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# Impact of Safety Culture Implementation on Driving Performance among Oil and Gas Tanker Drivers: A Partial Least Squares Structural Equation Modelling (PLS-SEM) Approach

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**Abstract:** This research aims to develop a safety culture model by investigating the relationship between safety culture and driving performance. In previous studies, safety culture has been one of the factors that determine safety issues. These issues were then contextually transformed via a pilot study and organized in the form of a theoretical model. The data were collected from 307 oil and gas tanker drivers in Malaysia through questionnaire surveys. Consequently, structural equation models of partial least squares (PLS-SEM) were applied to statistically assess the final model of this study. The results showed that the implementation of safety culture contributes to driving performance at a substantial level; there is a strong association with an effect of 67.3%. The findings of this research would serve as a benchmark for decision-makers in the oil and gas transportation sector, as promoting an awareness of safety culture should boost the efficiency of drivers. This research fills a gap in knowledge by identifying that positive safety culture practices and mindset are direct antecedents for the improvement of driver performance and, thus, the avoidance of road accidents.

**Keywords:** safety culture; driving performance; road safety; oil and gas tanker drivers; structural equation modelling

## 1. Introduction

Transportation is one of the most important areas in many sectors. In the transportation industry, fatigue in truck drivers is generally identified as the main safety issue because it has consistently been linked to road crashes [1–6]. A transportation department study from the United States reported that three independent studies identified lack of alertness or driving fatigue as one of the main reasons for serious accidents [3]. Fatigue has been linked to 10–20% of road accidents [7–11]. Furthermore, another truck driver study showed that 19% of tractor-trailer drivers have confirmed falling asleep at the wheel once or more in the month [12]. The association between rates of road accidents and fatigue is well documented [13]. Perceptions of what constitutes a safe environment may be different from person to person, for instance the perceptions of the safety directors may differ from those of the dispatchers. These perceptual differences may represent a tendency to disconnect from negative results and connect to positive results, depending on the self-serving motivations and bias of the individual [14]. In fact, there is evidence to show that people explain and interpret their safety environments according to their beliefs, the perceived importance

of events, and the impact of particular issues on their well-being [15]. Therefore, there is a need for the implementation of a safety culture that prevents accidents, efficiently saves resources, and mitigates losses [16].

Safety culture is considered to be the result of personal and collective attitudes, beliefs, and behaviour patterns, and it determines the commitment, willingness, style, and ability of organizations to manage health and safety issues [17]. In many countries, safety culture in the oil and gas industry is fundamentally competitive because it is one of the global requirements for sustainable growth. The association between strong safety culture and the occurrence and seriousness of accidents has long been recognized in various industrial environments [18,19]. Moreover, the literature review on safety culture has identified several management practices, i.e., beliefs and values, which underline the relevance of health and safety and could contribute to a strong safety culture [20]. In many manufacturing environments, the existence of a solid safety culture has produced a positive effect on safety consequences [21,22]. Perceptions of health and safety in workplace conditions have been linked to variables of incidents, such as near accidents, accident rates, and anxiety [23]. In addition, the safety expectations of the workers could be affected by their compliance with safety practices [23,24].

Previous studies in the Malaysian oil and gas transportation sector have examined the effects of exhaustion-related psychological risk factors [25], psychological well-being and fatigue [26,27], perceived stress [28], and driving fatigue [4,29]. Although these factors are important, the impact of safety culture on driving performance has been neglected. Currently, there is an urgent need to address the low performance of Malaysian oil and gas tanker drivers, which is caused by a lack of safety culture. There is a lack of evidence for the ways in which safety culture affects driving performance in the context of oil and gas transportation, especially in Malaysia [4]. Therefore, we set out the following research question for this empirical study: what is the impact of safety culture on oil and gas tanker driver performance? The present study aims to make up for the lack of empirical research on the effects of safety culture on driving performance in the Malaysian oil and gas transportation context via the partial least square modelling approach (PLS-SEM). This study would provide insights for decision-makers into how accidents in the oil and gas transportation sector might be reduced through an understanding of the ways in which general management practices lead to enhanced safety cultures, and also the extent to which drivers' perceptions of these practices vary among oil and gas transportation companies.

## 2. Literature Review

### 2.1. Safety Culture

Safety culture has been an interesting subject worldwide for both scientists and researchers because it is responsible for many organizational accidents and disasters [30]. Safety culture plays a crucial role in assessing the success or failure of an organization [31]. The term safety culture was coined as a result of the Chernobyl disaster in 1986 [32]. Safety culture refers to the extent to which individuals and organizations are committed to taking personal responsibility for safety, act to recognize and communicate safety concerns, adapt and modify behaviour based on lessons learned from previous mistakes, and how they are rewarded in line with these values [33]. According to Choudhry [30], safety culture can be defined as the outcome of the attitudes, values, competencies, and behavioural habits of the individuals and the groups that represent the organization's commitment to effective health and safety programs.

