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The Art of Covariance Based Analysis in Behaviour-Based Safety Performance Study Using Confirmatory Factor Analysis: Evidence from SMES

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Assessing behaviour-based safety performance measurement validity using the confirmatory factor analysis is viewed as an important approach in developing a highly reliable measurement tool in order to resolve a high number of the industrial accidents in small-medium enterprise (SME). The current study aims to examine how the extension of emergency climate factors (work ownership, Islamic work ethic and management commitment) affects behaviour-based safety performance (safety compliance and safety participation) in Malaysian SMEs. Self-administered questionnaires were distributed to the respondents using a stratified random sampling. A quantitative method was employed for data collection and data were analysed with AMOS 22.0. The assessment of the measurement model was made through the Confirmatory Factor Analysis (CFA) procedure, carried out in a sample of 500 employees drawn from SME manufacturing companies. The goodness-of-fit indices RMSEA = 0.058, Comparative fit index = 0.911, and parsimony goodness of fit index = 1.953 are satisfactory fit. The results of the behaviour-based safety performance of SME employees reported that work ownership (0.83) and Islamic work ethic (0.919) achieved a good fit with a high composite reliability. The underlying constructs of the employee behaviour-based safety performance

measurement model can be used as an effective safety evaluation tool in various SME industries in future studies.

Key words: *behaviour-based safety, confirmatory factor analysis, management commitment, normality, SME.*

Background of the study

SMEs have contributed significantly to the economic growth, when compared to large companies. However, they also contributed eight times more to fatal accidents (Tremblay & Badri, 2018b), were responsible for more than 50 per cent of non-fatal injuries (Guo, Goh, & Wong, 2018), as well as a higher number of occupational related accidents (Cagno, Micheli, Masi, & Jacinto, 2013; Floyde, Lawson, Shalloe, Eastgate, & D'Cruz, 2013; Ma & Yuan, 2009). Additionally, statistics show that MYR 2,948 million in total benefit claims from the Social Security Organization in 2016 (SOCSO annual report, 2016) comprise 36.6 per cent of the total GDP in Malaysia (SME Corp. Annual Report, 2016). According to the Social Security Organization (SOCSO), SMEs recorded 80 per cent (Thye, 2010) to 90 per cent of the total occupational accidents (Surienty, Hong, & Hung, 2011). Nor Azma, Mustafa, and Abdul Majid, (2016a) indicated that the total number of SME occupational accidents increased after 2008 and reached 48,472 in 2012. Furthermore, researchers point out that the estimated cost of occupational accidents in SME rises almost MYR 50 million a year (Nor Azma, Mustafa, et al., 2016a). Chee, Ramayah, and Subramaniam (2018) stated that the Malaysian manufacturing sector is one of the most hazardous industries. Scholars collectively agreed that SME is bound with a bundle of weaknesses, which lead to high accident occurrence (Masi & Cagno, 2015; Masi, Cagno, Micheli, Cagno, & Micheli, 2015).

Indirectly, a high number of industrial accidents and the huge cost of compensation claimed have a domino effect on the Malaysian economy. In a study of safety, (Silva, Ishiwatari, & Takahara, 2014) it was found such problems would have several disadvantages to the work environment, involving the rising cost of employee's compensation insurance, expensive medical costs and a high cost of administration, property loss, insurance premium, suffering, and damage to the organisation and owner's reputation, resulting in a negative effect on the employees. The academic literature on safety related study in SMEs has revealed that SME is fragile from an economic view due to various limitations, as it will indirectly influence the country economy (Guo, Yiu, & González, 2017). Therefore, control of industrial accidents is crucial to reducing Malaysians' compensation claimed costs.

