

Assessing the Fitness of a Measurement Model Using Confirmatory Factor Analysis (CFA)

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ABSTRACT: The purpose of this research is to assess the fitness of a measurement model using Confirmatory Factor Analysis (CFA). A survey methodology using simple random sampling was carried out covering the 300 students. A structured questionnaire using the entrepreneurial intention as a subject was then distributed to 300 students. Then the confirmatory factor analysis (CFA) in structural equation modeling was employed to assess the fitness of a measurement model. The results implied that the fitness indexed of a measurement model achieved the required level. Based on this study, it revealed that all the fitness indexes achieved the level of acceptance. The measurement model is accepted. The model is fit to the data. It can be assembled into the structural model for further analysis.

KEYWORDS: Confirmatory Factor Analysis (CFA), Measurement Model, Structural Equation Modeling (SEM), Fitness Indexes, Entrepreneurial Intention.

1 INTRODUCTION

Confirmatory Factor Analysis (CFA) is a special form of factor analysis. CFA is employed to test whether the measures of a constructs are consistent with the researcher's understanding of the nature of that construct. There are two methods of running the CFA namely CFA for individual model and the CFA for pooled measurement model [1]. In this study, the researcher used the CFA pooled measurement model method in running the confirmatory factor analysis. The CFA is solved using the Structural Equation Modeling (SEM). Structural Equation Modeling (SEM) is a statistical methodology that takes a confirmatory for example hypothesis testing approach to the analysis of a structural theory bearing on some phenomenon [2].

This paper applies entrepreneurial intention as a research subject to be test for assessing the fitness of a measurement model. In particular, this paper has four variables namely Attitude Towards Behavior (ATB), Subjective Norm (SN), Perceived Behavioral Control (PBC) and Entrepreneurial Intention (EI).

2 METHODOLOGY

The target population was the 300 university students from Kelantan and Terengganu. Reference [3] suggested that when there is five or less latent construct and each latent construct has more than three measuring items, the minimum sample required is 100 samples. This study used primary sources of data since the data or information for this study originally collected through questionnaire.

There are eight steps involved in validating the measurement model:

- Run confirmatory factor analysis (CFA) for the measurement model.
- Examine the required fitness indexes for the measurement model. If the fitness indexes do not meet the required level, examine the factor loading.
- The item with factor loading less than 0.60 must be deleted. The item must be deleted one at a time (select the lowest factor loading to delete first).
- Run the new measurement model (the model after an item is deleted).
- Examine the fitness indexes (repeat step 3-4 until the fitness indexes achieved the level of acceptance).
- If the fitness indexes are still not achieved, look at the Modification Indices (MI). The high value of MI (above 15) indicates there are redundant items in the model.
- To solve the redundant items, the researcher could choose whether to delete one of the item (choose the lowest factor loading) or set the pair of redundant item as “free parameter estimate”.
- Run the measurement model and repeat the above steps until the fitness indexes achieved the level of acceptance.

There are several Fitness Indexes in SEM that reflect how fit is the model to the data. It is recommended that the use of at least on fitness index from each category of model fit [4]. The information concerning the level of acceptance for fitness indexes are presented in Table 1.

Table 1. Index Category and Their Level of Acceptance

| Name of Category | Name of Index | Index Full Name | Level of Acceptance | Literature |
|-------------------------|---------------|---|---------------------|------------|
| Absolute Fit | Chisq | Discrepancy Chi Square | $P > 0.05$ | [5] |
| | RMSEA | Root Mean Square of Error Approximation | < 0.08 | [6] |
| | GFI | Goodness of Fit Index | > 0.90 | [7] |
| Incremental Fit | AGFI | Adjusted Goodness of Fit | > 0.90 | [8] |
| | CFI | Comparative Fit Index | > 0.90 | [9] |
| | TLI | Tucker-Lewis Index | > 0.90 | [10] |
| | NFI | Normed Fit Index | > 0.90 | [11] |
| Parsimonious Fit | Chisq/df | Chi Square/Degree of Freedom | < 5.0 | [12] |

3 RESULT AND DISCUSSION

3.1 DESCRIPTIVE ANALYSIS

Table 2 shows that the frequency for gender. The highest is female students which is 247 out of 300 students. The rest is male students which is 53 out of 300.

Table 2. Gender

| Gender | Frequency | Percentage (%) |
|--------|-----------|----------------|
| Male | 53 | 17.7 |
| Female | 247 | 82.3 |
| Total | 300 | 100 |

Table 2 shows that the frequency for race. The highest is Malay student which is 274 out of 300 and possessed the percentage of 91.3%.

Table 3. Race

| Gender | Frequency | Percentage (%) |
|---------|-----------|----------------|
| Malay | 274 | 91.3 |
| Chinese | 22 | 7.3 |
| Indian | 3 | 1.0 |
| Others | 1 | 0.3 |
| Total | 300 | 100 |

