ASIAN PEOPLE JOURNAL 2020, VOL 3(1), 132-140
e-ISSN: 2600-8971
https://doi.org/10.37231/apj.2020.3.1.131
https://journal.unisza.edu.my/apj

ASIAN PEOPLE JOURNAL
Multidiciplinary Social Science Journal
APJ

EXPLORATORY FACTOR ANALYSIS OF SAFETY MANAGEMENT COMMITMENT AND SAFETY ADMINISTRATION IN THE CONTEXT CONSTRUCTION INDUSTRIES

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Received: 30 October 2019 • Accepted: 22 January 2020 • Published: 30 April 2020

Abstract

Exploratory Factor Analysis (EFA) was carried out to develop appropriate questionnaire items as research instruments. This study has developed and certified the instruments of safety management commitment and safety administration through the EFA study. It is applied in the context of occupational safety and health management (OSH) of construction industry. This study was divided into two constructs namely Safety Management Commitment (SMC) and Safety Administration (SA) to measure safety attitude. Safety administration construct was measured by safety programs and safety monitoring. Whereas, safety management commitment construct was measured by safety planning and safety management. This study was conducted to evaluate the contractor's safety management attitude to the safety culture at the construction site. About 100 respondents were selected through simple random sampling to fill out the survey. Based on the reliability test, this study has set an instrument consist of eight items to develop two components for the construct of safety management commitment. While, for the construct of safety administration consist of six items for two components. This setting is based on the internal reliability value (Alpha Cronbach) for measurement of the instrument. The procedure is described in detail to carry out an EFA analysis to develop the instrument's construct of SMC and SA. For the future, researchers can develop a study by applying instruments thoroughly in various fields of research.

***Keywords**: Safety management commitment, safety administration, occupational safety, construction industry*

Him, N. N. F., Amirah, N. A, Hassan, A. (2020). Exploratory Factor Analysis of Safety Management Commitment and Safety Administration in the Context Construction Industries, *Asian People Journal*, *3*(1), 132-140.

INTRODUCTION

Construction sector is known as a hazardous industry worldwide (Langford et al., 2000). Construction safety has always been a major issue and has a reputation as the most dangerous sector with increased rates of accidents and deaths compared to other sectors (Jin et al., 2019). This industry has achieved improvements in the use of construction systems, standards and technology. However, such progress is not in line with safety performance in the context of management, task handling and occupational safety systems. Statistical reports show that 90% of accidents occur due to human behaviour (Sunindijo et al., 2017).

Past researches specifically focused on the unsafe behavior to the employee. The focus referred to the factor of organizational which less-than-attentive to safety management at workplace (Guo, Yiu, & Gonzalez, 2016). Awareness about the importance of organizational factors in safety management is influenced by the importance of safety climate in practicing safety culture at construction sites (Yiu et al., 2018). Organizations need to enhance their safety culture and provide a maximal commitment toward safety performance at construction sites. The organization of the construction industry has recognized the influence of safety culture on safety performance, particularly through the ability of organizational members to effectively implement and continue to improve safety management systems (Biggs & Bigss, 2013).

The safety climate is considered a subset of organizational climate that forms individual behaviour through the expectation of the established safety management system (Zohar & Luria, 2005). Neal, Griffin, and Hart (2000) state that the relationship between safety culture and safety behavior has been firm in occupational safety research, which creates good results on the management of OSH. Therefore, attitude and behaviour studies at construction site will increase in-depth understanding of motivation. Thus, the understanding can be used to improve the techniques of safety behaviour management (Langford, 2000).

LITERATURE REVIEW

Safety Management Commitment Construction Industries

According to Huang and Hinze (2006), past studies have shown that collaboration between contractors and other parties (sub-contractor, superior management and subordinate management) can improve the positive impact to construction activities. The role is to monitor and facilitate the safety management of each project (Li et al., 2015). Therefore, contractors and subcontractors are responsible in showing a good attitude through active involvement in improving safety performance (Hale, Guldenmund, van Loenhout, & Oh, 2010).