Using social cognitive theory, Bandura [34] attempted to understand the principle of safety culture as mutual determinism and derived three elements: behaviour, the individual, and the environment. Geller [35] adopted Bandura [34] and has been working to define the characteristics of each part, which has led to the development of a Total Safety Culture model. Choudhry et al. (2007) likewise adopted and developed Bandura (1986), and asserted by his modern paradigm that safety culture is a substance focused on interactions between individuals, workplaces, and organizations.

In summary, the literature revealed that safety culture is a term that has been tested outside the context of the Malaysian oil and gas sector, for instance, in construction companies, [36–39], vocational colleges [40], the manufacturing industry [31,41], and health care organizations [42]. Further attention is required to examine the safety culture in oil and gas transportation companies. This effort will enrich the understanding of safety culture in the oil and gas transportation context.

## 2.2. Driving Performance

Driving performance refers to a driver's effectiveness in accomplishing driving duty, which can be measured by studying driver vigilance, driver reaction time, and attention to duties [43–45]. In general, performance is the accomplishment of a specific job measured against recognized precision, completeness, speed, and cost. In a contract, performance is deemed to be the fulfilment of an obligation [46]. Driving performance involves attention [47] (which must often be split between driving duties such as maintenance of the lane position), speed, and other tasks, such as those which deal with dashboard instruments. The growing number of "technological" automotive distractions (e.g., smartphones, GPS, and entertainment systems) competing for driver attention is particularly worrying. Such distractions have been one of the primary causes of performance deficiency [48,49].

Previous research in the last decade has indicated that driving performance is influenced by several factors. These include driving for prolonged periods, monotonous environments [50–52], personality traits, age, executive functions [53], foggy conditions [54], drowsiness [55], a loss of focus [56], mental workload, the demand of the task [57,58], speed [54], and driver distractions, such as alcohol and energy drinks, eating, texting, loud music, mobile phone and smartwatch use, and caffeine [47,59–64]. Although the above studies focused on many important factors that influence driving performance, to date, the effect of safety culture on driving performance has not yet been empirically investigated.

## 2.3. Safety Culture and Driving Performance

In the transportation sector, safety measures are crucial and there is an ever-increasing demand for safe environments. Previous studies have discussed transport safety, including safety performance and safety cultures. Rigid safety requirements may create issues for tight scheduling requirements [65–69]. Moreover, these activities often lead to physical and mental fatigue, which lead to deteriorating levels of performance and safety [70]. Another study demonstrated that human accidents are caused by poor safety culture and other associated factors [71]. The safety of a journey relies mainly on the performance of the driver. The driver is the leading human operating a car, and in this specific situation, the car is considered the machine. The duties of the driver are very challenging because they must satisfy the many different demands and requests of a job [72]. They must also retain their driving skills, particularly in instances when the vehicle in question is a train or a commercial truck, and be attentive and environmentally friendly during monotonous journeys [73,74]. Both simulated and real case studies have demonstrated the connection between safety culture and impaired performance [70,75], medical and health services [68], manufacturing [76], vehicle driving [50], train driving [77,78], and oil and gas upstream operation [79].

## 2.4. Literature Summary and Contributions of This Study

In summary, previous studies have proven that there is empirical evidence for the relationship between safety culture and employee performance [66,67,75,80], medical and health services [68], manufacturing [76], operating nuclear power [65], vehicle driving [50,70], the rail industry [71–74,77,78], and oil and gas upstream operation [79,81]. However, the literature of previous studies shows that there is a lack of evidence for the relationship between safety culture and driving performance in the oil and gas transportation context, especially in Malaysia. Therefore, Figure 1 shows the hypothesis proposed for this study. Theoretically, based on the literature review, the current study will contribute to the body of

knowledge by investigating the impact of safety culture on driving performance. Practically, this study is among the first studies that will examine this relationship in the oil and gas transportation sector.
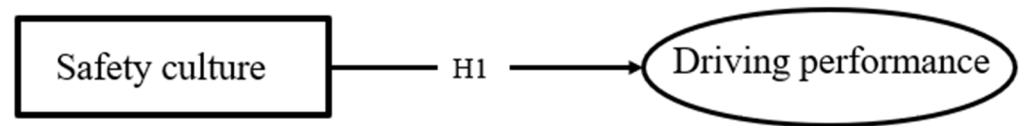


