Challenge H: For an even safer and more secure railway

Safety culture, Safety behavior and safety performance in Railway companies

Abstract

Forming a positive safety culture is considered as an essential indicator to prevent the possible railway accidents. Furthermore, improved safety behavior can reduce the frequency of work related accident and injuries and safety behavior is often tied to quality of performance. Therefore, this research aims at identifying the correlations among safety culture, safety behavior, and safety performance, as well as explaining the cause-effect factors affecting the above three dimensions. Most of the existing relevant references were conducted by literature reviews, few of them have been demonstrated by empirical evidence in railway companies. The factor analysis and structure equation modeling are adopted to examine the relationships among the safety culture, safety behavior and safety performance from Taiwan Railway System drivers’ perspective. A total of 536 effective samples were obtained.

Previous studies were conducted to investigate the major causes of the rail relevant accidents and incidents by the analysis of post-accident data. This study contributes to find empirical evidence to investigate the relationship among safety culture, safety behavior, and safety performance from railway organizational perspectives. Our empirical result indicates the positive safety culture has certain effect upon the awareness in safety behavior of railway driver. In addition, the positive safety culture was also found to have a positive effect on the positive perceived safety performance. The safety behavior was found to have a positive effect on the perceived safety performance. Several policies suggestions were included and could be useful for the decision makers of rail system’s operators and the government regulators when designing and regulating the safety management system.

Keywords: Safety culture; Safety behavior; Safety performance; Structural equation modeling

1. Introduction

Rail system could often provide fast, reliable and safe transportation service. However, the consequences of a rail accident are severe due to the kinetic energy caused by the operating speed and weight of train as well as the passengers on board (Elms,2001). Human error could be attributed to the majority of incidents and accidents of railway system (Baysari et al 2008; Krokos and Baker,2007; O’Hare,2000). To reduce the human error in the rail system operation seems to be one of the essential issues to be explored.
Human factors play a significant role in the safety of rail operations and safety culture was considered as the most difficult topics (Elms, 2001). Turner et al. (1989) defined safety culture as “the set of beliefs, norms, attitudes, roles, and social and technical practices that are concerned with minimizing the exposure of employees, managers, customers and members of the public to conditions considered dangerous or injurious”. Glennon (1982) found that organizations with poor safety culture scores had higher accident rates than those organizations with better safety culture scores. Safety culture was considered as a leading indicator of railway system safety (Harper, 1997; Sawacha, 1999; Hudson, 1999; Clarke, 2000; Cullen, 2001; O’Toole, 2002).

Campbell et al. (1993) there are only three determinants of individual difference in performance: knowledge, skill, and motivation mediate the relationship between the antecedents and components of performance. Wong (1999) indicated the development of safety systems, safety practice and procedures; monitoring of safety compliance, establishment of safety committees at site level, communication of safety policies to site personnel, participation of safety officers, consultation between site staff and safety officers also affect the safety performance. Erickson (2000) noted the improvements in organizational structure, organizational importance of safety, safety responsibility and accountability, communication, management behavior, employee involvement, and employee responses and behavior can help improve safety performance.

Previous studies were conducted to investigate the major causes of the rail relevant accidents and incidents by the analysis of post-accident data (Baysari et al, 2008; Gilroy and Grimes, 2005; Murphy, 2001; Shanahan et al 2005). This study contributes to demonstrate empirical evidence to investigate the relationship among safety culture, safety behavior, and safety performance from railway organizational perspectives.

Therefore, the rest of this study is organized as follows. Section 2 discusses the relationship among the safety culture, safety behavior and perceived safety performance. Section 3 presents research hypotheses, questionnaire design, sampling processes and modeling approach. Section 4 describes the empirical result of the modeling approach. The discussion and conclusions are included in the final section of this study.

