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A MINI-FACTOR HEALTH AND SAFETY COMPLIANCE: A MULTIVARIATE FACTORIAL ANALYSIS

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ABSTRACT

The construction industry employees all over the world experience serious injuries and deaths due to accidents in complex high-risk systems. These incidents have been attributed to conditions in which an employee is working or his actions that can result in human error or an unsafe action. Adherence to safety regulations features among Small and Medium-Sized Enterprises (SMEs) contractors' in Ghana were confirmed through the use of a confirmatory factor analysis. Findings from the Structural Equation Modleing (SEM) analysis confirmed that the Rio coefficient and the Cronbach's alpha coefficient on the internal consistency were over 0.70 criteria for acceptability. The influence of adherence to safety regulations features on the Health and Safety (H&S) compliance was found to be statistically significant. Hence, strong in predicting H&S compliance among SMEs contractors'. The paper makes a significance contribution towards SMEs contractors' adherence to safety regulations. The paper provides a significant insight into how H&S compliance among SMEs contractors' adherence to safety regulations could be improved.

Keywords: Adherence; safety regulations; compliance; confirmatory factor analysis; EQS 6.2 version; SEM software

1. INTRODUCTION

The Small and Medium-Sized Enterprises (SMEs) contractors' form bulk of the contractors in Ghana and provide operational flexibility to the larger firms as sub-contractors (Ofori and Toor, 2012; International Labour Organisation (ILO, 2005). There is high rate of accidents within the working environment of SMEs contractors' and these adversely have an effect on the well-being of their workers. The behaviour and compliance levels among workers of SMEs contractors might be due SMEs contractors non-comply with Health and Safety (H&S) regulations (Department of Occupational Safety and Health, DOSH, 2008). SMEs contractors are also plagued with lack of financial resources, expertise and shortage of staff. They also lack technical capacity, limited awareness of the existence of occupational safety and health standards, or how to comply with them without undermining business performance (ILO, 2005). These development have led to a significant effect on their safety regulations compliance (DOSH) (2008). They also lack equipment and capacity to train their staff due to limited resources (Ofori and Toor, 2012; ILO, 2005). Thus, it has become necessary to integrate of H&S policy into the management systems at all levels of construction industries and its effective implementation, regular education and training by both the government and the parties involved.

Adherence to safety regulations in relating to SMEs contractors H&S compliance were found to be lagging. This indicates that there is a fundamental link between theory and measurement leading to the confirmation of measures at the first stage of theory testing. It is presumed that the identified adherence to safety regulations constructs found in literature will be effective in measuring adherence to safety regulations for H&S compliance in the Ghanaian cultural context. The purpose of this paper was to carry out a confirmatory factor analysis of adherence to safety regulations features for use in H&S compliance study among Ghanaian SMEs contractors. The paper begins with an overview of a literature review on the topic in question. The adopted methodology for the study is presented, followed by the findings based on measurement model and testing of the direct influence of adherence to safety features on overall H&S compliance. Finally, conclusions are drawn and recommendations made. The paper makes a significant contribution towards adherence to safety regulations features.

2 SMEs CONTRCATORS' AND OCCUPATIOANL HEALTH AND SAFETY

Small and Medium-Sized Enterprises (SMEs) are recognized as the engines of local economy and the major source of present and future employment in all countries. In response to the demands for flexibility arising from globalization, many large companies concentrate on a few specialized core areas. Hence, the high numbers of SMEs contractors, micro-enterprises and self-employed workers (ILO, 2005) are due to outsourcing and subcontracting. Most SMEs contractors in the developing countries are not adequately covered by safety and health legislation and a large number of them operate in the informal economy beyond any coverage by the formal Occupational Safety and Health (OSH) or inspection services. SMEs contractors are also reluctant to seek advice that is relevant with H&S inspection (ILO, 2005). Hence, occupational hazards and risks are recognized to be more widespread in SMEs contractors than in large enterprises.

A report from the South African Construction Industry Development Board (CIDB, 2009a) shows that the activities in the construction industry are at high risk due to its poor H&S performance record. This is coupled with various legislative and institutional frameworks, of which the primary objective is the prevention of accidents and their consequences in terms of injury, disablement, fatality and ill health within the work environment. Weil (2007) posited that the number and severity of H&S standard violations provide one measure of the degree to which a contractors operations comply with Occupational Safety and Health Act (OSHA) standards. Research has also shown that legislation or targeted regulations can influence H&S performance of either a project, industry or a stakeholder (CIDB, 2008). Moreover, construction H&S has become one of the top ten risks (Furter, 2011).).