**Figure 1.** Influence of safety culture on driving performance.

**Hypothesis 1.** *safety culture has a significant impact on the driving performance of oil and gas tanker drivers*.

### 3. Method

A conceptual model begins to develop the research approach. A literature review is summarized as the conceptual model to establish the theory underpinning (hypothesis) the analysis, which will be examined by empirical evidence [82]. This approach is based on a three-phase procedure: (i) identifying model constructs, (ii) categorization of constructs, and (iii) specifying relationships between these constructs [83]. The conceptual model is displayed in Figure 1. The procedure that followed and the research design are outlined in Figure 2, adapted from Kineber [84].
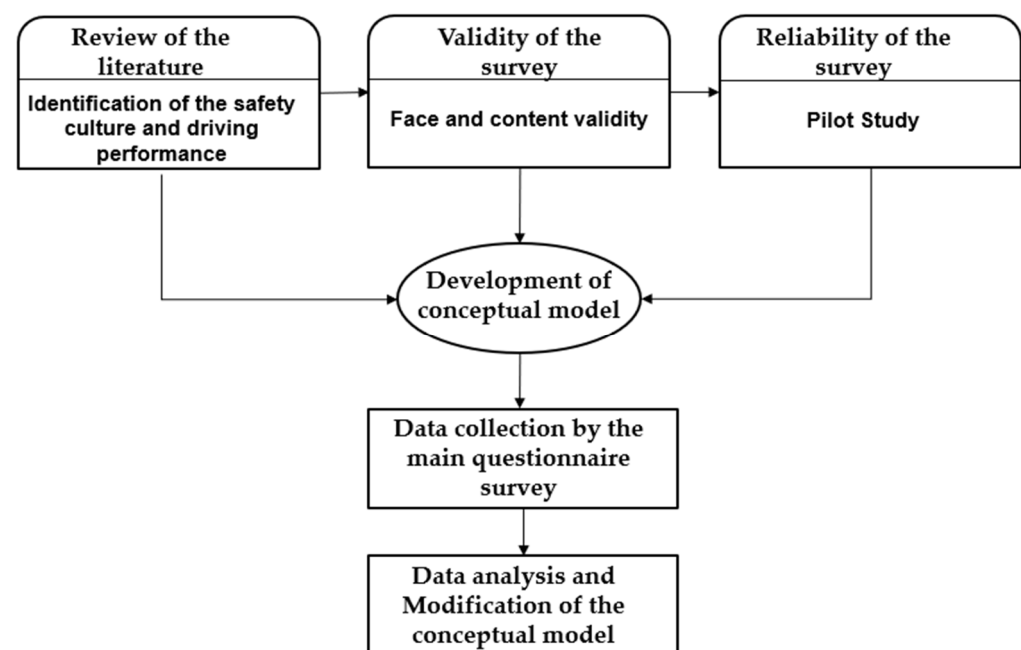


**Figure 2.** Research design.

Throughout previous literature, the studies adapted measuring instruments for safety culture and driving performance. Consequently, this study conducted three phases of questionnaire surveys. The first phase is the face and content validity of the survey. The second phase consists of a pilot study, which is important for testing the reliability and validity of the instruments before the main study has been carried out [85]. The last phase is the main survey, which tests the theoretical hypothesis.

### 3.1. Design of Survey

A systematic, cross-sectional questionnaire was developed based on the literature review. Appropriate changes were made according to the preliminary questionnaire (pilot study). The research has taken place in regions of Malaysia. To determine the impact of

safety culture on driving performance, a wide range of potential oil and gas tanker drivers were approached and asked to complete the main questionnaire. The sample size was dependent on the methodological analyses of the Morgan table [86]. Kline [87] believes that a sophisticated path model requires about 200 samples or more, while Yin [88] recommends that the SEM sample size should exceed 100. This study utilized the SEM analysis approach; using random stratified sampling techniques, the total 357 surveys were distributed among tanker drivers working in oil and gas transportation companies. The survey was taken in person (self-administered) and resulted in a high response rate of about 85.9% [89].

This questionnaire has been designed in two main parts: part one, demographic information of the respondents; part two, factors designed to measure two variables utilizing a five-point Likert scale ranging from "1" (never) to "5" (always), using instruments that have been adapted from previous studies [90–92]. Safety culture measures safety responsibility, communication, and the role of communication in the development of safety culture, along with management attitudes to safety and patterns of driver behaviour that determine the commitment to health and safety during driving duties. Driving performance, meanwhile, measures driver attention, vigilance, and reaction time, as shown in Table 1.