A competent contractor is responsible in appointing man in charge to supervise safety at the construction site. The management is responsible in implementing safety policies to ensure construction workers' safety (Jin & Chen, 2012). The superior management needs to determine the goals and results of achievement. The preparation of policies goes through procedures with tactical guideline which relevant to the goals and results involved the whole subunit at construction site (Bigss & Bigss, 2013). Therefore, superior management needs to concern about the implementation of safety procedures. It can facilitate the implementation of policies in the organization. In this aspect, the supervisor performs this procedure on subordinates. Construction workers are responsible for implementing procedures through specific instructions and actions according to the situation (in line with the supervisor's direction) (Zohar & Luria, 2005).

The involvement of management in safety management will trigger contractors in practicing a safe working culture (Huang and Hinze, 2006). The management can implement variety strategies and approaches to minimize numbers of facilities, injuries and unsafe practices. These approaches are based on job hazard analysis (JHA), hazard prediction training, and safety culture (Jin & Chen, 2012). As the construction industry is endangered, the superior management should be committed with the approaches creating safe culture at work. The contractors and management determine the strategy to be implemented. The implemented strategies to prove the effectiveness of improving the safety performance at construction site (Jin et al., 2019). The opinion states the role of the management commitment to create a culture of safety within the organization (Gao et al., 2019). Contractors who demonstrate a commitment to safety and the concern to ensure the welfare of employees in the organization (Fernandez et al., 2014).

Safety Administration Construction Industries

Supervisors have close relationship with employees to hierarchy level of an organization (construction contractor cases) and conscientious on the safety performance at the construction sites. The participation of contractors with safety programs at construction sites should commence with the establishment which related clearly with the implementation of OSH. Effective safety programs combine the aspect of commitments of management, training and education which can improve safety performance (Jin et al., 2019). The contractors developed programs known as “owner safety program” as a guideline for them. Safety programs can be developed to each safety project conducted to address safety issues according to the suitability of certain project features. This program is an initiative to control the risk at construction sites (Gambatese, 2000).

Practicing a good OSH management culture depends upon behaviour of contractor (Khoo et al., 2018) in administering construction organizations. Additionally, practicing safety culture efficiently can control the behaviour of workers at construction sites. The safety culture of an organization is influenced by three main factors, namely individual commitment, management commitment and policy commitment (Amirah, Asma, Muda, & Mohd Amin, 2013). Therefore, every members of organizations play important role to the management of OSH in practicing good behaviour at the construction site. At the same time, monitoring and enforcement should be implemented periodically at construction sites. Consequently, monitoring the construction site frequently help to prevent the tragedy happened. Thus, those who involved are more accountable to the responsibility in safeguarding the safety of workers and the public (Ismail, Doostdar, & Harun, 2012; Su, Tsai, & Yu, 2005). Under the OSH law, employers are responsible for providing a safe and healthful workplace which provides interested the opportunity to gain assistance in improving their safety and health management programs; and promotes safety and health training (Kiersma, 2014).

METHODOLOGY

The study was conducted using quantitative design through survey method. The survey method used in this study is the current survey or cross-sectional survey that collects data once from a sample at a time (Cresswell, 2016). Cross-sectional studies can answer the objectives of this study on selected samples. This study involved data collection as instruments distributed through questionnaires to the construction contractors graded from G1 to G7. The contractors are from east coast of Malaysia who are specified in building construction.

Instrument of Study

This questionnaire referred to the questionnaire from the past studies in developing the questions (Wu et al., 2016;

Faroqui, 2011). The instruments used questionnaires which are distributed to construction contractors as respondents. Questionnaire was measured using interval scale. The interval scale for approval level has been established according to the 10 basic questionnaires scale (Zainudin, Asyraf & Mustafa, 2016).