2. Methodology
2.1 Research hypotheses

This research aims at identifying the correlations among safety culture, safety behavior, and
safety performance, as well as explaining the cause-effect factors affecting the above three dimensions. McDonald et al. (2000) explored the relationships of different aspects of safety culture and safety management systems and presented a revised model of safety management systems. Improvements in organizational structure, organizational importance of safety, safety responsibility and accountability, communication, management behavior, employee involvement, and employee responses and behavior can help improve safety performance (Erickson, 2000). Edkins and Pollock (1997) indicated useful strategies for improving driver vigilance should be directed at improving the safety culture of the operating environment.

The lack of motivation in fostering a safety culture at both organizational and project levels has resulted in a poor safety record in general, with construction being one of the most hazardous industries globally (Harper, 1997; Sawacha, 1999). Cooper (2000) presented a reciprocal model of safety culture to understand its dynamic, multi-faceted and holistic nature. The promotion of a positive safety culture is now considered to be a viable way of managing risk, creating a culture within an organization where everyone is personally involved in ensuring safety (Hudson, 1999). Cullen (2001) has encouraged high risk industries to reduce their reliance on accident and incident data and to direct health and safety systems towards investigating the culture and climate that may contribute to incidents. O'Toole (2002) identified that safety culture as a critical factor that sets the tone for the importance of safety within an organization. Therefore, the following hypothesis is proposed.

**H1: Safety culture has a positive effect on perceived safety performance**

Helmreich & Merritt (1998) developed a model of interrelationships of elements that can lead to a safety culture and safety behaviors. This model can also determine the style of training and the nature of training delivery, the profession culture may influence the safety culture through feelings of responsibility. Clarke (2000) defined the term safety culture, and proposed a theoretical model by which safety culture affects safety behaviors in organizations. Farringto-Darby (2005) also identified forty main factors that influence safe behavior and safe culture. Hofmann and Stetzer (1996) indicated six broad categories of unsafe behavior including improper tool use, improper work strategies at risk to self, failure to wear personal protective equipment; improper storage of tools; improper storage by others; and improper work strategies with risk to others. Thus, the following hypothesis is warranted.

**H2: Safety culture has a positive effect on safety behavior**

Improvements in organizational structure, organizational importance of safety, safety
responsibility and accountability, communication, management behavior, employee involvement, and employee responses and behavior can help improve safety performance (Erickson, 2000). Vredenburgh (2002) indicated that safety behavior is often tied to quality of performance. Thus, an added benefit of safety behavior maybe productivity improved. Garavan and Obrien (2001) found unsafe acts or behaviors are a major causal factor in workplace accident/injuries. Improved safety behavior reduces the frequency of work related accident and injuries. This phenomenon induces the following hypothesis.

**H3: Safety behavior has a positive effect on perceived safety performance**

2.2. Questionnaire design

After a review of previous literature and personal interviews with railway safety experts, the step-by-step stages of the questionnaire design were based on Churchill (1991). The first part of questionnaire, safety behavior, was based on the research of Pousette et al. (2003) and Larsson et al. (2008). The measurement items of safety culture were developed according to the questionnaires proposed by Fernández-Muñiz (2007) and Díaz-Cabrera et al, and the measurement items of safety performance were based on Neal’s (2000) study. Respondents were required to indicate agreement with the importance of each statement on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaires were pre-tested and revised. Questions in the questionnaire were based on previous studies and discussions with a number of railway safety executives and experts. 33 attribute variables were selected for the questionnaire (see Table 1).

**Table 1 could be inserted here**

2.3 Sampling processes

This study aims to investigate the relationships among safety culture, safety behavior, and safety performance in railway industry. To collect primary data in the railway industry, Taiwan Railway Administration (TRA) is considered as a case study. The anonymous questionnaires were distributed to all TRA drivers in April, 2008. Researchers first sent the anonymous questionnaires to 7 depots and then asked the supervisors for distributing the questionnaires to drivers during monthly on-the-job training occasion. Eventually, 537 usable samples were collected (return rate=53.7%).