There is a growing body of literature that recognises the importance of proactive safety management action, which is also called behaviour-based safety associated with accident prevention. Behaviour-based safety is frequently used as a term for a variation of safety

interventions that place emphasis on front-line employee's safety behaviour (Guo et al., 2018). Previous research has proven that an effective behaviour-based performance is agreed as a set of critical success factors associated with safety, health programs, and activities (French & Geller, 2012). Similarly, Tang, Ho, Dawal, and Olugu, (2018) found that a safety performance is desirable as it enables more effective accident prevention, resulting in a reduction in death and injury. In a study investigating behaviour-based safety, Guo et al., (2018) reported that the successful behaviour-based safety program implemented in the Singapore construction industry was effective in reducing six groups of the unsafe act. A study conducted in the Chinese driving institutes indicated that the effectiveness of the behaviour-based safety education method was highly influenced with driving behaviour (Wang, Xing, Luo, & Yu, 2018). Choudhry, in a series of behaviour-based safety studies, demonstrated that behaviour-based safety initiatives were useful towards improving safety performance (Choudhry, 2012, 2014; Choudhry, Fang, & Mohamed, 2007). On the other hand, a case study conducted in construction by a prominent researcher stated that an effective measure of behaviour-based safety would be more significant with the integration of committed management (Choudhry, 2014). Beyond this, several researchers revealed that climate emergency considerably encouraged positive safety performance in the workplace (Nguyen, Teo, Grover, & Nguyen, 2017; Zohar, 2008) and negatively correlated with unsafe behaviour in the workplace, and can be used to predict safety performance of different severities (Olsen, Næss, & Høyland, 2015). Collectively, these studies outline the critical role of climate in behaviour-based safety in order to resolve safety issues in numerous industries.

The literature which deals with the ideal safety performance for SME safety, contains information on how interventions should work. However, empirical results were found to be inconsistent with the literature (Lu & Yang, 2011) due to a lack of psychometric properties and failure to consider individual differences (Golubovich, Chang, & Eatough, 2014), divergent safety climate measures and dimensions, (Flin et al., 2000; Guldenmund, 2007) and different culture (Brooks, 2008). Moreover, the validity, or low transferability, of the research outcomes to support the work of reality has become a big question for professional safety practitioners in SMEs (Masi et al., 2015). In this light, the research will explore the construct validity of the extension climate-based construct on the behaviour-based safety performance model for SME in Malaysia.

Another concern is the method used to assess the measurement model. The phrase measurement model refers to covariance analysis or structural equation modeling, which is broadly covered by an ever-increasing group of approaches such as, statistical, mathematical, and graphical (Hair, Babin, & Krey, 2017). A prominent researcher indicated that "factor analysis is at the heart of the measurement of psychological constructs" (Nunnally, 1978; Nunnally & Bernstein, 2010). Generally, CFA provides a more meaningful understanding of the covariation between a set of indicators because the number of components is less than the

number of measured constructs (Brown & Moore, 2014). These concepts described that each indicator in a set of observed measures is a linear function of one or more common factors and one unique factor (Brown & Moore, 2014). Additionally, CFA is commonly applied for several objectives. For instance, psychometric evaluation, the detection of method effects, construct validation, and the evaluation of measurement invariance (Brown & Moore, 2014). Nowadays, CFA is a form of the structural equation model, found to be widely used in the measurement model (measuring individual latent construct) (Aziz et al., 2019; Asnawi et al., 2019). A confirmatory test of the measurement model, that is conducted using the CFA, covered three main procedures: uni-dimensionality, validity and reliability of the items measuring the construct (Aziz et al., 2019; Asnawi et al., 2019). Uni-dimensional was achieved during the Exploratory Factor Analysis (EFA), for which the explanation is not in the scope of this article. The CFA offers several advantages, as it was selected for construct validation in this present study. Many researchers specified that confirmatory factor analysis is meaningful for exploratory study using covariance based-structural equation modeling (CB-SEM) (Hair et al., 2017). Besides that, the assessment of the fitness index provided by Jorg. Henseler, Christian, and Sinkovics (2009), namely, Cronbach Alpha, Convergent Reliability (CR), indicator reliability, Average Variance Extracted, and cross loadings is more acceptable in CB-SEM (Aziz et al., 2019; Asnawi et al., 2019). A prominent researcher in CB-SEM indicated that the fitness indexes in CB-SEM are more comprehensive because it relies on the sample size required, proportion variances and covariance matrix (Aziz et al., 2019; Asnawi et al., 2019). As far as the assessment of measurement method has been concerned, no effort is made to examine validity of behaviour-based safety performance using covariance based in Malaysian SME. To address this issue, this paper aims to assess the validity of the extension model of safety behaviour developed by Zohar et al. (2014), using the systematic covariance based psychometric properties of confirmatory factor analysis in Malaysian SME. The specific objectives of this study are listed as follows:

- To assess the validity of the measurement model
- To assess the reliability of the measurement model
- To assess the normality of the data

Behaviour-based safety performance

What is behaviour-based safety performance? Behaviour-based safety is basically everything an individual employee does or says in maintaining safety in the workplace and which is usually affected by several climates in the organisation. According to a key researcher in behaviour-based safety, the original ideal of behaviour-based safety is an extract from behaviourism (Choudhry, 2014). From a psychological perspective of view, behaviours are actions or reactions of persons or are feedback to two types of stimulus: either external or internal (Choudhry, 2014). It has been noted that behaviour-based safety is the systematic application of psychological investigation on human behaviour related to safety (Choudhry,

2014; Cooper, 1994; Liu et al., 2015). In this study, researchers have defined behaviour-based safety performance as an employee safety performance measured based on the effect of climate-based constructs: work ownership, Islamic work ethic and management commitment on two established safety performance components: safety compliance and safety participation.

A systematic literature review of safety related studies indicated that there are two types of safety performance, which are organisational safety performance and individual safety performance. According to Yang, Wang, Chang, Guo, and Huang, (2009), the proper management system improved organisational safety performance. On the other hand, Guo et al., (2018) specified that most of the safety performance evaluation studies were emphasised on measuring the individual level of frontline employees, as it is relatively easier to measure. Zohar (2002) points out that measuring behaviour-based safety performance at the individual level provided more precise results, which often have a small base rate and data dispersal in small skewed distribution. Additionally, several researchers discussed that the individual measure of safety is easy to obtain or access, and can provide meaningful results. Particularly, in the context of production employees, because they are more accountable for their personal safety and frequently remain in one area (Glendon & Litherland, 2001). Interestingly, previous studies consistently demonstrate that there are two components of employee safety performance, namely: safety compliance and safety participation, which are significantly affected by a positive employee safety climate and effectively reduce workplace accidents and injuries (Clarke, 2006; Curcuruto, Conchie, Mariani, & Violante, 2015; Andrew Neal & Griffin, 2006).

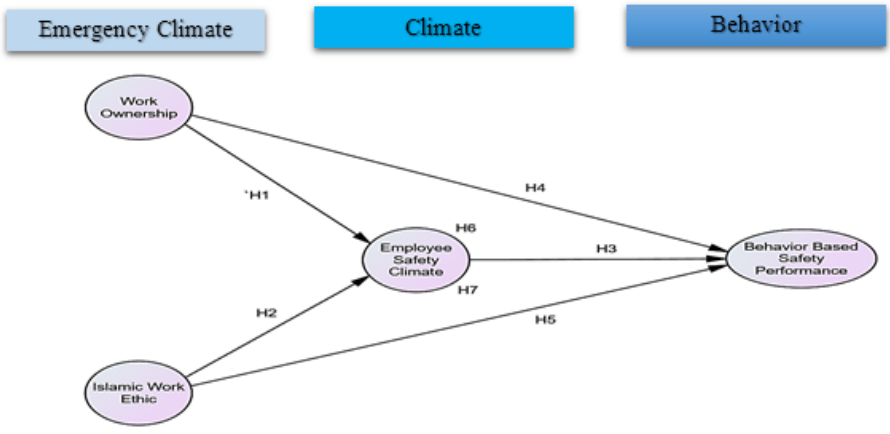
Safety behaviour contains safety compliance that is likely to be reflective of the employee's formal work role (Clarke, 2006), which is directly affecting of the reward system and employee personal safety (Kapp, 2012). A study by Inness, Turner, Barling and Stride (2010) has recommended that this formal work role needs a formal mechanism control, such as rewards and punishes, in order to attain greater safety compliance. In addition, many scholars in the study of safety have recognised the vital role of safety compliance as a precaution of occupational related accidents (Christian, Bradley, Wallace, & Burke, 2009; Clarke, 2010; Dahl & Olsen, 2013; Fernández-Muñiz, Montes-Peón, & Vázquez-Ordás, 2014). Previous evidence specified that management commitment to safety is a predictor of safety compliance, and safety compliance is an important factor as well as the companion of safety participation in predicting behaviour-based safety performance. Hence, a positive impetus towards strengthening safety compliance in SMEs via management commitment, is likely to have a significant influence on behaviour-based safety performance.

