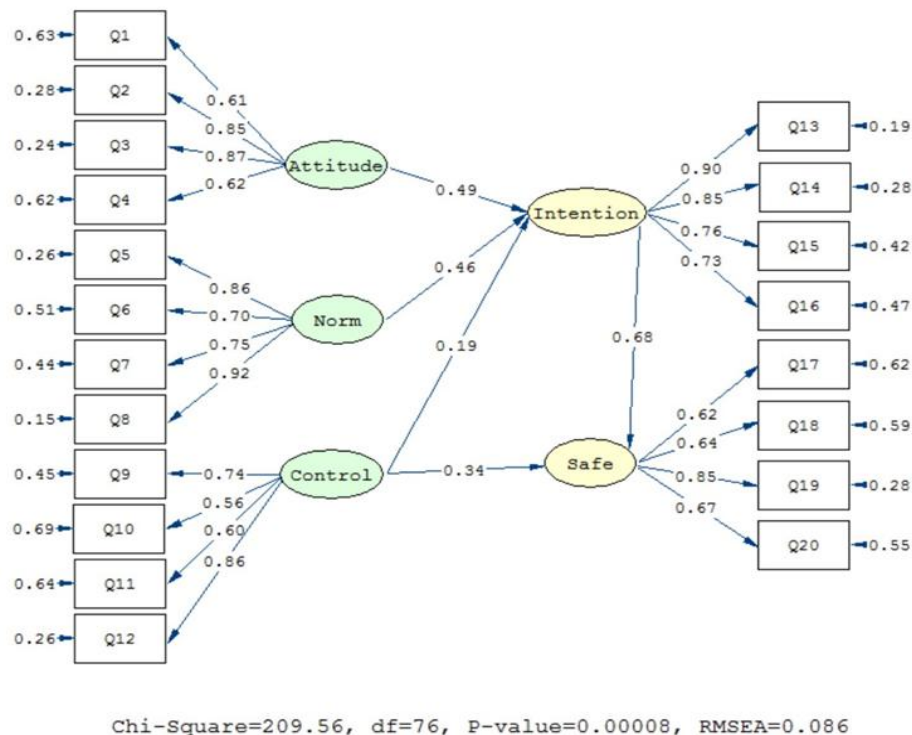


Fig. 2. Experimental model of the research in the mode of standardized path coefficients

Table 1. Reliability of internal consistency (Cronbach's alpha)

Variable	Number of questions	Cronbach's alpha
Attitude	4	0.76
Subjective norm	4	0.85
Perceived behavioral control	4	0.73
Behavioral intent	4	0.88
Safety behavior	4	0.78

Table 2. Skewness and Kurtosis values and Kolmogorov-Smirnov test to evaluate the normal distribution of the variables

Variable	Kurtosis	Skewness	Kolmogorov-Smirnov significant
Attitude	-0.193	0.067	0.129
Subjective norm	0.895	0.195	0.063
Perceived behavioral	-0.245	0.421	0.096
Behavioral intent	0.027	0.077	0.115
Safe behavior	0.376	0.640	0.076

Table 4 gives the results of the structural modeling (relationships between the variables). The table also includes the values of the standardized path coefficients (t-value) and significant levels (p-value). The results from the relationship analysis and conceptual model confirmed all of the five research hypotheses ($P < 0.05$). The structural modeling was the basis for testing the research hypotheses as well as the effect of the variables under study. In relation to the t-test, if the t-value exceeds 1.96, it means that the relationship between two variables is significant at the error level of less than 0.05 ($P < 0.05$) and at the confidence level of 95%. If the value of t is greater than 2.58, it means that the relationship between the two variables is statistically significant at the error level less than 0.01 ($P < 0.01$) and at the confidence of 99%. In this research, all of the research hypotheses were approved at the confidence level of 95%.