Exploratory Factor Analysis

Exploratory Factor Analysis (EFA) is carried out to form a new construct that appropriate to the process of collecting the samples. The main purpose is to identify the dimensions contained in the selected constructs for other analyses. The inappropriate items will be terminated through this process. This EFA test is conducted to confirm the items in the SMC and SA constructs. EFA analysis is carried out to obtain the validity of constructs that represent the variable of attitudes of management toward OSH at the construction.

This study was adapted from the instruments that were introduced by previous researchers. The statement of instrument was adjusted according to the practicability to be conducted by this study. Based on Awang (2010; 2012) and Hoque et al., (2016), if a researcher adapted an instrument from previous researchers and modified the statement into a new item then they need to implement the procedure of Exploratory Factor Analysis (EFA). This procedure is important to be carried out. Differ in areas of studies and combined items from the previous studies may not be applicable to the current studies.

Additionally, the Internal Reliability value of instruments measured through Alpha Cronbach values may have changed (Awang, 2010; Hoque et al., 2016). In line with the recommendations of Awang (2010; 2012) and Hoque et al., (2016), researchers have decided to re-run the Exploratory Factor Analysis (EFA) on items measuring their respective constructs.

RESULT AND DISCUSSION

Exploratory Factor Analysis Constructs Safety Management Commitments

The construct of safety management commitment (SMC) is measured using 8 items labelled as SMC 1 to SMC 8. The statement for each item was measured using the interval scale between 1 to 10. The data collection involved 100 respondents. The Exploratory Factor Analysis (EFA) used Principal Component Analysis (PCA) method with Varimax Rotation to measure 8 items of the management commitment.

Table 1 show the Bartlett's Test value is significant (P-Value <0.05). The value for the Measure of Sampling Adequacy measure by Kaiser-Meyer-Olkin (KMO) is 0.872 which is exceeds the minimum value of 0.6 (Awang, 2010; Hoque et al., 2016). Based on this result, (Significant Bartlet Test, and KMO value> 0.6) it shows that the data is feasible for the next procedure of the Exploratory Factor Analysis (EFA) (Awang, 2010; 2012; Hoque et al., 2016).

Table 1: The value of KMO and Bartlet Test for SMC construct

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.872
Bartlett's Test of Sphericity	Approx. Chi-Square	403.573
	df	28
	Sig.	0.000

Table 2 shows the total value of the variance estimated by the items used to measure the constructs of the SMC. From Table 2, the SMC construct is measured using two components. Component 1 measures the construct by 35.158% while component 2 measures the construct by 33.545%. The total estimated variance for the SMC construct was 68.703%. This value is excellent since it exceeds the minimum requirement which is 60% (Awang, 2010; 2012; Hoque et al., 2016).

Table 2: Total Variance explained for the SMC construct

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.629	57.864	57.864	4.629	57.864	57.864	2.813	35.158	35.158
2	0.867	10.840	68.703	0.867	10.840	68.703	2.684	33.545	68.703

The findings from Table 3 show the constructs of SMC measured by two components in order to identify the selected items for each component. All of items have the value of Loading Factor exceeds the minimum limit of 0.6.

Table 3: Rotated component for SMC constructs

No item	Statement	Component 1	Component 2
SMC1	Set a complete safety corporate goals and organizational charts		0.661
SMC2	Appoint representatives to update risk information at workplace		0.802
SMC3	Management involves the employees and subcontractors in the provision of safety procedures		0.868
SMC4	Review of accidents reports by executive management		0.681
SMC5	Executive management promotes OSH activities	0.735	
SMC6	Executive management provides an incentive scheme to employees	0.741	
SMC7	Executive management reviews the inspection reports of construction site.	0.818	
SMC8	Management are aware about the OSH issues	0.748	

It is important for researchers to get the reliability value of items to measure the construct. The reliability value of instrument measured by estimating the Alpha Cronbach value. The Cronbach Alpha value of an instrument must exceed the minimum of 0.7 for adoption of the next study.