2.4 Data analysis approach

The research methods include factor analysis, reliability test, and structural equation modeling (SEM). SEM simultaneously explains the pattern of a series of inter-related dependence relationships between a set of latent (unobserved) constructs, each measured
by one or more observed variables (Hair et al., 2006). SEM includes one or more linear regression equations that describe how the endogenous constructs depend upon the exogenous constructs. Their coefficients are called path coefficients, or sometimes regression weights (Reisinger and Turner, 1999). In addition, SEM is an applicable method for analyzing hypotheses as it allows for the analysis of multiple relationships simultaneously and provides measures of overall model fit. It also explains the significance of each of the relationships between the variables (Kline, 1998).

3. Results of empirical analyses

The analyses were carried out using the SPSS to conduct descriptive statistics analysis, factor analysis, and reliability analysis, as well as the AMOS statistical packages for SEM model analysis to examine the overall fit of the empirical data to the hypothesized model.

3.1 Descriptive statistics result analysis

3.1.1 Profile of respondents

Of all the valid samples, slightly over half of the respondents were aged between 50 to 59 years of age (51.4%). With regard to education level, the majority were high school (60.5%). Regarding to working hour, most respondents worked 40 to 49 hours per week. In addition, approximately 54.4% of respondents have a seniority of over 20 years, indicating that many of TRA drivers were senior drivers (Table 2).

Table 2 could be inserted here

3.1.2 Importance of attribute variables of the dimensions: safety culture, safety behavior and safety performance

An evaluation of aggregated drivers evaluation on the key factors in safety culture, safety behavior and safety performance, which has a higher average value is “Drivers could actively propose positive suggestions and recommendations to improve organizational performance (4.02) in the dimension of safety behavior. This indicates drivers perceive that communication between the staff and the manager level is considered as the most important service attribute.

In the dimension of safety culture, “Periodical external evaluations (audits) and prevention management system “ (mean = 3.66) was perceived as the most important factor indicating independent safety audit system is essential for forming TRA’s safety culture.
With respect to the perceived safety performance, the attribute variable “I help my coworkers when they are working under risky or hazardous conditions (mean = 4.30)” is a key issue determining safety performance perceived by the TRA’s train drivers. This indicates that preventing risk is of importance to improve safety performance.

### 3.2 Exploratory factor analysis

Factor analysis is a technique used to reduce a large set of variables to a smaller set of underlying factors, helping to detect the presence of meaningful patterns among the original variables and extracting the crucial dimensions. Principal components analysis with VARIMAX rotation was employed to identify key dimensions, and factor loadings greater than 0.50 are statistically significant (Hair et al., 2006). This study uses 33 attribute variables to conduct factor analysis and 6 factors are extracted.

#### 3.2.1 Factor analysis result and factor labeling

We have three main dimensions: safety culture, safety behavior and safety performance for examining their relationships. According to the exploratory factor analysis, safety culture dimension includes that communication and emergency response and safety management. Safety behavior dimension includes structural safety behavior and personal safety behavior. Perceived safety performance includes safety compliance and participation and perceived accident rate. The Cronbach’s α values of all factors are greater than 0.6.

### 3.3 Structural equation modeling analysis

Some indices are used to evaluate the proposed SEM model such as \( x^2 \) value, the goodness of-fit index (GFI) value, the adjusted goodness-of-fit index (AGFI), and the root mean square error of approximation (RMSEA) (Hair et al., 2006). The value of the Chi-square \( (x^2 = 10.33) \) is not significant at the 1% level, which implies the differences between predicted and actual matrices are not significant and demonstrates the model’s fitness to the data collected. The goodness of-fit index (GFI) value is 0.994. After adjustment for the degrees of freedom relative to the number of variables, the adjusted goodness-of-fit index (AGFI) is 0.977, implying that 97% of the variances and covariance in the data observed are predicted by the estimated model. The overall modified model fit is found adequate after processing a normalized residual analysis. The \( p \) value is significant (\( P = 0.11 > 0.05 \)), and therefore the model is credited. The RMR = 0.109 and RMSEA = 0.04, implying that the model has a model-fit evaluation with an appropriate goodness-of-fit (see Figure 1).
AMOS program could also provide the assessment of the unidimensionality of the model. Unidimensionality could be verified through the overall goodness of fit of the confirmatory factor model, and through the convergence and discrimination of items (Anderson and Gerbing, 1988). The fitness of measurement model of the items on the constructs is almost in the appropriate direction and statistically significant at the 0.05 level. The overall model fit is found to be appropriate, which supports unidimensionality (see Figure 1).