The Institution of Occupational of Safety and Health (IOSH, 2004) contends that it is insufficient, for example, to provide safe equipment, systems and procedures if the culture is not conducive to a healthy and safe working environment. Since, culture creates a homogeneous set of assumptions and decision premises in which compliance occurs without surveillance (Grote, 2007). Dingsdag, Biggs, Sheahan and Cipolla (2006) furtheer argued that a positive culture leads to both improved H&S as well as organisational performance. Behaviour is a product of culture just as much as accidents are a product of the prevailing culture (Wiegmann, Zhang, von Thaden, Sharma and Mitchell, 2002). Dingsdag et al. (2006) opined that "Sustained improvement in H&S would not happen without cultural change" OSH culture can be described in terms of the informal, cultural aspects of an organisation. The latter can have an impact on how OSH is perceived and dealt with, and on whether people are aware of OSH-related issues and act in a safe and healthy way (European Occupational Safety and Health Act. EU-OSHA, 2011). 'OSH culture' - can be seen in terms of the relationship between organisational culture and OSH. OSH culture is about how an organisation's informal aspects influence OSH in a positive or negative way. This is done at two levels (Antonsen in EU-OSHA, 2011) by:

i. Setting the values and norms, and underlying beliefs and convictions, through which workers deal with or disregard risks;
ii. Influencing the conventions for (safe or unsafe, healthy or unhealthy) behaviour, interaction, and communication.

OSH culture can be assessed as part of a process of organisational improvement. It is also perceived and dealt with among workers in an organisation and whether workers are aware of OSH-related issues and act in a safe and healthy way. The knowledge and information, gained from such a cultural approach, can, in turn, be very useful in the process of changing OSH-related policies, processes, and practices step by step, adapting them to the existing local context and culture, and eventually leading to better OSH performance (EU-OSHA, 2011).

In order to achieve continuous improvement of workers' safety and health, a systematic, integrated, proactive, participative, and multiple-strategy approach towards OSH management is needed. Sound OSH management, incorporated into an organisation's overall management and business, and addressing regulatory, technical or engineering, organisational, and managerial aspects, is critical to ensure OSH excellence. Employers, business managers and OSH professionals striving for excellence in the field of occupational safety and health, the key issue is to ensure that occupational accidents and work related ill health are prevented as much as possible, and that safe and healthy behaviour among all employees is promoted (EU-OSHA , 2011). Policy formulation, implementation and monitoring are the responsibility of government and it are vital indicators that determine compliance of H&S among SMEs contractors. However, an organisation's H&S policy statement details out how it will ensure a healthy and safe work environment. Individual policies need to be developed for specific hazards and issues. Policies should be supported by procedures that provide the step-by-step instructions on how policies will be achieved. Section 2 of Health and Safety at Work (HSW) Act 1974 has indicated that if an organization employs more than five people, it must have a written H&S policy (Construction Development Management, CDM, 2007).

The first step towards the management systems approach to OSH and is reflected in the Occupational Safety and Health Convention of 1981 (No. 155). Although, the Act deals with OHS and working environment in a comprehensive manner, but it is largely a policy rather than a prescriptive instrument. The Occupational Safety and Health Convention of 1981 (No. 155) also provide priority to the formulation, implementation and periodic review of a national policy to prevent accidents and injury to health arising from or that is linked with occurrence of accident in the course of work. It also seeks to minimize, as far as possible the causes of hazards inherent in the working environment (ILO, 2005). Moreover, the scope and coverage of OSH provisions has evolved from a focus on industrial safety to one on workplace safety and health, from protection to prevention and assessment of risks. Modern standards reflect not only on collective responsibilities to workplace safety and health, but also the respective roles, rights, responsibilities and areas for cooperation of and between employers, workers and their representatives (ILO, 2005).