Several researchers in safety related literature have discussed the crucial factor of management commitment in safety climate affected by safety participation (e.g., (Clarke & Ward, 2006; Conchie, Taylor, & Donald, 2012). Some writers have agreed that the sustained management

commitment to safety is one of the primary requirements in ensuring a successful safety participation (Clarke & Ward, 2006; A Neal, Griffin, & Hart, 2000). Besides that, a number of studies have verified that a safety participation was noticeably linked with occupational injuries and accidents (Agnew, Flin, & Mearns, 2013; Clarke, 2006; DeArmond, Smith, Wilson, Chen, & Cigularov, 2011; Jiang, Yu, Li, & Li, 2010). Employees with excellent behaviour-based safety performance should have a high safety participation and safety compliance in order to overcome safety issues, namely: risk associated with unsafe practices, reduce accidents, and eliminate potential risks and rule violation (Jiang et al., 2010).

To date, the social exchange theory seems to be the most popular theoretical framework in order to explain the antecedents of behaviour-based safety, as it was applied in (Alfayez, Subramaniama, & Mohd Zin, 2017; McGonagle et al., 2016; Nguyen et al., 2017; Nor Azma, Mustafa, & Abdul Majid, 2016b). Social exchange theory explains the human relationship based on cost and benefit in social association (Blau, 1964). Cropanzano (2005), in inter-discipline reviews, demonstrated that social exchange theory become the most powerful conceptual paradigm in understanding workplace behaviour. In the study by Zohar et al. (2014), social exchange theory has been applied to predict the mechanisms of emergency climate on truck driver safety behaviour performance. Aspects that added to the body of the knowledge were, amongst others, borrowed from the social exchange. The social exchange theory, hence, seems to be a practical construct to apply when trying to explain employee behaviour-based safety performance in SME.

Fig. 1. Theoretical framework of behaviour-based safety performance



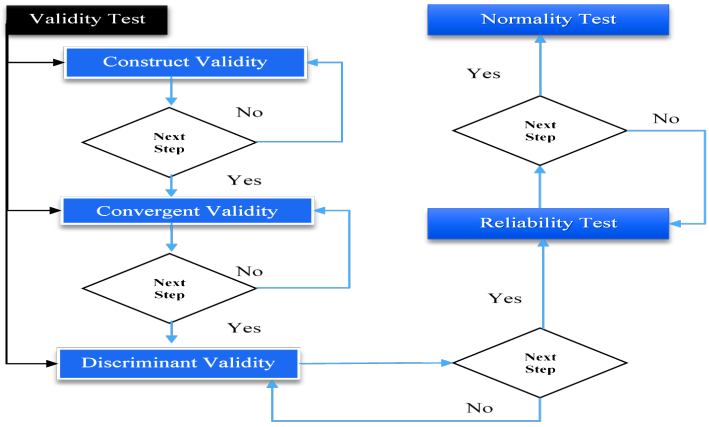
Methodology

Participation and procedure

In order to assess the objectives above, data was collected through sampling from employees of the Malaysian SME industry. Approximately 500 employees were selected in various SME settings in the East Coast Peninsular of Malaysia. Confidentiality was guaranteed by allocating time freedom to respond within a week and each SME company was provided with an addressed envelope that allowed the company to return the completed questionnaires directly to the researchers.

