## 3.0 Results and Discussion

### 3.1 Demographic Analysis

Among N=220 respondents, there were only 3.6% of female respondents and 96.4% were male. Moreover, survey results also revealed that 47.7% of the respondents were supervisors, followed by 38.2% of operators and only 14.1% of technicians. Furthermore, most of the survey respondents are from the middle age (40 to 49) years old which represented 38.2%, followed by age range 50 to 59 years old with 33.6%, age range 31 to 39 years old with 20.9% and 7.3% respondents with below 30 years old. The respondents were also asked to share their working experience in the company in order to see whether they really understood and appreciated the importance of safety climate at their working environment (Shang & Lu, 2009). The survey revealed that most of the respondents were with working experience of 16 to 20 years which consumed 30.0%, followed by working experience of 11 to 15 years with 28.2%. There 26.8% of respondents who work less than 5 years and 15% of workers with less than 10 years working experience.

**Table 4** KMO values of dependent and independent variables

| Variable | KMO value |
|---|---|
| Safety Climate Factor | 0.779 |
| Safety Performance | 0.676 |

**Table 5** Individual factor loadings for Safety Behaviour

| Items | Factor Loading |
|---|---|
| SB1 | 0.572 |
| SB4 | 0.683 |
| SB5 | 0.766 |
| SB8 | 0.734 |

**Table 6** Individual Factor loadings for Safety Climate Factors

| Items | Factor Loading |
|---|---|
| SC1 | 0.796 |
| SC2 | 0.741 |
| SCM3 | 0.485 |
| SS1 | 0.657 |
| SS2 | 0.865 |
| SS3 | 0.648 |
| SS4 | 0.851 |
| SS5 | 0.725 |
| WP1 | 0.845 |
| WP2 | 0.642 |
| WP3 | 0.734 |
| WP4 | 0.67 |
| SV2 | 0.696 |
| SV3 | 0.861 |
| SCP1 | 0.592 |
| SCP2 | 0.481 |
| SCP3 | 0.457 |
| SCP4 | 0.734 |
| SCP5 | 0.878 |

### 3.2 Factor Analysis

The factor analysis technique was used to identify the underlying cluster of factors which affect safety climate factors. A principal component analysis (PCA) with varimax rotation (converged in 9 iterations) on the 26 items for safety climate and varimax rotation (converged in 3 iterations) on the 7 items for Safety Performance (N= 220) was carried out through the SPSS 22.0. According to George and Mallery (2006), the KMO value (Kaiser-Meyer-Olkin

Measure of Sampling Adequacy) should be greater than the acceptable threshold of 0.5 and a value greater than 0.6 is classified as mediocre, greater than 0.7 is defined as middling, value of greater than 0.8 is meritorious and value of KMO more than 0.9 is marvellous in order for a factor analysis to be proceeded (Shang & Lu, 2009). In this study, the KMO value for safety climate factors were obtained as 0.779 and KMO for safety performance was obtained as 0.676 (Table 4). KMO value of 0.676 and 0.779 which is above the threshold value indicates that the data is appropriate for factor analysis. Initially there were seven individual factors proposed for safety behaviour to measure safety performance, however only four safety behaviour items were remained after factor analysis. All the individual factor loadings were more than 0.4 which is the minimum criteria for accepting individual factors in factor analysis (Pallant, 2011) which could be referred in Table 5 for safety behaviour and Table 6 for safety climate factors.

Meanwhile for safety climate factors, 7 of 26 factors were excluded during factor analysis for subsequent analysis. Those six items (SV1, SC4, SC3, SCM1, SCM2, SCP6 and SCP7) were excluded since these factors act as only 2 items per latent variable.

**Table 7** Extracted Safety Climate Factors

| Item | Safety Climate Factors | | | |
|---|---|---|---|---|
| | **Safety Management and Work Pressure** | **Safety Competence** | **Safety Communication** | **Safety Procedures** |
| | Factor Scores (overall KMO=0.789) | | | |
| SCM3 | 0.521 | | | |
| SS1 | 0.598 | | | |
| SS3 | 0.669 | | | |
| WP1 | 0.87 | | | |
| WP2 | 0.667 | | | |
| WP3 | 0.799 | | | |
| SV2 | 0.648 | | | |
| SCP1 | | 0.6430 | | |
| SCP2 | | 0.659 | | |
| SCP3 | | 0.569 | | |
| SCP4 | | 0.693 | | |
| SCP5 | | 0.869 | | |
| SC1 | | | 0.848 | |
| SC2 | | | 0.785 | |
| SV3 | | | 0.796 | |
| WP4 | | | 0.711 | |
| SS2 | | | | 0.83 |
| SS4 | | | | 0.8170 |
| SS5 | | | | 0.585 |