It is mandatory for the formulation H&S policy by the government to guide the activities of contractors' in the construction industry. The formulation of the government policy and its implementation will enable contractors' to provide safe and healthy work environment for all their employees, store their equipment, formwork and false work at a safe place. Finally, to monitor all operations of employees and insist on putting off all equipment during service. It is now the responsibility of the H&S personnel to provide general H&S advice, and also advice relating to construction H&S issues (Lingard & Rowlinson, 2005; Carpenter, 2006a) for employees. Occupational Health and Safety (OHS) is core to the successful long-term sustainability of any business and fortunately in South Africa, Health and Safety (H&S) is a legislatively compliant criterion, enforced by the OHS Act 85 of 1993 and the Department of Labour (Action Training Academy, 2014).

Health policy is best formulated through rigorous and objective assessment of data. Modern health policy poses complex legal, ethical and social questions. Hence, the goal of health policy is to protect and promote the health of individuals and the community. Government officials can accomplish this objective in ways that respect human right (Gostin, n.d.). However, official government policy making that is legally binding or least has persuasive force in law should comprise of evaluation of the relevant strengths and weaknesses of each government with respect to health policy formulation. It should also examine sources of information and influence that will help to drive policy making.

Table 1: Adherence to safety regulations conceptual variables

Latent constructs	Indicator variables
Adherence to Safety Regulations (ASR)	Adhere to warning signs and notices
	Follow safety regulations
	Adhere to company safety policies

3 METHODOLOGY

A quantitative method of data collection was used in the study. A face-to-face method of questionnaire administration was adopted among SMEs contractors in Ghana. Data collected were analysed using SEM software with EQS version 6.2. The SEM software was used to assess the factor structure of the constructs. The conceptual variables were then tested as a prior using SEM of the questionnaire survey results.

Model testing

A total of 558 samples deemed fit for the SEM analysis were finally taken through random sampling before carrying out the exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). A total of 269 samples were realised for the EFA and 289 samples for CFA. CFA using EQS version 6.2 was used to test the adherence to safety regulations features (Hu and Bentler, 1999). The construct parameters used the maximum likelihood method. Consideration was given to Yuan, Lambert and Fouladi's coefficient, since psychometric data have a tendency not to be normally distributed. This means that if Yuan, Lambert and Fouladi's values showed significance deviation from normality, the Satorra-Bentlet scale statistics (robust) would be used as these have been found to perform adequate under such conditions (Bentler, 1990).

The construct validity for the variables was conducted to demonstrate the extent to which the constructs hypothetically relate to one another in order to establish the score reliability. This also referred to the test of measurement invariance (MI), factorial invariance or measurement equivalence between indicator variables. MI is an important requisite in

SEM because it attempts to verify that the factors are measuring the same underlying latent construct within the same condition. MI ensures that the attributes would relate to the same set of observations in the same way. The MI for the adherence to safety regulations features was determined based on the examination of the residual covariance matrix from CFA output results as opposed to the correlation matrix. Covariance matrix establishes the variables that adequately measure the adherence to safety constructs.

Therefore, EFA was conducted on the adherence to safety regulations indicator variables to identify which items appropriately measure the adherence to safety regulations features. Identified indicator variables with an unacceptable high residual covariance matrix greater than 2.58 were dropped after the CFA was performed. This implies that the identified indicator variables do not sufficiently measure the adherence to safety features regardless of their importance in other cultural contexts and previous studies. Bryne (2006) and Joreskog and Sorbom (1998) opined that residual covariance matrix greater than 2.58 are considered large. Therefore, in order for a variable to be described as well-fitting in measuring a construct such as adherence to safety regulations, the distribution of residual covariance matrix should be systematically and centred on zero (Bryne, 2006; Joreskog and Sorbom, 1998). This procedure was adopted as a means to ensure that the indicator variables were measuring the latent constructs. The assumption of measurement invariance is mostly tested in CFA (Meredith, 1993) in order to allow for comparison of indicator variables under the same condition. In the current paper, multi-sample CFA was used for the assessment of measurement invariance across latent variables. This procedure was adopted by several researchers (Aigbavboa and Thwala, 2013; Musonda, 2012; Reise, Widaman and Pugh, 1993).