Of the 500 questionnaires initially distributed, 360 were completed and returned. In order to ensure the quality of the data analysis, a screening and cleaning procedure was obtained. Researchers found more than five per cent in missing items out of 360 questionnaires. After missing data points were imputed with the median of nearby points of each case, 286 questionnaires were useable and completed and were used for the CFA. In this study, the definition of small firms is based on new guidelines of the SME definition provided by (SME Corp. Malaysia, 2013), which was adopted for analysis. SME companies were selected as those employing more than five employees or less than 75 employees.

Figure 2. Flow Chart of the Covariance Based using CFA Validity Procedure



Data analysis procedure

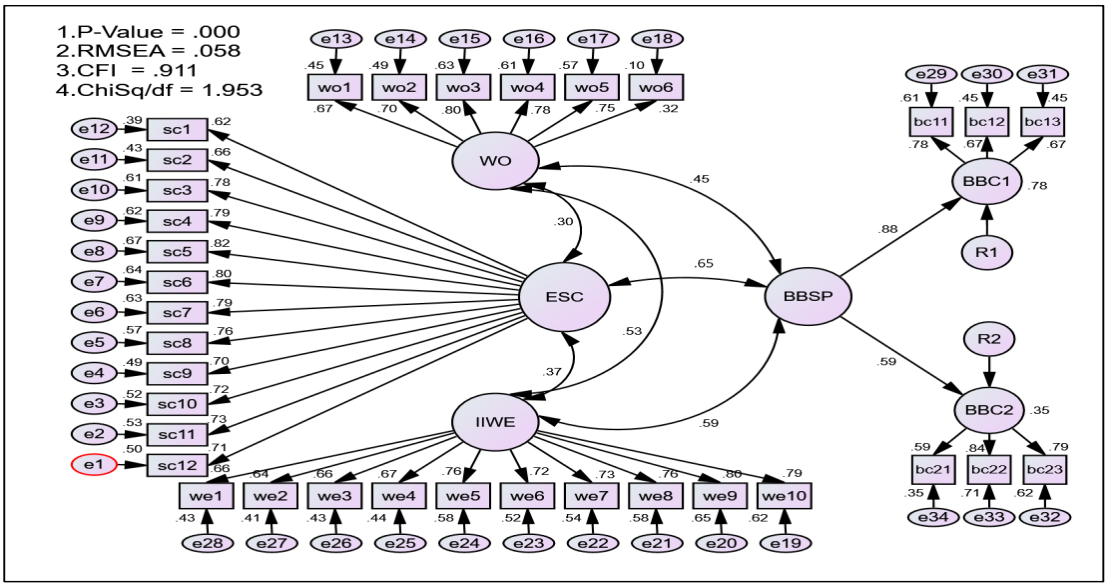
The covariance based analysis using confirmatory factor analysis of measurement models was conducted by using IBM SPSS AMOS software version 22. For the purpose of data analysis, the covariance based analysis using CFA was emphasised on measurement model procedures, which is comprised of a validity, reliability and normality test. There are three types of validity, namely: construct validity (based on fitness indexes), convergent validity, and discriminant validity of multi-trait-multi-method (MTMM) data, which has been proposed by Campbell and Fiske (1959) and is also highlighted by Ziegler and Hagemann (2015). Moreover, the reliability

test comprises of two elements, namely: internal reliability and CR. Finally, the normality test data is described based on the skewness of the para metric data contribution. A flow chart of the Covariance Based using CFA Validity Procedure is illustrated in Figure 2.

Results

The model for this study comprised four latent constructs; work ownership, Islamic work ethic, management commitment to safety, and behaviour-based safety performance (BBSP). Two constructs, namely, work ownership (WO), and Islamic work ethic (IIWE) which is a reflective management commitment (ESC) construct. The behaviour-based safety performance (BBSP) scale consisted of two components: safety compliance (BBC1), and safety participation (BBC2).