**Table 1.** Questionnaire items.

| Construct | CODE | Item | References |
|---|---|---|---|
| Safety Culture | SC1 | Concern about the possibility of killing or injuring persons | [91] |
| | SC2 | Concern about being assaulted (collision) | |
| | SC3 | Concern about slipping when climbing in and out of the cabin | |
| | SC4 | Does safety have a high priority within the company? | |
| | SC5 | In my workplace, management ignores safety issues | |
| | SC6 | My manager consults me to assist in resolving workplace problems | [90] |
| | SC7 | Management react quickly to any safety concerns | |
| | SC8 | My manager always informs me about relevant safety issues | |
| | SC9 | I am encouraged to offer ideas on safety | |
| | SC10 | If I report a safety issue, I feel I am blamed for the problem | |
| | SC11 | I can approach my manager to discuss problems regarding work | |
| | SC12 | There are not always enough people to do the job safely | |
| | SC13 | Feedback from any safety incident is good | |
| | SC14 | I am unable to do my job if I follow procedures and rules exactly | |
| | SC15 | Training covers the safety-critical aspects of the job | |
| Driving Performance | DP1 | Operating entertainment systems does not distract me from driving (e.g., playing the radio) | [93,94] |
| | DP2 | Operating navigation systems does not distract me from driving | |
| | DP3 | I sometimes push the wrong pedal | |
| | DP4 | My reactions are faster than they used to be (e.g., braking in an emergency) | |
| | DP5 | Sometimes I cannot judge my speed | |
| | DP6 | I have no difficulty judging the speed of oncoming vehicles | |
| | DP7 | I have no trouble judging the distance from the vehicle in front | |
| | DP8 | I have no difficulty identifying and reading road signs | |
| | DP9 | Sometimes I cannot hear the horns of other vehicles/sirens from emergency vehicles | |
| | DP10 | Sometimes my speedometer is hard to read during the daytime | |
| | DP11 | Sometimes my speedometer is hard to read during the night time | |

Distribution and collection of the questionnaire was done manually, and the data obtained were then stored in the online database with an acceptable response rate of 85.9%. To further conduct numerous data screening tests, the data were filtered and entered into statistical software. Before starting the data screening process, the items of measurement were keyed in and coded. Outliers found in the results were eliminated, meaning the tests carried out in the data screening were reduced to 304.

*3.2. Analysis Approach Structured Equation Modelling (SEM)*

To investigate the influence of safety culture on driving performance, four approaches from the literature review were evaluated and compared in order to choose the best approach for the implementation of safety culture and to create the driving performance model. The four approaches were multiple linear regressions (MLR), system dynamic (SD), artificial neural network (ANN), and structural equation modelling (SEM). First, the regression equation has not been used because the relationship between variables is not observed, and this is an important limiting requirement when using the equation of regression. Second, the system dynamics method could not be employed due to the nature of the data, specifically because the data are unrelated to time. Third, the artificial neural network is a predictive method, whereas the essence of this research is to test the influence of safety culture on driving performance. Lastly, the structural equation modelling (SEM) method describes the relationship between many measurable and non-observable variables, making this approach suitable for the requirements of the study. The SEM is a useful method for dealing with errors in variables [95]. In this research, the SEM approach was employed to establish the relationship between safety culture and driving performance and to create the model. Byrne [96] has noted that structural equation modelling has now developed into a non-experimental research method, whilst techniques to hypothesis assessment have not been recognized previously. Furthermore, Yuan [97] concluded that structural equation modelling is a common and well-known approach to analysing data in social science research.

Hair et al. [98] highlighted that partial least squares (PLS) are now well known as an alternative to the SEM approach. Among other programs such as AMOS and LISREL, the PLS-SEM is a flexible and useful instrument for the building and prediction of statistical models [99]. The relatively recent approach operates well with structural equation models, incorporating latent variables and a series of cause and effect relationships. The PLS path model is more suitable for complex models, such as those with hierarchical structures and a complete disaggregation technique [100].

In previous research, the SEM analysis method has been utilized in the transportation sector [101–103], the construction industry [84,89,104,105], competitive performance [106], organization and the environment [107,108], and higher education [109]. To test the relationship between safety culture and driving performance, the partial least square (PLS) has been employed to evaluate the impact of safety culture on driving performance.

## 4. Results

*4.1. Common Method Bias*

Common method bias explains the variance in the results of an analysis (or error) as being attributed to the measurement method rather than to the constructs that are described through the measurements [110]. Common method bias may also be defined as the overlap between the variance that is ascribed to constructs and that which is ascribed to the measuring instruments [110]. Common method bias is a very important test when analysing data collected by self-administered means, such as survey questionnaires [111,112]. In some instances, data from self-reports might be exaggerated which will affect on results of the case under investigation, which would cause problems [112,113]. Therefore, it is important to address these problems to detect any biased data, particularly for this study, because the data are self-reported and collected from a single source. According to Harman's experiment [114], the one-factor test is considered to be one of the best common methods for testing biased data.