### 3.3 Multiple Linear Regression

Total 26 safety climate factors and 4 safety behaviour factors extracted through factor analysis were preceded with factor score analysis in order to develop the relationship through multiple regressions. There were 4 components of safety climate factors were extracted. All individual variables have factor loadings of value more than 0.5. These extracted 4 components were renamed as safety management and work pressure, safety competence, safety communication and safety procedures. Component safety management consist of supervision, commitment and safety procedures variables which were found to be more accurately related to management based on the previous researchers Shang ans Lu (2009) and Vinodkumar and Bhasi (2009). The extracted components of safety climate factors are shown in Table 7.

From Table 8, it also could be seen that some of the items of safety procedures (SS1 and SS3) are grouped under safety management because the constraints SS1: *Company emergency response plan give sufficient guidelines on how to deal with emergencies and it is tested* and SS3: *An effective documentation management system ensures the availability of procedures* more explains the role of management. Meanwhile, for safety behaviour indicators, all individual factors were found to be more than 0.4 as shown in Table 8.

**Table 8** Extracted Safety Behaviour Items

| Items | Factor Score |
|---|---|
| SB1 | 0.416 |
| SB4 | 0.466 |
| SB5 | 0.813 |
| SB8 | 0.852 |

## 3.4 Modelling of Safety Climate Factors and Safety Performance Factors

Multiple linear regression analysis was used in this study to study the relationships between safety performance (dependent variable) and safety climate factors (independent variables). A stepwise variable selection was adopted as it is the most frequently used method for model building (Pallant, 2011). The stepping method criteria selected the p value = 0.05 for a variable to enter the regression equation and p value = 0.10 to remove an entered variable. The model gives an equation which contains a constant (intercept) and partial regression coefficients for each of the critical success factors. The four extracted component of safety climate factors were used as independent variables, meanwhile safety behaviour component was retained as dependent variable. The regression analysis computed adjusted $R^2$ value which is interpreted as the percentage of variance in the outcome variable that is explained by the set of predictor variables. Significance of the variables also maintained ($p<0.05$) (Hoaglin, 2013). The summarized regression analysis is tabulated in Table 9.

**Table 9** Summary of Multiple Linear Regression Analysis

| Item | Adjusted R Square | Significance |
|---|---|---|
| Constant | | |
| Safety Management and Work Pressure | 0.323 | 0.000 |
| Safety Competence | 0.444 | 0.000 |
| Safety Communication | 0.462 | 0.025 |
| Safety Procedures | 0.472 | 0.004 |

From Table 9, it can be seen that all those 4 factors are significant ($p<0.05$) and each of the safety climate factors contribute the relationship with safety performance, meanwhile R square adjusted value explains the percentage of variance each safety climate factors influence on safety performance. Overall R square value obtained as 0.472, which indicates that only 47.2% of variance of safety performance is explained by these 4 safety climate factors.

## 3.5 Validation Model

Based on the extracted safety climate factors and safety performance indicators through multiple regressions, a final model explaining the relationship between safety climate factors and safety performance indicators was validated using SmartPLS which could be seen in Figure 1.

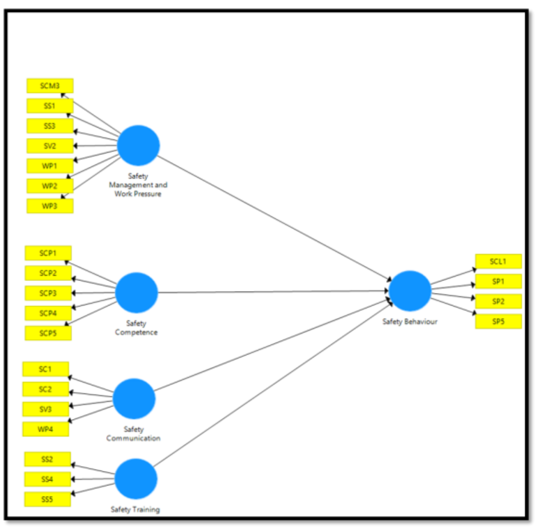


**Figure 1** Validation Model

### 3.6 Model Evaluation

Measurement model evaluation is aimed to evaluate the consistency and validity of the observed variables. Consistency of the observed variables is explained through construct reliability tests and validity of the observed variables is explained through convergent validity (Joseph F. Hair, Black, Babin, & Anderson, 2010).