Convergent validity could be assessed by t values that are statistically significant on the factor loadings. Our result indicates almost all the t values are greater than 1.96 or smaller than -1.96, which implies statistical significance (Segar 1997; Byrne, 2001). The larger the factor loadings or coefficients are, as compared with their standard errors, the stronger is the evidence that there is a relationship between the measured variables and their constructs (Koufteros, 1999). Table 3 reveals that most of the variables exceed the t value at the 0.05 level of significance implying that the majority of variables are significantly related to their specified constructs.

The analysis results show that safety culture would influence safety behavior. That is, improving the internal safety culture is able to improve employees’ cognition and attitude toward safety behavior. Through structural equation modeling (SEM), this study discovers that the path coefficient from safety culture to safety behavior is 0.10 (t-value=5.14>1.96), indicating that safety culture is positively related to safety behavior of TRA. H1 is thus supported, and this result is consistent with previous literature. Particularly, “communication and responsiveness” and “safety management” are the most significant factors to evaluate safety culture and both positively affect safety culture.

3.3.2 The influence of safety culture on safety performance.
According to Cooper (2000) and Williams (2003), safety culture has a significant and positive influence on organizational safety performance. In this study, the path coefficient from safety culture to safety performance is 0.11 (t-value=3.58>1.96), indicating that safety culture is positively and significantly related to safety performance of TRA. Namely, with a mature safety culture, TRA is capable of improving the safety performance, and that is consistent with previous research. H2 in this study is supported as well. In addition, “safety compliance
and participation” affects safety performance most, so the coefficient is assigned as 1, and the path coefficient of “accident rate” is hence 0.98. The t-values of both factors are greater than 1.96, indicating these two factors significantly and positively influence safety performance.

3.3.3 The influence of safety behavior on safety performance

Previous research has proven that improving safety behavior is helpful for safety performance (Grindle, Dickinson, and Boettcher, 2000; McAfee and Winn, 1989; Sulzer-Azaroff, Harris, and Blake-McCann, 1994). This empirical results show that the path coefficient from safety behavior to safety performance is 0.70 (t-value=3.03>1.96), which indicates a significant and positive relationship between safety behavior and safety performance of TRA. Moreover, H3 in this study is supported. In this study, “organizational safety behavior” has the greatest impact on safety behavior, and the coefficient is assigned as 1. Therefore, the coefficient of “personal safety behavior” is 2.79. The t-values of both factors are greater than 1.96, indicating these two factors have a significant and positive influence on safety behavior.

Table 4 could be inserted here

4. Conclusions and discussion

The present study provides the empirical evidence to support the relationship among the safety culture, safety behavior and perceived performance of railway drivers. Our empirical result indicates the positive safety culture can influence on the safety behavior of railway driver. In addition, the positive safety culture was also found to have a positive effect on the positive safety perceived performance. The safety behavior was found to have a positive effect on the perceived safety performance, which corresponds well the finding of Grindle, Dickinson and Boettcher (2000); McAfee and Winn (1989); Sulzer-Azaroff, Harris, and Blake-McCann (1994).

Of the latent construct “safety culture”, communication and emergency and safety management were considered as two essential variables affecting safety culture, which is consistent with Brown et al., 2000; Demichela and Piccinini, 2006; Fernandez-Muniz, 2007; Manuel Montes-Peón, and Vaquez-Orda’s (2007); Hofmann and Stetzer, (1996); Mearns et al., (2003); Zohar, (1980) and the relationship between safety culture and communication and emergency was justified, which is consistent with Farringto-Darby, 2005; Diaz-Cabrera et al, (2007); Fernandez-Muniz (2007).
Challenge H: For an even safer and more secure railway

Our finding also shows structural safety behavior and personal safety behavior are two main variables affecting the construct of safety behavior (Pousette et al., 2003; Larsson et al, 2008). In regard to the perceived safety performance, safety compliance and participation and perceived accident rate were deemed as the two essential factors.