Common method bias is defined as the error (variance) measurement which impacts the validity of the research. This is a systematic variation of error linked with estimated and measured variables [110]. This may be measured using the Harman single-factor test, which shows different measures of the structure [114]. The single-factor test for measuring the variance of the standard technique has been utilized in this study [115]. Based on the results, if the overall variance of the variables is less than 50%, the common bias technique

does not influence the data [114]. As Table 2 shows, the first set of variables is 43.84% of the total variance, meaning the common method variance cannot impact the findings as it is below 50% [114].

**Table 2.** The common method variance outcome.

| | Extracted Sums of Squared Loadings | |
|---|---|---|
| **Total** | **% of Variance** | **Cumulative %** |
| 17.98 | 43.84 | 43.84 |

*4.2. Measurement Model*

The SEM is illustrated in Figures 3 and 4, while Figure 1 illustrates the conceptual model of the study. According to Hair Jr. [116], the assessment of the measurement model involves an estimate of (i) reliability of indicators, (ii) composite reliability, (iii) average variance extracted (AVE), and (iv) discrimination of validity. According to Wong's [117] the PLS algorithm is analysis the path weighting, average data metric, variance 1, maximum iterations of 300, and 1.0 weight criterion. Generally, outer load indications from 0.40 to 0.70 must be eliminated only if the removal of the item leads to a considerable rise in AVE and composite reliability [118]. Table 2 shows that outer loading values for all items in the measurement model were above 0.70. The values above 0.70 are suitable for further analysis [116]. Next, the internal consistency of composite reliability (cr) was evaluated for all outer loads above 0.70 [116]. As seen in Table 1, all items in the model achieved a cr > 0.70 threshold and, hence, were approved. AVE is a common measure for assessing the convergent validity in the constructs of the model with values above 0.50, meaning that, as Wong [117] recommended, it is a suitable convergent value. The findings in Table 3 demonstrate that this test was passed for constructs of the model.
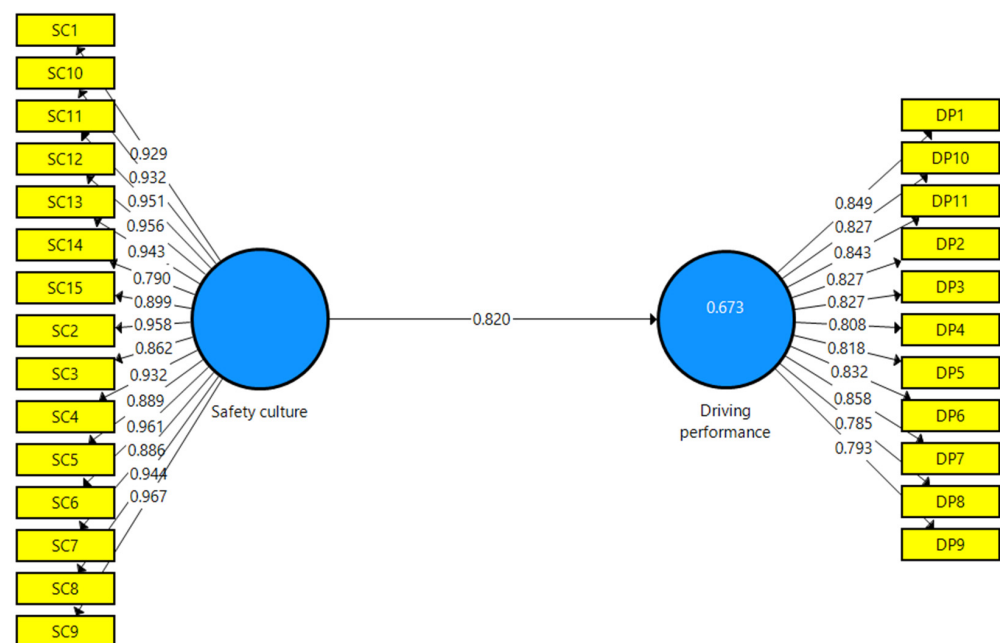