### 3.7 Consistency of Observed Variables

Cronbach's alpha and Composite Reliability (CR). Cronbach's alpha and CR indicate how well a set of manifest variables appraises a single latent construct. However, compared to Cronbach alpha, composite reliability is considered a better measure of internal consistency because it employs the standardized loadings of the observed variables (Fornell & Larcker, 1981). Litwin (1995) suggested that value of for composite reliability should be more than 0.70; however, for analysis through Partial Least Square Structural Equation Modelling, the suggested value of composite reliability is within 0.60 to 0.90 (Litwin, 1995). In this study, the composite reliability for each construct were obtained to be within the suggested range of 0.60 to 0.90 which proves that the observed variables are consistent with each other (Table 10)

**Table 10** Composite Reliability and AVE values of Safety Climate Factors

| | **Composite Reliability (0.60~0.90)** | **Average Variance Extracted (AVE) (>0.5)** |
|---|---|---|
| Safety Behaviour | 0.799 | 0.599 |
| Safety Competence | 0.879 | 0.593 |
| Safety Communication | 0.703 | 0.578 |
| Safety Management and Work Pressure | 0.905 | 0.579 |
| Safety Procedures | 0.917 | 0.787 |

### 3.8 Convergent Validity

Convergent validity of the constructs is often determined through outer loadings which measures individual reliability of the variables, and Average Variance Extracted (AVE) test on variables which determines the amount of variance captured by latent variable from its relative observed variables due to measurement errors (Fornell & Larcker, 1981). According to Ringle, Sinkovics, and Hensele ,(2009), observed variables with outer loading 0.7 or higher are considered highly satisfactory, however loading value of 0.5 is still regarded as acceptable criteria (Liu et al., 2015). Joseph F. Hair et al. (2010) argued that a minimum 50% of the variance from observed variable should be captured by latent variables which implies that AVE value of the construct should be greater than 0.5 (Ringle et al., 2009). In this study, the outer loadings obtained for each individual variable are more than 0.6 (Table 11 and Table 12), meanwhile AVE values obtained as more than 0.5 which indicates that the construct of the finalised model is valid (Table 10).

### 3.9 Discussion

A positive significant relationship was found between safety management and work pressure, safety procedures, safety competence and safety communication and safety performance. Jazayeri and Dadi (2017) explained that International Civil Aviation Organization (ICAO) has defined safety management systems as "*systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies and procedures*" meanwhile International Labour Organization (ILO) has defined safety management systems as "*A set of interrelated or interacting elements to establish occupational safety and health policy and objectives, and to achieve those objective* (Jazayeri & Dadi, 2017). Safety management is considered to be a crucial factor in explaining the safety performance of a firm where Choudhry, Fang, and Mohamed (2007) explains the role of safety management in construction industry. Implication of safety management could be able to reduce the number of injuries to personnel and operatives in the workplace and also minimize the risk of major accidents. Moreover, systematic safety management is believed to minimize production interruptions and reduce material and equipment damage which indirectly minimize legal cost of accident litigation, fines, and also reduce expenditures of emergency supplies. Although those implications are focussed only in construction industry, it strongly believed that chemical industries also could have the same positive implications if proper safety management is take place.

Moreover, the finding of safety management approach is similar to some of the previous studies by Liu et al (2015) who concluded that management has a key role in safety and accountable for safety performance of a company. Liu et al. (2015) furthermore explains that when the top management is committed to safety, they may set goals for safe production, establish occupational safety management organization, increases communication and feedback, provide enough support and resources to safety activities which later will increase safety behaviour. Leaders have been found to affect safety compliance positively by standing out as positive and safe behaving role models for their staff by challenging workers to develop improved practices and by inspiring their staffs to achieve exceptional safety standards, thus safety supervision is crucial in explaining the safety performance of a firm. Furthermore, they also concluded that leadership will be more positive if supervisors involve in daily work operations (Kvalheim & Dahl, 2016).

Although there were fewer studies investigated the role of work pressure on safety performance, the finding of this study has similarities to previous studies. Brown, Willis, and Prussia, (2000) defined work pressure as conceptualize pressure for production as an employee's perception that the organization encourages him or her to work around safety procedures in order to meet production quotas, keep up with the flow of incoming work, or meet important deadlines. Work pressure has been found to have a small effect in predicting safety performance, accident and injuries relative to other safety climate dimensions in a meta-analytic study by (Brown et al., 2000). However, this finding against the findings of Masood and Choudhry (2011), whereas they found that work pressure is negatively impact safety performance in construction industry of Pakistan. Other than these, previous researchers had found that there are strong correlations between safety procedures and safety performance in industries.