5. Managerial implications

These findings contribute several implications. First, the executives of TRA should set up a clear goal for the entire organization to protect passengers’ safety, such as no injuries are allowed to happen in the short run. In the middle and the long term, because the most important factors affecting safety behavior are “organizational safety behavior” and “personal safety behavior”, the regulated safety behavior should be propagated to the staff. Employees’ personal safety behavior should also be inspected in order to establish relative reward and punishment regulations. Finally, “communication and responsiveness” and “safety management” are the most important factors affecting safety culture. TRA is thus suggested to establish a seamless communication channel between staff and executives. To ensure the effectiveness of the communication channel, each case should be documented. Furthermore, TRA can set up a specific supervising department to periodically inspect the performance improvement and modify the inappropriate regulations and unfinished objectives.

5.1 Limitations and future research

Due to the limited time and budget, this study addressed the train drivers to investigate the cause-effect relationship among safety culture, safety behavior and perceived safety performance. The future study could investigate the multi-level effect of safety culture, safety behavior on the safety performance to examine the hierarchical perceived difference. In addition, the future study could investigate various types’ railway companies’ safety culture and safety behavior on safety performance such as the difference in the transit system, conventional railway system and high-speed rail system’s operators.
Reference


Challenge H: For an even safer and more secure railway

Challenge H: For an even safer and more secure railway


Challenge H: For an even safer and more secure railway

European Conference on Rail Human Factors.
Challenge H: For an even safer and more secure railway

![SEM Analytical Result](image)

\[ \chi^2 = 10.33 \text{ df}=6, \text{ P value } = 0.11 \text{ GFI } = 0.994, \text{ AGFI } = 0.977, \text{ RMSR } = 0.109, \text{ CFI } = 0.995 \]

Note: Path coefficients with * are critical ratios exceeding 1.96 at the 0.05 level of significance (t statistics).

Figure 1 SEM analytical result
Table 1: Attributes variables affecting the safety culture, safety behavior and perceived safety performance