**Figure 3.** The structural model with $R^2$ values and path coefficient, outer loading.
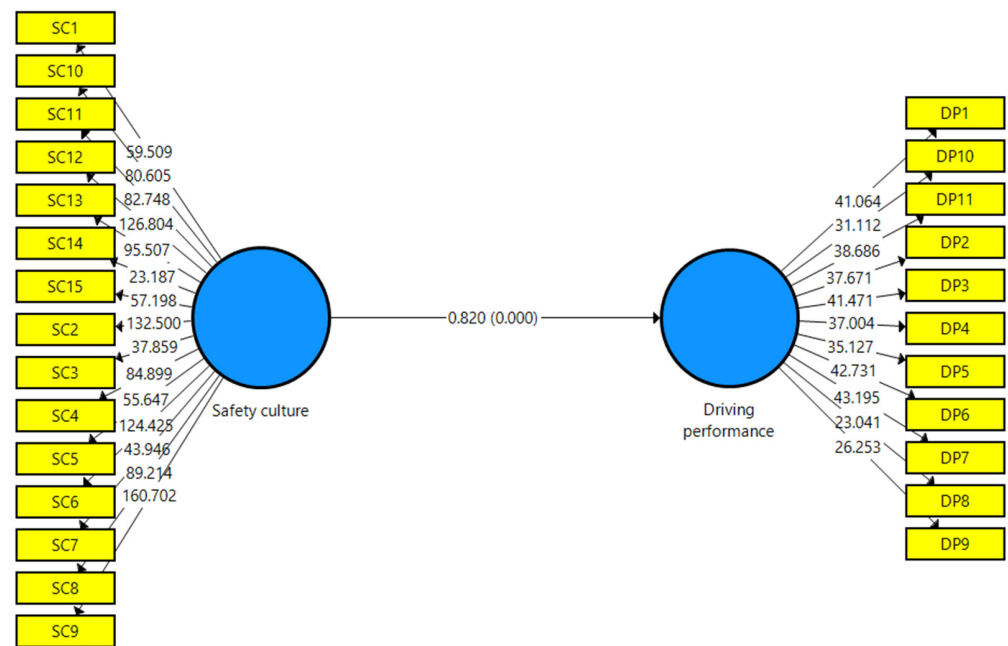
**Figure 4.** The bootstrapping analysis, path coefficients, and *p*-values.

**Table 3.** Construct validity and reliability.

| Constructs | Item | Outer Loading | Cronbach's Alpha | Composite Reliability | AVE |
|---|---|---|---|---|---|
| Safety culture | SC1 | 0.929 | 0.987 | 0.988 | 0.849 |
| | SC2 | 0.958 | | | |
| | SC3 | 0.862 | | | |
| | SC4 | 0.932 | | | |
| | SC5 | 0.889 | | | |
| | SC6 | 0.961 | | | |
| | SC7 | 0.886 | | | |
| | SC8 | 0.944 | | | |
| | SC9 | 0.967 | | | |
| | SC10 | 0.932 | | | |
| | SC11 | 0.951 | | | |
| | SC12 | 0.956 | | | |
| | SC13 | 0.943 | | | |
| | SC14 | 0.790 | | | |
| | SC15 | 0.899 | | | |
| Driving performance | DP1 | 0.849 | 0.953 | 0.959 | 0.680 |
| | DP2 | 0.827 | | | |
| | DP3 | 0.827 | | | |
| | DP4 | 0.808 | | | |
| | DP5 | 0.818 | | | |
| | DP6 | 0.832 | | | |
| | DP7 | 0.858 | | | |
| | DP8 | 0.785 | | | |
| | DP9 | 0.793 | | | |
| | DP10 | 0.827 | | | |
| | DP11 | 0.843 | | | |

Discrimination validity is defined as a construct that markedly varies from the other constructs by the standards observed. The discriminatory validity of the model, therefore, means that there are unique constructs which catch phenomena that are not well represented otherwise in the model [119]. In the present study, discriminant validity

based on two methods was assessed: Fornell Larcker's (1981) criterion, and the cross loading criterion.

To measure the validity of the discriminating construction, each construct square AVE root may be contrasted with the correlations between one and the other. Based on the principles of Fornell and Larcker [120], the square root of the AVE should be greater than the correlation between latent variables. The results in Table 4 demonstrate the discriminating validity of the measuring model [121].

**Table 4.** Discriminant validity (Fornell–Larcker).

| Constructs | Driving Performance | Safety Culture |
|---|---|---|
| Driving performance | 0.824 | – |
| Safety culture | 0.820 | 0.821 |

In this analysis, the second technique is the cross-loading criterion, which was also used to assess discriminant validity. This methodology tries to determine that the loading of indicators on a certain latent construct should exceed all other constructs per line. This means that the loading of indicators or items on the main construct must be greater than the loading on other constructs. The data in Table 5 show that the loading of all latent variables (indicators) is higher than that of other constructs, by row. For each construct, the outcomes reveal a high degree of one-dimensionality.