RESULT and DISCUSSION

Human behavior is a reflection of various factors, and recognition of this network, with the aim of influencing behavioral factors, is one of the most important issues that has been the focus of many behavioral science experts over the years. Safety solutions that rely solely on engineering approaches and regulations will fail if safety attitudes are weak. The results of the present study show the usefulness of TPB [12]. According to the model results (Fig 3), the effect of subjective attitude on the behavioral tendencies was 0.49 at the significance level of 7.29. In other words, if a person's attitude is more appropriate to the nature of his/her job; he/she will be more likely to have

safer working behaviors. Appropriate attitude means a sense of importance at work, motivation, and organizational belonging. The effect of subjective norms on behavioral tendencies was 0.46 at the significance level of 7.54. Whatever a person has more appropriate subjective norms towards safety behaviors [13], he/she would be more inclined to have safe behaviors. The effect of perceived behavioral control on behavioral tendencies was 0.19 at the significance level of 2.49. The greater the perceived behavioral control over the performance, the more a person tends to have safe working behaviors. Perceived behavioral control is voluntary control in different situations and circumstances. The effect of behavioral tendencies on safe behaviors was obtained to be 0.68 at the significance level of 10.35. The safer one behaves, the more likely he/she will do safe working behaviors. The effect of perceived behavioral control on safe behavior was 0.34 at the significance level of 5.61. The higher the perceived control over performing safe work behaviors, the more likely a person is to perform safe work behaviors.

CONCLUSION

The theory of planned behavior is a social cognitive decision-making pattern [14]. From this point of view, one can achieve an optimal prediction of behavior based on the measurement of intention. The intention, in turn, is the product of attitude (positive or negative evaluation of behavior), subjective norm (perceived effects that influencers may have on behavior), and perceived behavioral control (the extent to which people believe they can have control over their behavior). Based on the results, there was found a positive and significant correlation between the variables, pairwise.

Table 3. Pearson correlation matrix between the main variables

Variables	4	2	3	4	5
Attitude	1				
Mental norm	**0.300	1			
Perceived behavioral control	**0.832	**0.410	1		
Behavioral intention	**0.709	**0.654	**0.692	1	
Safety working behavior	**0.584	**0.768	**0.637	**0.812	1

** P<0.01 · *P<0.05

Table 4. Investigating the effect of the variables in the structural model

Effect	Standardized Coefficient	T-value	P-value	Result
positive effect of the employees' behavioral attitude on their behavioral intention	0.49	7.92	< 0.01	Confirmed hypothesis
Positive effect of the employees' subjective norms on their behavioral intention	0.46	7.54	< 0.01	Confirmed hypothesis
Positive effect of the perceived behavioral control on behavioral intention	0.19	2.49	< 0.05	Confirmed hypothesis
Positive effect of the perceived behavioral control on safety working behaviors	0.34	5.61	< 0.01	Confirmed hypothesis
Effect of the employees' behavioral intention on safety behavior	0.68	10.35	< 0.01	Confirmed hypothesis

Whatever the subjective norms, subjective attitude, and perceived behavioral control increase in an individual, his/her behavioral tendencies will also increase. The greater the behavioral tendencies, the more likely the actual behavior occur and the relationships between the structures in the TPB will be approved strongly. The results also showed that the TPB is a useful tool for understanding the psychological background of defective procedures that are often associated with accidents [8]. The perception of behavioral control is to identify situations where people lack complete control over their behavior [9]. When the behavioral intention is sufficient to do something or the voluntary control over behavior is high, the third factor (perceived behavioral control) is reduced and the attitudinal and normative variables gain power. This is in line with the results of the present study. The perceived behavioral control is inversely related to the extent to which individuals believe they can control their behavior. Since no relevant research was found on the assessment of safety working behaviors of the employees in construction workshops from the perspective of TPB, it was not possible to compare the obtained results with that of other studies. However, here provides a brief comparison of the findings. The results of this study were in line with the study by Safizal Abdullaha et al who showed that culture of