<table>
<thead>
<tr>
<th>Safety behavior attribute variables</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drivers should actively propose positive suggestions and recommendations to improve organizational performance</td>
<td>4.02</td>
<td>0.64</td>
</tr>
<tr>
<td>Drivers should seek for mistakes and errors to report to supervisors</td>
<td>3.92</td>
<td>0.67</td>
</tr>
<tr>
<td>We have written rules and procedures that guide creative problem solving</td>
<td>3.57</td>
<td>0.76</td>
</tr>
<tr>
<td>Our workers have the authority to correct problems when they occur</td>
<td>3.44</td>
<td>0.90</td>
</tr>
<tr>
<td>Drivers should meet safety quality demand, regardless of reasonability</td>
<td>3.39</td>
<td>1.05</td>
</tr>
<tr>
<td>We believe that when making decisions, the overall effects of a decision should be considered</td>
<td>3.21</td>
<td>0.87</td>
</tr>
<tr>
<td>We believe that employees from one department should work with employees from other departments</td>
<td>2.91</td>
<td>0.91</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Safety culture attribute variables</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>External evaluations (audits) periodically conducted of validity and reliability of prevention management system</td>
<td>3.66</td>
<td>0.80</td>
</tr>
<tr>
<td>Written circulars elaborated and meetings organized to inform workers about risks associated with their work and how to prevent accidents.</td>
<td>3.65</td>
<td>0.70</td>
</tr>
<tr>
<td>Management has established in writing the functions of commitment and participation and the responsibilities in safety for all organization members</td>
<td>3.64</td>
<td>0.83</td>
</tr>
<tr>
<td>All workers informed about emergency plan.</td>
<td>3.58</td>
<td>0.76</td>
</tr>
<tr>
<td>At the introduction of new system, organization will negotiate with system providers in conducting educational training courses for handling instructions</td>
<td>3.58</td>
<td>0.88</td>
</tr>
<tr>
<td>When accidents occur, current emergency handling plan should be able to solve such incidents</td>
<td>3.53</td>
<td>0.78</td>
</tr>
<tr>
<td>Written declaration is available to all workers reflecting management’s concern for safety, principles of action and objectives to achieve.</td>
<td>3.53</td>
<td>0.77</td>
</tr>
<tr>
<td>Organizational safety policy can focus on safety problem issues</td>
<td>3.52</td>
<td>0.82</td>
</tr>
<tr>
<td>All workers informed about emergency plan</td>
<td>3.51</td>
<td>0.78</td>
</tr>
<tr>
<td>There is a fluent communication embodied in periodic and frequent meetings, campaigns or oral presentations to transmit principles and rules of action.</td>
<td>3.50</td>
<td>0.90</td>
</tr>
<tr>
<td>Accidents and incidents reported, investigated, analyzed and recorded.</td>
<td>3.49</td>
<td>0.79</td>
</tr>
<tr>
<td>When starting in new job position worker provided written information about procedures and correct way of doing tasks.</td>
<td>3.49</td>
<td>0.81</td>
</tr>
<tr>
<td>Firm coordinates its health and safety policies with other HR policies to ensure commitment and well-being of workers.</td>
<td>3.48</td>
<td>0.87</td>
</tr>
<tr>
<td>Station staff and drivers maintain a good communication</td>
<td>3.44</td>
<td>0.82</td>
</tr>
<tr>
<td>When performing regular safety inspections, organization can immediately handle appropriately to solve safety problems</td>
<td>3.43</td>
<td>0.78</td>
</tr>
<tr>
<td>Frequent use of teams made up of workers from different parts of organization to resolve specific problems relating to working conditions.</td>
<td>3.26</td>
<td>0.93</td>
</tr>
<tr>
<td>Resolutions frequently adopted that originated from consultations with or suggestions from workers.</td>
<td>3.20</td>
<td>0.92</td>
</tr>
<tr>
<td>When organization adopt staffs’ safety proposals, rewards are</td>
<td>3.00</td>
<td>1.01</td>
</tr>
</tbody>
</table>
### Challenge H: For an even safer and more secure railway

<table>
<thead>
<tr>
<th>Safety performance attribute variables</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>I help my coworkers when they are working under risky or hazardous conditions.</td>
<td>4.30</td>
<td>0.62</td>
</tr>
<tr>
<td>I ensure the highest levels of safety when I carry out my job.</td>
<td>4.21</td>
<td>0.58</td>
</tr>
<tr>
<td>I use the correct safety procedures for carrying out my job.</td>
<td>4.12</td>
<td>0.59</td>
</tr>
<tr>
<td>I voluntarily carry out tasks or activities that help to improve workplace safety.</td>
<td>3.98</td>
<td>0.59</td>
</tr>
<tr>
<td>Over the past year, I strengthened my emergency handling capability.</td>
<td>3.77</td>
<td>0.63</td>
</tr>
<tr>
<td>Over the past year, the occurrences of railway related responsible or none responsible incidents increased significantly</td>
<td>3.50</td>
<td>0.77</td>
</tr>
<tr>
<td>Over the past year, death and injuries of railway staff during duty decreased significantly</td>
<td>3.48</td>
<td>0.72</td>
</tr>
<tr>
<td>Over the past year, break-downs of railway machinery equipment decreased significantly</td>
<td>3.24</td>
<td>0.85</td>
</tr>
</tbody>
</table>
Table 2. Profile of respondents

