Developing items for measuring ergonomic risk factor among Malaysian train passengers: An exploratory factor analysis procedure

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ABSTRACT – Ergonomic Risk Factors (ERF) are usually related to the workers and the conditions of their workplace and the way they work, which affects their health impact and comfort level while carrying out their daily work. However, from the previous literature review on ERF, little is known about the ERF dimension among train passengers. Therefore, this study aimed to contribute to the literature by conducting a detailed validation of the five dimensions of ERF through the Exploratory Factor Analysis (EFA) procedure by using IBM-SPSS version 25.0. Study data was obtained using a structured questionnaire from 110 randomly selected passengers from the KTM Komuter. A total of 78 items were initially developed to measure this study construct. However, from the EFA procedure, the study found that 7 items with factor loading below the cut-off point of 0.6 were deleted. This study established a validated and reliable instrument for measuring the impact of ERF among train users in Malaysian public transportations.

1. INTRODUCTION

Ergonomic is the most important term often associated in manufacturing, construction, engineering technology, and transportation industries. Most developing countries are not aware of the contribution of ergonomics to national well-being and economic development. Most people in Malaysia do not take issues related to ergonomics seriously, and even the level of awareness on this issue is still low. The use of trains as a significant vehicle for them to go to and from work to home exposes them to this ergonomic risk daily.

Therefore, this study aims at contributing to literature by conducting an in-depth validation of these five dimensions; ergonomic risk factors, musculoskeletal disorder, health symptoms, passenger comfort, and passenger satisfaction through exploratory factor analysis (EFA). Besides that, this study also hopes to help reduce the negative health impact that gives uncomfortable feelings together with dissatisfaction by train passengers when they board the train for heading to the intended destination.

2. LITERATURE REVIEW

Ergonomic Risk Factor are the aspects of a job or task that impose a biomechanical stress on the worker. Several studies have been conducted to assess exposure to ergonomic risk factors in workers population [1]. However, less research has been done on the risk of ergonomic factors in the train faced by the passengers of the vehicle. Ergonomic risks such as noise, vibration, and ventilation are among the factors contributing to the negative effects received by train passengers. Noise in the train cabin due to the friction of the train moving in track rails, ventilation conditions in the train, and the vibrations received by passengers have an unhealthy impact on them. There have been several previous studies by other researchers on the issue of ergonomic in this train cabin. Among the earlier studies regarding trains in terms of ergonomic risk factors, from [2], Hanneke studied ambient noise inside train cabins, Li et al., [3] have analyzed air ventilation inside train cabins, and Abdullah et al., [4] have studied vibration levels during train moving for KTM Komuter. All these studies are from different railway systems from various countries. However, some studies combine studies on noise and vibration in trains. This is because the train's movement causes vibration and gives unwanted sound to the passengers [5]. The results of this literature review found that there is no further study conducted on the combination of these three ergonomic risk factors, namely noise, vibration, and ventilation in rail transport in Malaysia.

Musculoskeletal Disorder (MsDS) is defined as a musculoskeletal strain reported by an individual as a neck, shoulder, lower back, or other skeletal pain or strain [6](in this research referring to the train passenger). The effects of being exposed to ergonomic risks as described above have an impact on this MSDS.

The negative impact faced by train passengers is the effect of this ergonomic risk on their health symptoms. Consciously or unconsciously, they are exposed to these health symptoms if exposed beyond the standard limits that have been set. Health symptoms are physical or mental problems that a person experiences that may indicate a disease or condition. It cannot be seen and does not show up on medical tests. Some examples of health symptoms are headache, fatigue, nausea, and pain. Passengers obtain these health effects due to exposure to ergonomic risks as described in the above statement.

When riding a public transport, it is important to keep passenger comfort during their journey. Comfort is a subjective concept which is difficult to define and measure. The primary aim of this research is to present to the train user with an exposition of some fundamental problem associated with the ergonomics factor on train
Passenger satisfaction has long been a central issue in the service industry but has not been fully explored in the railway industry. Passenger satisfaction is defined as a post consumption evaluation judgement concerning a product, service or firm [7]. In this research, passenger satisfaction is based on their experience using the KTM Komuter service as their daily transportation to the destination. Overall, previous research on passenger satisfaction, passenger comfort, musculoskeletal disorders, health symptoms, and ergonomic risk factors is grounded on different theoretical models from various studies from other researchers covering various fields. Particularly, there is a gap of knowledge on the effects of passenger expectations on their perceptions of service quality from this KTM Komuter service. The impact obtained by train users, which affects the health of passengers, raises the issue of discomfort, which in turn increases the dissatisfaction of passengers towards the railway service.

3. RESEARCH METHODOLOGY

The approach for this study is quantitative, and data was obtained using a self-administered questionnaire. A detailed literature review was carried out to identify items measuring all the constructs. The items were adapted and modified to suit this research. A total of 110 questionnaires were distributed to KTM Komuter users. There are screening questions about the frequency of train use, the duration of the user's use, and the purpose of train use. Once completed, they submit the questionnaire to the researcher (at the station or inside the train). This study approach in estimating the inter-relationship among the constructs. Precisely, the method used was Structural Equation Modelling (SEM) in IBM SPSS-Amos 25.0.

4. EXPLORATORY FACTOR ANALYSIS (EFA)

The research adopted the measuring instrument for all the constructs mentioned above from the previous literature and modified the items to suit the current study. According to Bakhia et al., [8], pre-test and pilot tests must be conducted to validate the modified instrument, mainly if the original instrument was developed in the different populations and industries from the present study. Once the modification process was concluded, the experts reviewed the questionnaire, a professor and expert worker in railway transport, for the modified instrument. The result shows that the five items from ERF and two items from HS have been deleted because the value of factor loading is more than 0.6. the results also showed that the construct could adequately be measured using 71 items with a total variance above 60%. The Kaiser-Meyer-Olkin (KMO) value of >0.6 shows that the data is adequate for this study. Additionally, the items in all measurable components assessing the construct possess excellent internal reliability since all Cronbach’s values have surpassed the acceptable range of 0.7.

<table>
<thead>
<tr>
<th>No</th>
<th>Constructs</th>
<th>Items Before Run EFA</th>
<th>Number of Items Dropped</th>
<th>Number of items Retained After Run EFA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ergonomic Risk Factor</td>
<td>30</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>Musculoskeletal Disorder</td>
<td>11</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>3</td>
<td>Health Symptom</td>
<td>23</td>
<td>2</td>
<td>21</td>
</tr>
<tr>
<td>4</td>
<td>Passenger Comfort</td>
<td>8</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>Passenger Satisfaction</td>
<td>6</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>Total Item</td>
<td>78</td>
<td>7</td>
<td>71</td>
</tr>
</tbody>
</table>

6. CONCLUSION

The dimension that has been identified in this study are an ergonomic risk factor, musculoskeletal disorder, health symptom, passenger comfort, and passenger satisfaction. The results from the EFA disclosed that the measurement items from the five dimensions adapted from the literature review were grouped into five components. The detailed measurement development and validation process of the current study has confirmed that the new questionnaire instrument is internally consistent and reliable. This study also contributed by establishing a validated and reliable instrument for measuring the ergonomic risk factor, musculoskeletal disorder, health symptom, passenger comfort and passenger satisfaction.

REFERENCES
warning signals in the ambient noise of Dutch train cabins. *Ergonomics*, 64(4), 474-484.