safe behavior is significantly influenced by employees' attitudes and subjective norms [7]. Another study found that attitude and subjective norms were effective on past behavior and parental control whereas perceived behavioral control could not predict behavioral tendencies [15]. They also emphasized on the effective role of attitudinal, normative, and perceived behavioral control structures on the behavior of the drivers under study [16-17]. The findings of the research on the effective role of attitudes, norms and perceived behavioral control on drivers' safe behavior emphasize the relationship between these structures with behavioral intention and intention [16-17]. Similar research has also emphasized the effective relationship between positive attitude and behavior [18]. In addition, the results of a study showed that safety knowledge and behavioral intention had a significant effect on safety performance, while perceived behavioral control did not have a significant effect on the variable [19]. The relationship between attitudinal structures, subjective norms, and perceived behavioral control with behavioral intention was also confirmed [20]. This theory can be used as a theoretical framework for designing and implementing safety interventions in workplaces. Safety is a set of measures, principles, and regulations that, if applied, can effectively protect workers and capital against various and possible hazards and provide a safe and healthy

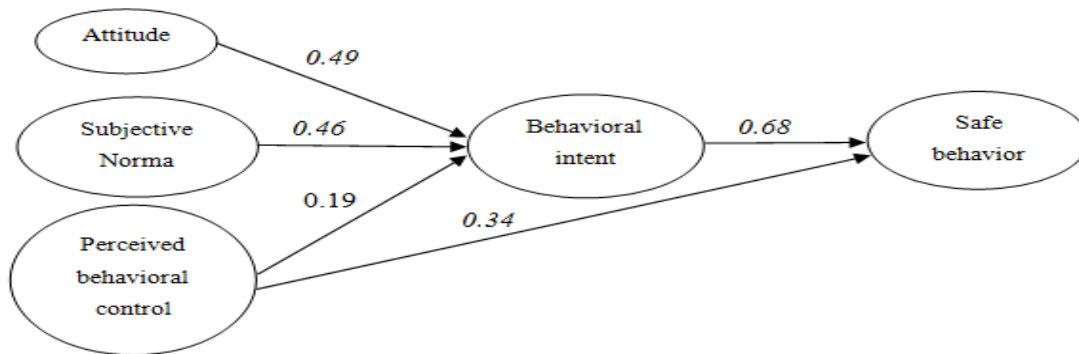


Fig. 3. Conceptual model of the research based on the impact intensity of the variables

working environment to increase employees' productivity. Here are the suggestions for improving safety:

1) As noted above, based on the TPB, subjective attitudes are effective in the incidence of safety working behaviors; therefore, it is possible to avoid the consequences of unsafe behaviors if the employment of a person, who has an inappropriate attitude towards occupational safety, can be prevented. Accordingly, it is suggested that at the time of recruitment, the employees' attitude towards the nature of work is determined through job interviews.

3) If the person is employed by the organization, then, the option of unemployment of the individuals with insecure attitudes will be no longer applicable. In addition, recruiting, training, and dismissing of employees are very costly and it is not possible to dismiss simply any employee who has committed any type of unsafe behavior. Education is a strategic measure to maintain and develop organizations in today's complex environmental conditions. The strategic importance of labor as the designer, constructor, and processor of procedures, operations, and resources, on one hand, and emergence of new information-based and science-oriented organizations, and the contribution of human resources to the success of these organizations, on the other hand, show the growing importance and necessity of staff training. Therefore, in many cases, industry-based training will have a better effect on changing employees' attitudes towards safe working behaviors. Changing attitudes can affect employees' behavior by informing them of the consequences of unsafe working behaviors and showing appropriate ways of perceived behavioral control.

3) Subjective norms reflect the values, beliefs, and overall culture of an organization in relation to unsafe behaviors. By improving organizational culture and norms, it would be possible to promote effectively safety-working behaviors in the organizational environments. The results of the present study showed that educational interventions, based on the constructs of the TPB, could change knowledge, attitude, and normative and perceived behavioral control of unsafe behaviors and improve safety performance. This

research was an attempt to examine the factors affecting safety behaviors of the employees working at a construction workshop based on the TPB. It is suggested that these factors, according to the theoretical structures, are checked among the employees engaged in other industries to develop a comparative behavior pattern based on the obtained results. Regarding the effectiveness of attitudinal structures and subjective norms obtained from the results of the present study, it is suggested to investigate the factors promoting the level of positive attitude and subjective norms, including the role of motivation.

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