4 FINDINGS

4.1 Measurement model for adherence to safety regulations

A total of 558 samples were analysed and the data showed three (3) indicator variables (ASR 1, ASR 2 and ASR 3) with acceptable residual covariance matrix, hence CFA was conducted. The assessment of the adherence to safety regulations model goodness-of-fit was based on the three (3) indicator variables in Table 1. The question of the number of constructs to be used is debatable (Bollen, 1998; Hayduk and Glaser, 2000). Some scholars (Bollen, 1998; Bryne, 2006; MacCallum, Browne & Sugawara, 1996) have suggested a minimum of four indicator variables. Analysis of Yuan, Lambert and Fouladi's values showed that data deviated significantly from normality (Yuan, Lambert and Fouladi = 262.0696), hence the decision to use the robust maximum likelihood method. The examination of the Bentler-Weeks structure representation for the approved construct revealed that ASR construct has three (3) dependent variables, four (4) independent variables and six (6) free parameters. The number of fixed non-zero parameters was four (4).

Table 2 shows that the sample data on ASR measurement model yield an $S - B\chi^2$ of 3249.5 with 1861 degrees of freedom. The associated p-value was determined to be 0.0000. The chi-square value advocated that the difference between the sample data and the postulated adherence to safety regulations features measurement model was significant. From these values, the chi-square value was determined to be 1.75. The normed chi-square is the procedure of dividing the chi-square by the degree of freedom. The normed values up to 3.0 or 5.0 are recommended (Kline, 2005). The ratio of $S - B\chi^2$ to the degree of freedom was lower than the lower limit value of 3.0 suggesting a good fit of the data to the construct.

Table 2: Robust fit indexes for adherence to safety regulations features construct

Fit Index	Cut-off value	Estimate	Comment
$S - B\chi^2$		3249.5	

df	0≥	1861	Good fit
CFI	0.90≥ acceptable 0.95≥ good fit	0.794	Acceptable
RMSEA 95%	Less than 0.05 with confidence interval (CI) 0.00-0.05 "good fit"	0.051	Good fit
NFI	Greater than 0.90 "good fit"	0.629	Acceptable
NNFI	Greater than 0.80. "good fit"	0.777	Acceptable
RMSEA 95% CI		0.048: 0.054	Acceptable range

Table 2 shows the goodness-of-fit indexes. The comparative fit index (CFI) of 0.794 was found to be slightly lower than the cut-off value for good fit model. A model is said to be good fit if the CFI is above the cut-off value of 0.95 (Hu and Betler, 1999; Joreskog and Sorbom, 1998). This indicates a drop (difference of 0.156) in the CFI value, hence the model can be described to have an acceptable fit, though not well fitting. However, the robust mean square error of approximation (RMSEA) with 95 per cent confidence interval was found to be 0.051 (lower bound value = 0.054 and the upper bound value =0.048) which is within the acceptable range for a good fit model (MacCallum et al., 1996). Moreover, both the normed fit index (NFI) and non-normed fit index (NNFI) were found to be within the acceptable range of 0.629 and 0.777 respectively. Evaluation of RMSEA (95% CI), CFIs, NFIs and NNFIs indicated an acceptable fit of the measurement model, but poor for an adherence to safety regulations features factor.

4.2 Testing the direct influence of adherence to safety regulations (ASR) features on overall health and safety compliance

Determination of the internal consistency for the ASR measurement model was made possible through the examination of the Rio coefficient and the Cronbach's alpha coefficient to establish reliability. Kline (2005) posited that the desired multivariate reliability coefficient should fall between zero and 1.00. The Rio coefficient of internal consistency was found to be 0.964 which was above the minimum value of 0.79. The Cronbach's alpha was found to be above the minimum value 0.70 at 0.937. High levels of internal consistency and internal reliability were as shown in Table 3.

The examination of the magnitude of the parameter coefficients led to the determination of the construct validity. Hence, high parameter coefficients greater than 0.50 indicate a close relation between the factor and the indicator variable. Hair, Anderson, Tatham and Black (1998) opined that a parameter coefficient of 0.50 is interpreted as 25 per cent of the total variance in the indicator variable being explained by the variable (factor). In this case, a parameter coefficient has to be between 0.50 and 0.70 or greater to explain about 50 per cent of the variance in an indicator variable. Hence, the inspection of the standardized parameter coefficient shown in Table 3 shows that they were significantly high (values from 0.747 to 0.604). The minimum estimate of 0.604 suggested that the measured factor accounts for 9.540 of the Z-statistics in predicting the overall health and safety (H&S) compliance. The Z-statistics for each indicator variables by the endogenous variables revealed that the scores were significant at 5 percent level.