**Table 11** Outer Loading of Individual Items of Safety Climate Factors

| Items | Outer Loadings (>0.5) |
|---|---|
| SC1 | 0.737 |
| SC2 | 0.613 |
| SCM3 | 0.755 |
| SCP1 | 0.761 |
| SCP2 | 0.834 |
| SCP3 | 0.689 |
| SCP4 | 0.727 |
| SCP5 | 0.828 |
| SS1 | 0.746 |
| SS2 | 0.922 |
| SS3 | 0.807 |
| SS4 | 0.854 |
| SS5 | 0.885 |
| SV2 | 0.635 |
| SV3 | 0.647 |
| WP1 | 0.859 |
| WP2 | 0.661 |
| WP3 | 0.835 |
| WP4 | 0.688 |

**Table 12** Outer Loading of Individual Items of Safety Behaviour

| Items | Outer Loadings (>0.5) |
|---|---|
| SB1 | 0.702 |
| SB4 | 0.747 |
| SB5 | 0.649 |
| SP8 | 0.723 |

Kvalheim and Dahl (2016) indicated that negligence of perceived procedure in offshore service vessel industry to be negatively related to safety compliance. Furthermore, Antonsen (2009) also have suggested that simplicity of procedures are significant success criteria for high compliance. Furthermore, the finding of safety communication also were found to be similar with some of the previous studies by Sampson, Dearmond, and Chen (2008) where they highlighted that improved communication between line workers and supervisors will results in decreasing minor accidents and increasing in personal protective equipment (PPE) use.

### 3.10 Impact on Industry

It is strongly believed that reliable safety climate scale could provide proactive information about safety problems before they develop into accidents and injuries (Seo, Torabi, Blair, & Ellis, 2004). Although the finding that safety climate perceptions will not necessarily match actual levels of safety performance, M D Cooper and Phillips (2004) recommends that industry should focus its primary safety improvement effort on changing unsafe situations and conditions as well as people's safety behaviour at all organizational levels, rather than concentrating on improving people's attitudes, beliefs, and perceptions about safety. Even though previous studies in various industries found that worker's perceptions play major role in highlighting effectiveness of safety system in a firm, but there are always a need of physical changes within an organization (M D Cooper & Phillips, 2004).

## 4. Conclusion and Future Work

### 4.1 Conclusion

The main purpose of this study was to identify safety climate factors and safety performance in chemical industries in Johor and has been established. The finding of this study which derived the safety climate factors of safety communication, safety procedures, safety competence, safety management and work pressure are found to be similar to previous studies in various industries. Safety management was renamed to explain the safety commitment and safety supervision factors. A newly reliable developed relationship was able to explain 47.2% of relationship between safety climate factors and safety performance which full fill the second objective of this study. Although, only 47.2% of safety climate factors were found to impact safety performance of chemical industries in Johor, which common findings in a social investigation, then reflections of safety climate factors on safety performance could not be similar with each industry as compared with other researchers finding. In addition, the findings would fluctuate due to geographical context and individual context. Furthermore, even though the only 47.2 % of derived safety climate factors explain the relationship with safety performance, it is found that all 26 individual constructs are found to be valid and consistent thorough model evaluation. Although, the findings of the study were able to achieve the objectives, there are plenty of gaps and limitations which need be considered for future work.

### 4.2 Study Limitations

The findings of this study must be interpreted based on the following limitations. The results of this study were dependent upon sincere and honest responses from participants and there are no complimentary actions. Moreover, demographic factors also play an important role in manipulating the relationship between safety climate factors and safety performance (Vinodkumar & Bhasi, 2009). Thus, in future, effects of demographic factors on safety performance also should analyse co-currently, and the respondent's perceptions shall be analysed by demographic factors such as age, working experience, education and position in the particular firm.

Despite these limitations, this study actually contributes to the literature revealing factor structures of safety climate, where appropriate level of reliability and validity measures of safety climate scale was developed. However, it is strongly recommended to do more exploration on the safety climate factors by increasing the number of independent variables and number of samples and also compare the findings with previous studies by revalidating the previous established safety survey instrument.

### 4.3 Future Work

There are few items and issues to be considered in order to improve and increase the final results. Since in this study, the area of study was just focused on chemical industries in Pasir Gudang. In future, it should be expanded to more chemical industries around Johor and also around Malaysia. Furthermore, a longitudinal study should be carried out for the collected survey data since in this study was only in cross sectional. Furthermore, safety performance based on the perceptions will need to be supported by collecting more objectives and quantitative data measuring actual safety performance such as accident rates, injury cases, fatal cases and near missed cases. Other than these, this study also can be expanded by developing a model to explain the relationship between safety climate factors and safety performance by using Structural Equation Modelling (SEM) respectively.

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