Figure 3. Behaviour-Based Safety Performance Measurement Model



The construct validity was assessed based on the fitness index of the model. The CFA results in Figure 3 indicated that the structures of the behaviour-based safety performance model present a satisfactory in three model fit category. The absolute fit index (RMSEA= 0.058) was accepted at less than 0.08 and incremental fit index of CFI = 0.911 was satisfactory, while the parsimony fit index of chisq/df = 1.953 achieved the requirement level. Moreover, the behaviour-based safety performance model was significant at p=0.00. The good Fitness index is reflected from the low modification index (MI) (MI <15) of every item (Awang, 2015) and it also specified that data is free from a multicolinearity problem. This indicator must be achieved before data is qualified for further covariance based analysis, likely convergent and discriminant validity.

The CFA results in Table 1 demonstrated that the standardised parameter loading ranged between 0.62 and 84 for all items in the behaviour-based safety performance model. One item from the work ownership construct (wo6 =0.32) has a slightly low factor loading and was retained regarding a good model fitness. The results of the CFA of all the items used to measure latent constructs are not eliminated due to high factor loadings for every item, which is more than the rule of thumb level of 0.6 (Zainudin Awang, 2015). The Criterion Reliability (CR) values represent the latent construct of the behaviour-based safety performance model, exceeding the recommended value of 0.7 (Hair et al., 2010) and as it was practiced in Awang, Afthanorhan, Mohamad, et al. (2015). The average variance extract value indicates that the variance of WO, IIWE, ESC and BBSP contributed a high degree of variance to the overall measurement model, which is higher than the recommended value of 0.5 (Hoque et al., 2017; Hair et al., 2017).

Table 1: Measurement model

Items	WO	IIWE	ESC	BBSP
1	0.67	0.66	0.62	0.78
2	0.70	0.64	0.66	0.67
3	0.80	0.67	0.78	0.67
4	0.78	0.76	0.79	0.59
5	0.75	0.72	0.82	0.84
6	0.32	0.73	0.80	0.79
7		0.76	0.79	
8		0.80	0.76	
9		0.79	0.70	
10			0.72	
11			0.73	
12			0.71	
AVE	**0.500**	**0.531**	**0.551**	**0.531**
CR	**0.837**	**0.919**	**0.936**	**0.870**

Table 2 shows the results of discriminant validity and correlation between constructs in the measurement model. The square root of AVE of each construct is presented diagonally, (marked by *) and is found more than its corresponding correlation coefficients with a pair of constructs, presented in rows and columns. Besides that, the correlation coefficient between the construct was lower than 0.85 and verified that the measurement model is free from redundant items. In addition, Rose and fellow researchers (2017) in one study described that exogenous should not be closely related with each other in the model because it will expose it to a serious multi-collinearity problem. All these results are presented in the Table 2 and indicate the WO, IIWE, ESC and BBSP constructs pass the discriminant validity test as it was recommended by Hair et al. (2017).

Table 2: Discriminant validity

	WO	IIWE	ESC	BBSP
WO	*0.70			
IIWE	0.53	*0.72		
ESC	0.30	0.37	*0.74	
BBSP	0.45	0.59	0.65	*0.728

Note: * figures indicated the square root of AVE of each contract.

For the purpose of normality analysis, skewness and kurtosis were considered. According to Kamaruddin et al. (2017) and Yuan et al. (2018), the distribution of data in this current study is considered normal if the value of skewness and kurtosis is in the range between -1 and +1. Table 3 revealed that the constructs work ownership, Islamic work ethic, and management commitment to safety and behaviour-based safety performance, all have skewness and kurtosis values of less than 1. Therefore, it can be summarised that the data is normally distributed.