**Table 5.** Discriminant validity of indicators tested by cross-loading.

| Items | Driving Performance | Safety Culture |
|---|---|---|
| DP1 | 0.849 | 0.683 |
| DP10 | 0.827 | 0.677 |
| DP11 | 0.843 | 0.705 |
| DP2 | 0.827 | 0.691 |
| DP3 | 0.827 | 0.658 |
| DP4 | 0.808 | 0.661 |
| DP5 | 0.818 | 0.688 |
| DP6 | 0.832 | 0.664 |
| DP7 | 0.858 | 0.701 |
| DP8 | 0.785 | 0.677 |
| DP9 | 0.793 | 0.629 |
| SC1 | 0.750 | 0.929 |
| SC10 | 0.762 | 0.932 |
| SC11 | 0.759 | 0.951 |
| SC12 | 0.759 | 0.956 |
| SC13 | 0.768 | 0.943 |
| SC14 | 0.732 | 0.79 |
| SC15 | 0.753 | 0.899 |
| SC2 | 0.758 | 0.958 |
| SC3 | 0.788 | 0.862 |
| SC4 | 0.773 | 0.932 |
| SC5 | 0.654 | 0.889 |
| SC6 | 0.747 | 0.961 |
| SC7 | 0.799 | 0.886 |
| SC8 | 0.739 | 0.944 |
| SC9 | 0.763 | 0.967 |

### 4.3. Path Analysis (Structural Model)

Path analyses are a statistical technique for linear regression. For social science and management analysis techniques, path analysis is preferred. Path analysis is also a dominating methodology for investigating complicated relationships of research simultaneously [122]. After the model has been fitted, the structural equation modelling can

be conducted to examine the relationships between variables. The relationships between study variables are described in detail in the structural model [123]. The results demonstrate the relationship between exogenous or independent and dependent or endogenous variables. Structural model assessment is focused primarily on the fit of the overall model, with hypothesised parameter estimates, dimensions, path, and importance [123]. In the final section, the study relationship was confirmed based on the study hypothesis given in Figure 1.

Following the research context in this model, the effect of safety culture on driving performance was investigated by PLS-SEM. Figure 3 shows the associated hypothesis model. The significance of the model hypothesis was measured in the bootstrapping approach as shown in Figure 4. The random reassessment of the original data involves the procedure of bootstrapping for generating samples that are equal to the original data. Not only does this method assess the reliability of the data, but it also predicts the importance and the error of the measured path coefficient [124]. As seen in Figures 3 and 4, the endogenous construct was tested for the standardized path coefficients ($\beta$) and *p*-values, path significance, and $R^2$. Table 6 displays *p*-values for the study path in the result of the bootstrapping process. The findings showed that safety culture has a statistically significant effect on driving performance. According to these findings, safety culture had a positive and significant impact on driving performance ($\beta = 0.820$, $p < 0.000$).

**Table 6.** Hypothesis and path coefficient.

| Path | $\beta$ | SE | T Value | *p*-Value |
|---|---|---|---|---|
| Safety culture→Driving performance | 0.820 | 0.026 | 31.760 | <0.000 |

### 4.4. The Explanatory Power of the Structural Model

The findings demonstrate high reliability of individual items, and convergent and discriminatory validity of the measurement model. The predictive strength of the structural model can be measured by assessing the difference in the dependent variable described by the model. The PLS algorithm provided multiple squared ($R^2$) correlations for the endogenous variables of the model. $R^2$ in the SEM-PLS algorithm is considered as conventional regression [125].

The $R^2$ is defined as the sum of the variance. The $R^2$ has been demonstrated by the explanation of independent variables in the dependent variable. A better $R^2$ value thus increases the predictive capability of the structural model. In this study, the $R^2$ values were calculated by the PLS algorithm as shown in Table 7. The $R^2$ value in this model for the dependent variable (driving performance) was 0.673, indicating that the latent exogenous variable (safety culture) could explain 67.3% of driving performance. According to Chin [124], the outcome of $R^2$ as 67.3% means that the influence of safety culture is substantial.

**Table 7.** Explanatory power of the structural model ($R^2$).

| Endogenous Latent Variable | $R^2$ | Adj $R^2$ | Explained Size |
|---|---|---|---|
| Driving Performance | 0.673 | 0.672 | Substantial |

### 4.5. Predictive Relevance of the Structural Model

The ability to determine the predictive relevance of the model is an important feature of a structural model. The blindfolding technique was used to monitor cross-validated redundancy tests for the dependent variable. The results showed that the performance of the $Q^2$ (0.45) project was higher than 0, meaning that the exogenous construct has predictive significance for the endogenous construct in this study [126]. The value of $Q^2$ in Table 8 is above 0, and thus an excellent predictive relevance of the model can be safely concluded.

**Table 8.** The predictive relevance ($Q^2$).

| Endogenous Latent Variable | SSO | SSE | $Q^2$ (=1 − SSE/SSO) |
|---|---|---|---|
| Driving performance | 3344.000 | 1824.898 | 0.45 |

*4.6. Importance-Performance Matrix Analysis (IPMA)*

The PLS-SEM approach shows how the independent variable relative value represents the dependent variable in the path model [116,126]. Importance-performance matrix analysis (IPMA) extends SEM outcomes, and also takes into account each variable's performance. The outcome may be taken from two dimensions (importance and performance), which are important in the selection of management actions [116]. The overall results of the structural model (importance) and the average value of latent variable scales (performance) were used to illustrate areas that will improve the management practices (or the basic emphasis of the model). IPMA has utilized safety culture as the dependent variable in the current research. Table 9 illustrates the importance and performance of the exogenous variable (safety culture).