<table>
<thead>
<tr>
<th>Characteristics of the respondents</th>
<th>Number of respondents</th>
<th>Percentage of respondents (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30-39</td>
<td>65</td>
<td>12.10</td>
</tr>
<tr>
<td>40-49</td>
<td>184</td>
<td>34.30</td>
</tr>
<tr>
<td>50-59</td>
<td>276</td>
<td>51.40</td>
</tr>
<tr>
<td>More than 60</td>
<td>12</td>
<td>2.20</td>
</tr>
<tr>
<td><strong>Education background</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junior high school</td>
<td>14</td>
<td>2.60</td>
</tr>
<tr>
<td>Senior high school</td>
<td>325</td>
<td>60.50</td>
</tr>
<tr>
<td>University and above</td>
<td>198</td>
<td>36.90</td>
</tr>
<tr>
<td><strong>Train driving experience</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 5 years</td>
<td>34</td>
<td>6.30</td>
</tr>
<tr>
<td>6-10 years</td>
<td>66</td>
<td>12.30</td>
</tr>
<tr>
<td>11-20 years</td>
<td>145</td>
<td>27.00</td>
</tr>
<tr>
<td>More than 20 years</td>
<td>292</td>
<td>54.40</td>
</tr>
<tr>
<td><strong>Position</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driver</td>
<td>496</td>
<td>92.40</td>
</tr>
<tr>
<td>Chief driver</td>
<td>28</td>
<td>5.20</td>
</tr>
<tr>
<td>Driver assistant</td>
<td>13</td>
<td>2.40</td>
</tr>
<tr>
<td><strong>Working hours per week</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40-49</td>
<td>413</td>
<td>76.90</td>
</tr>
<tr>
<td>50-59</td>
<td>113</td>
<td>21.00</td>
</tr>
<tr>
<td>More than 60</td>
<td>11</td>
<td>2.00</td>
</tr>
</tbody>
</table>
Table 3 Parameter estimates, standard errors and critical ratios for the revised model

<table>
<thead>
<tr>
<th>Latent variable</th>
<th>Item</th>
<th>Unstandardized factor loading</th>
<th>Completely standardized factor loading</th>
<th>Standard error&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Critical Ratio&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety culture</td>
<td>Communication and emergency response</td>
<td>1.000</td>
<td>0.946</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>Safety management</td>
<td>0.367</td>
<td>0.699</td>
<td>0.024</td>
<td>15.288</td>
</tr>
<tr>
<td>Safety behavior</td>
<td>Structural safety behavior</td>
<td>1.000</td>
<td>0.316</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>Personal Safety behavior</td>
<td>2.794</td>
<td>0.925</td>
<td>0.509</td>
<td>5.487</td>
</tr>
<tr>
<td>Perceived safety performance</td>
<td>Safety compliance and participation</td>
<td>1.000</td>
<td>0.528</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>Perceived accident rate</td>
<td>0.984</td>
<td>0.585</td>
<td>0.114</td>
<td>8.605</td>
</tr>
</tbody>
</table>

<sup>a</sup>S.E is an estimate of the standard error of the covariance.

<sup>b</sup>C.R. is the critical ratio obtained by dividing the estimate of the covariance by its standard error. A value exceeding 1.96 represents a level of significance of 0.05.

<sup>c</sup>Indicates a parameter fixed at 1.0 in the original solution.
Table 4. The estimates of the modified SEM model

<table>
<thead>
<tr>
<th>Variables</th>
<th>Estimate (a)</th>
<th>S.E. (a)</th>
<th>C.R. (b)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety culture → Safety behavior</td>
<td>0.10</td>
<td>0.02</td>
<td>5.14</td>
<td>0.00</td>
</tr>
<tr>
<td>Safety culture → Perceived safety</td>
<td>0.11</td>
<td>0.03</td>
<td>3.58</td>
<td>0.03</td>
</tr>
<tr>
<td>Safety behavior → Perceived safety</td>
<td>0.70</td>
<td>0.23</td>
<td>3.03</td>
<td>0.00</td>
</tr>
</tbody>
</table>

\(^a\) S.E. is an estimate of the standard error of the covariance.
\(^b\) C.R. is the critical ratio obtained by dividing the covariance estimate by its standard error;
\(^c\) Underlined values are critical ratios exceeding 1.96 at the 0.05 level of significance.

\(\chi^2\) value = 10.33 (P = 0.11), df = 6, \(\chi^2/df = 1.667\), GFI = 0.994, AGFI = 0.977, RMSEA = 0.04