Table 3: Normality of data

BBSP			WO			IIWE			ESC		
Items	Skew	Kurtosi	Items	Skew	Kurtosi	Items	Skew	Kurtosi	Items	Skew	Kurtosi
bc21	-0.015	-0.367	wo1	-0.678	0.288	we1	-0.612	-0.496	esc1	-0.11	-0.687
bc22	-0.328	-0.388	wo2	-0.549	0.424	we2	-0.286	-0.587	esc2	-0.011	-0.684
bc23	-0.538	-0.168	wo3	-0.588	0.072	we3	-0.219	-0.581	esc3	-0.304	-0.812
bc13	-0.328	-0.267	wo4	-0.34	-0.288	we4	-0.13	-0.581	esc4	-0.12	-0.441
bc12	-0.314	-0.356	wo5	-0.411	-0.039	we5	-0.194	-0.616	esc5	-0.1	-0.763
bc11	-0.376	-0.158	wo6	-0.134	-0.138	we6	-0.402	-0.329	esc6	-0.502	-0.622
						we7	-0.96	0.436	esc7	-0.281	-0.569
						we8	-0.236	-0.502	esc8	-0.243	-0.659
						we9	-0.291	-0.528	esc9	-0.198	-0.588
						we10	-0.331	-0.369	esc10	-0.49	-0.232
									esc11	-0.377	-0.331
									esc12	-0.371	-0.529

Conclusion and Discussion

From this assessment, the result reveals consistency of the Malaysian study with the Malaysian and the non-Asian sample by drawing the integrated conceptualised model of behaviour-based safety performance of employees from SME in the present empirical study. The practical implication of this study is to empirically validate through five systematic steps, the adapted

behaviour-based safety performance measurement model which is likely applicable in the context of the Malaysian SME setting. The validated measurement model can further be used as an alternative evaluative measure to assess the level to employee behaviour-based safety performance in SME. Significantly, the identified constructs of work ownership and Islamic work ethic as climate emergency employee safety climate, would enable all stakeholders, including employees, practitioners, business owners, and academicians as well as researchers, to know that specific emergency climate constructs influence the employee safety climate and the effectiveness of behaviour-based safety performance in SME.

The results of this study also supported some popular results from previous research in the relationship of safety discipline. Consistent with the literature, the antecedent of emergency climate, work ownership and Islamic work ethic were confirmed in this study, which corroborates the results of a great deal of the earlier studies in safety performance (Olsen et al., 2015; Zohar, 2008; Zohar et al., 2014). Work ownership is also validated as an antecedent of behaviour-based safety, which is proposed in research in the safety literature (Haro, 2010; Weatherford, 2011; Zohar & Faraj, 2011; Zohar et al., 2014). Besides that, Islamic work ethic has been proven as an antecedent of adaptive behaviour performance in tourism and business studies (Farrukh, Butt, & Mansori, 2015; Javed et al., 2016). Moreover, work ownership and Islamic work ethic were found to be significantly and positively related to employee safety climate. These results reflect those of Mashia et al. (2017), who also found that employee perceived management commitment to safety has a significant role in behaviour-based safety performance. The evidence from this study supported that management commitment remained the most important dimension of employee safety climate practices across sectors and countries and is the most frequently used safety indicator of employees perception concerning the safety priority in the workplace (Christian et al., 2009; Guo et al., 2017; McGonagle et al., 2016; Nahrgang, Morgeson, & Hofmann, 2011; Xia et al., 2017).

Researchers had discussed in detail the statistical analysis of the results shaped from the employee survey at SME companies. The generalisation of the results would be limited due to the population and sampling conditions. This study was realised on all employees from Malaysian SME, which is not generalisable to the population of all SME's employees worldwide. Adding, to this point, the researcher found that results of the study varied with the sampling issues, such as sample size, and unit of the analysis. This is paralleled with a key researchers statement that the model fits varying sample sizes (Hair et al., 2017). Besides that, unit of analysis has a huge impact on the measurement model, commonly divided into certain levels, such as individual level, group level and organisational level. It was strictly suggested by a prominent researcher in a behaviour-based safety study, that all data must be measured at the individual level (Clarke, 2010). This indicated that the measurement model should have the same level of measurement for all measured construct in the model. Adding to this array, a previous study has highlighted that a sample of the study population is usually different from

other studies relating to several respondents personal characteristics; namely, language, business setting and cultural variations (Nor Azma, Abdul Halim, & Munauwar, 2016) and participation standpoint (Ngo & Nguyen, 2016; Rose et al., 2017).

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