**Table 9.** Importance and performance of safety culture.

| Predictor | Importance | Performances |
|---|---|---|
| Safety culture | 1.178 | 70.496 |

## 5. Discussion

Enhancement of safety culture among oil and gas tanker drivers can substantially improve the level of driving performance. The analysis of SEM models and the statistical values provide sound basis for understanding correlations between these variables. Some important results were revealed during the review and interpretation process.

It is essential to investigate the influence of safety culture on driving performance to improve the performance of oil and gas tanker drivers and to avoid fatal crashes [5]. The analysis has been utilized to examine the influence of safety culture on driving performance. The findings show that the enhancement of the safety culture among oil and gas tanker drivers will contribute 67.3% to the level of driving performance. Similarly, safety culture has a significant impact on driving performance when the value of β = 0.820, which is significant when the organizations increase safety culture by 1 unit, and it would also increase the level of driver performance by 0.820. The results indicate that better safety culture would help the drivers to manage their job demands, to remain focused, to avoid fatigue, and to maintain good reaction time during driving duty. This result is in line with Arboleda [127], who agreed that the implementation of safety culture could enhance drivers' perceptions of safety culture, whereas, currently, safety culture among drivers is more influenced by the organization's commitment to managing safety culture and training drivers to avoid fatigue. Moreover, Deepak and Mahesh [128] agreed that safety culture is one of the most important tools for minimizing accidents that in construction projects. It is not surprising, therefore, that in the oil and gas industry safety culture is necessary for accident prevention [129,130].

From the results mentioned above, we can conclude that the output of the safety culture will have an impact on driving performance. The level of safety culture, which is defined in consideration of safety responsibility, communication, the role of communication in the development of safety culture, management attitudes to safety, and patterns of driver behaviour, determines the commitment to the health and safety of drivers during their duties. All findings on driving performance met expectations in the current research. The objective of this study has been achieved and is in line with previous studies [90–92], and has shown that safety responsibility, the role of communication in the improvement of safety culture, management attitudes, and patterns of driver behaviour have a positive impact on driving performance and ultimately lead to the sustained vigilance of drivers.

Therefore, safety culture has been utilized as a supportive technique to enhance driver performance [43–45].

## 6. Conclusions

Safety culture is highly important in many industries and, as in many other industries, the oil and gas transportation sector has experienced road accidents due to poor driver performance. Safety culture should be adopted in order to reduce this. The PLS-SEM technique has been utilized to examine the impact of safety culture on driving performance. Based on the data obtained from the oil and gas transportation sector in Malaysia, a direct path has been validated in the developed model. Moreover, the direct path between variables has been identified through the examination of the relationship between variables. The outcomes agree that the adoption of a safety culture can enhance the performance of drivers and can contribute to reducing the possibilities of road accidents.

Several implications can be drawn from this study. First, the study contributes to the body of knowledge on the oil and gas transportation sector by improving the understanding of safety culture. Second, the current results provide a foundation for future researchers by empirically confirming that an interest in safety culture has a strong and positive impact on driving performance. The current study also provides a clear vision for managers of oil and gas transportation companies which aim to succeed in their transportation duties through an interest in safety culture. The current study can help all parties involved—administrators, supervisors, and drivers—through an interest in safety culture, by focusing on the attention and vigilance of drivers during transportation of oil and gas.

Despite the contributions of this study, a number of inherent limitations related to data collection and generalization are acknowledged. First, as with cross-sectional studies or snapshot survey research, this does not reflect a deep understanding of the context, as in the case of Malaysian oil and tank transportation sector drivers, when compared to theory building methods. Therefore, it is recommended that larger sample sizes should be employed. Second, the survey sample consisted of oil and gas tanker drivers from one country, Malaysia. Evidently, findings may not be generalized to encompass other developing countries and, therefore, future studies should be extended to other parts of Asia. Third, whilst our study focused on oil and gas tanker drivers, the importance of freight transportation must be noted, given the growing volume of international trade and freight transportation [131–133]. Future studies should also include other modes of transportation such as trucks, trains, and large ships, as well as the challenges faced by them. Similarly, further research should investigate driver distraction and other correlated factors that can impact driving performance. Finally, a limit within the methodology is the fact that the study was conducted using self-reported questionnaires. For further research, an experimental approach for measuring the vigilance and reaction time of drivers would be preferred.

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