Table 4 shows the Alpha Cronbach value for both components exceeding the value of 0.7. Thus, they can be adopted in this study (Awang, 2010; Hoque et al., 2016).

Table 4: The reliability value for SMC construct

Reliability Statistics		
Component	N of Items	**Cronbach Alpha**
1	4	**0.838**
2	4	**0.844**

Exploratory Factor Analysis of Safety Administration Construct

The SA construct was measured using 7 items labeled as SA1 to SA7. Each item of the statement is measured using the Interval Scale of 1 to 10.

The Exploratory Factor Analysis (EFA) procedure was carried out using the Principle Component Analysis (PCA) method with Varimax Rotation to measure 7 items of the SA construct. The findings from Table 5 indicate that the Bartlett's Test value is significant (P-Value <0.05). While, the value of Measure of Sampling Adequacy by Kaiser-Meyer-Olkin (KMO) is 0.778 which is exceeds the minimum value 0.6 (Awang, 2010; Hoque et al., 2016).

These two results (Significant Bartlett's Test and KMO value> 0.6) indicate that data is feasible for further procedures in Exploratory Factor Analysis (EFA) (Awang, 2010; 2012; Hoque et al., 2016).

Table 5: The value of KMO and Bartlett's Test for the SA constructs

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.778
Bartlett's Test of Sphericity	Approx. Chi-Square	283.472
	df	21
	Sig.	0.000

The findings from Table 6 showed the SA constructs measured by two components to identify the selected items for each component. Table 7 shows the distribution of items for two components that measure the SA constructs. Item SA1 to SA4 were measured for component 1 while item SA5 to SA6 for component 2. All of the items have the value of Loading Factor exceeds minimum limit 0.6.

Table 6: Total Variance estimated by SA construct

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.630	51.855	51.855	3.630	51.855	51.855	2.652	37.886	37.886
2	1.116	15.944	67.799	1.116	15.944	67.799	2.094	29.914	67.799

Extraction Method: Principal Component Analysis.

Table 7 shows the findings for the SA measured by two components. The selected items can be identified to measure each component. All items have the value of Loading Factor exceeds the minimum limit of 0.6.

Table 7: Rotated component for SA construct

No item	Statement	Component 1	Component 2
SA1	Investigate the non-compliance on the using of PPE among workers	0.783	
SA2	Safety issues are discussed during the pre-construction and project progress meetings.	0.743	
SA3	Safety bulletin boards are provided and exhibited to the employee	0.749	
SA4	Safety signs and posters are clearly displayed at the construction site	0.782	
SA5	Safety inspections/ audits are frequent at the construction site		0.905
SA6	Safety checks on the construction equipment are carried out routinely.		0.853

The reliability value of items is important for researchers to measure the construct. The reliability value of instrument measured by estimating the Alpha Cronbach value. The Cronbach Alpha value of an instrument must exceed the minimum of 0.7 for adoption of the next study. Table 8 shows the Alpha Cronbach value for both components value of minimum 0.7. Thus, they can be applied in this study (Awang, 2010; Hoque et al., 2016).

Table 8: The Reliability value of instruments

Reliability Statistics		
Component	N of Items	**Cronbach Alpha**
1	4	**0.806**
2	2	**0.802**

CONCLUSION

This study contributes to the measurement of SMC and SA constructs in the context of occupational safety and health management of the construction industry. The results of the analysis on SMC construct measurement have resulted in two components, while for safety administration dimension have produced two components. Construct for safety management commitment are referring to the planning and management while construct for safety administration are safety programs and safety monitoring. The construct for SMC were measured through eight items while the construct for SA were measured through six items. All of the results of the constructs satisfied the Cronbach Alpha and Bartlett's Test. The development and validation of this instrument is to ensure the adjustment of the item to be tested on the sample involved.

ACKNOWLEDGEMENT

I would like to thank the Ministry of Higher Education Malaysia (KPTM) for funding my studies through the MyBrain15 scholarship. MyPHD funding has helped me in the success of this research.

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