Table 3: Reliability and construct validity of ASR Model

Indicator Variable	Stand. Coeff. (λ)	*Z*-Stat.	R^2	Factor Loading	Sig. at 5% level?
ASR 1	0.604	8.279	0.635	0.6565	Yes
ASR 2	0.618	8.482	0.618	0.6476	Yes
ASR 3	0.618	8.468	0.618	0.6476	Yes

Cronbach's alpha = 0.937; Rio coefficient = 0.964

(Robust statistical significance at 5% level)

*** SEM analysis norm (Kline, 2005) – One variable loading per latent factor is set equal to 1.0 in order to set the metric for that factor*
**Parameter estimates are based on standardized solutions*

Moreover, the assessment of the inter-factor correlation (R^2) values for the adherence to safety regulations feature indicator measures revealed that none of the indicator value was close to the desired value of 1.00, therefore not significant in predicting the adherence to safety regulations of H&S compliance. The inter-factor correlation test of statistics (Z-stats) which functions as a Z-statistics test shows that the estimate is significantly different from zero. However, the R^2 did not significantly measure the R^2 variable. The statistical assessment of the score results showed that the influence of this factor on the R^2 variable was weak (indirect). This is not withstanding, the fact that the combined results revealed that it has a good indirect association in the prediction of the overall H&S compliance.

5 DISCUSSION OF RESULTS

Findings from the study show that adherence to safety regulations indicator variables satisfied internal reliability and the construct validity criteria. The Rio value was above the minimum value of 0.70. The construct validity criteria were justified by the magnitude and statistical significance of all parameter coefficients. The CFA analysis of the adherence to safety regulations feature indicator revealed that three indicator variables passed the test and were used for the assessment of the adherence to safety regulations measurement model goodness-of-fit. Moreover, the indicator variables were closely associated with the dependent variable. The remaining indicator variables were weak in predicting the adherence to safety regulations feature variables. This was clear in the assessment of adherence to safety regulations overall H&S compliance. Further assessment of the Z-statistics accounted for each measure by the indicator variables revealed that the scores were not significant, since none of the Z-statistics values were close to 10.00. These results suggest that the direct influence of these variables on the H&S compliance was weak (indirect).

Since the government of Ghana is responsibility for the H&S policy formulation, implementation and monitoring among contractors. The given adherence to safety regulations by contractors' are additional information to H&S compliance among their employees. This measure will serve as an important indicator that will determine contractors' compliance. Conducting a confirmatory factor analysis to confirm the factorial validity of the adherence to safety regulations features is vital because of its application in H&S study among contractors in Ghana. The analysis of confirmatory factor analysis made it possible to characterize and identify specifically the factors of adherence to safety regulations which have statistically significant influence on the SMEs contractors' in Ghana. Hence, contractors will find it important to implement and monitor the safety policy formulated by the government in relation to their established adherence to safety regulations to ensure H&S compliance. The preceding facts indicate that that the confirmation measures should be the first stage of theory testing.

5 CONCLUSION AND RECOMMENDATION

The postulated prior was analysed using SEM software with EQS version 6.2. The SEM process was undertaken as both EFA and CFA of the prior variables. The CFA analysis revealed that three indicator variables were successful in the factorial validity test conducted. The three indicator variables were used for the assessment of the adherence to safety regulations measurement model goodness-of-fit. Further findings indicated that the Z-statistics for the three indicator variables were within the acceptable range. The robust fit indexes had an acceptable fit, while RMSEA value and the RMSEA with 95 per cent confidence interval produced an acceptable range. Moreover, the parameter estimates were statistically significant and dealt with successfully. Hence, the measurement model for adherence to safety regulations features had an adequate fit to the sample data.

The CFA result shows that only few variables were classified as predictors of adherence to safety regulations in other cultural contexts from the literature review to determine adherence to safety regulations among SMEs contractors' in Ghana. Other studies that have used different research methods on the determinants of adherence to safety regulations among SMEs contractors' are in agreement with the above view. The paper supports the theory confirmation that measurement of indicator variables should be the first stage of theory testing. The authors were of the view that the SEM software with EQS version 6.2 should be used to further improve on the variables that may be considered in the development of future H&S compliance projects. It is therefore recommended that a checklist of items defining the factors of adherence to safety regulations features should be made available to guide all contractors'. Such basic requirement should have an influence on H&S compliance.

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