3.2 CONFIRMATORY FACTOR ANALYSIS (CFA)

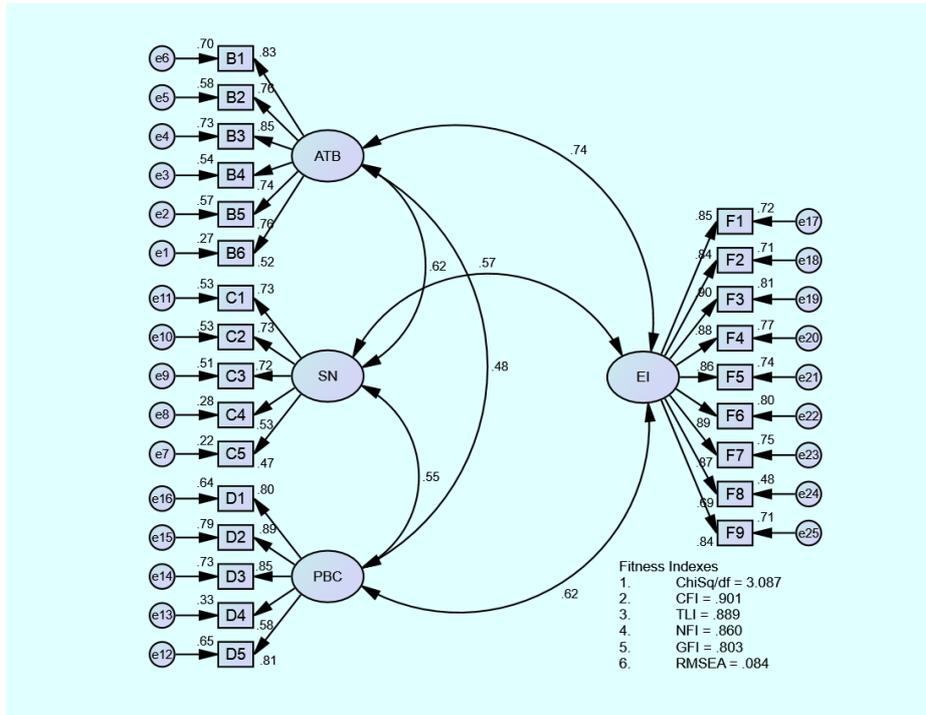


Fig. 1. The Factor Loading for all Items

Fig. 1 shows the CFA results with the fitness indexes and the factor loading for every item. As shown in the above figure, certain fitness indexes do not achieved the required level. There are several items that have factor loading less than 0.60 which are B6, C4, C5 and D4. These items must be deleted one by one and run the new measurement model.

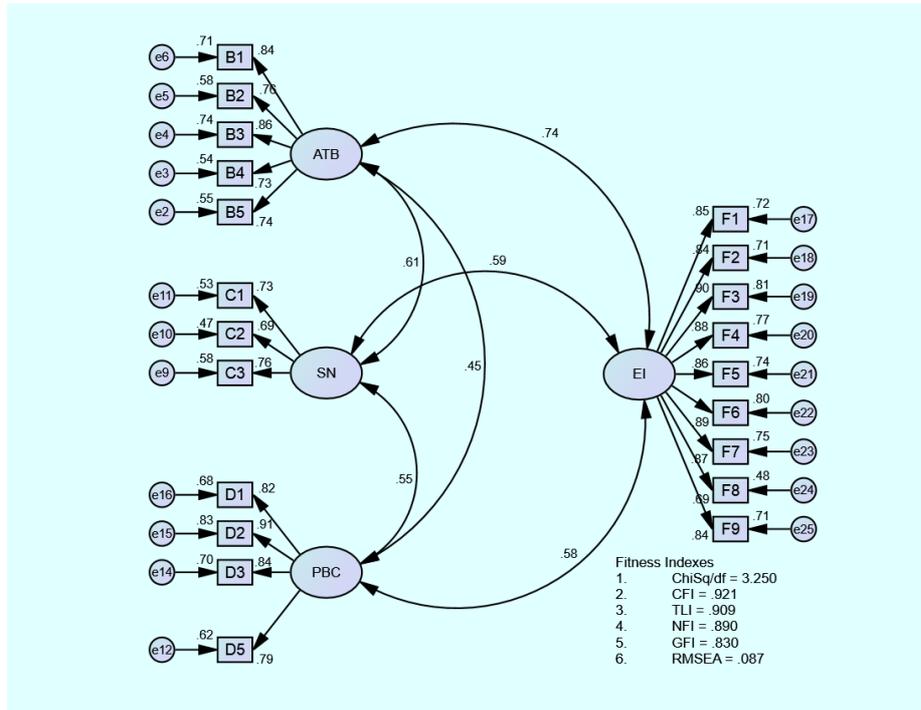


Fig. 2. The New Factor Loading After The Four Items were Deleted

Fig. 2 shows that the new measurement model after deleted item B6, C4, C5 and D4 one by one that have low factor loading less than 0.60. However, the fitness indexes for the model do not achieved the required level. Therefore, the value of Modification Indices (MI) was observed.

Table 4. Modification Indices (MI)

| | Value of MI |
|--------------|-------------|
| e23 <--> e24 | 18.576 |
| e22 <--> e23 | 52.666 |
| e19<--> e23 | 20.747 |
| e19 <--> e22 | 17.834 |
| e19 <--> e20 | 63.298 |
| e16 <--> e23 | 15.605 |
| e15 <--> e16 | 19.291 |
| e3 <--> e5 | 29.130 |
| e2 <--> e3 | 16.866 |

Table 4 shows the value of MI. The MI value of 63.298 is the highest. When the MI value is greater than 15, the items are redundant. The correlated measurement error here is between e19 and e20. The redundant item is between F3 and F4. The researcher decides to delete one of the two redundant items and run the new measurement model. Since that the factor loading for item F4 is lower than the factor loading for item F3, the item F4 should be deleted.

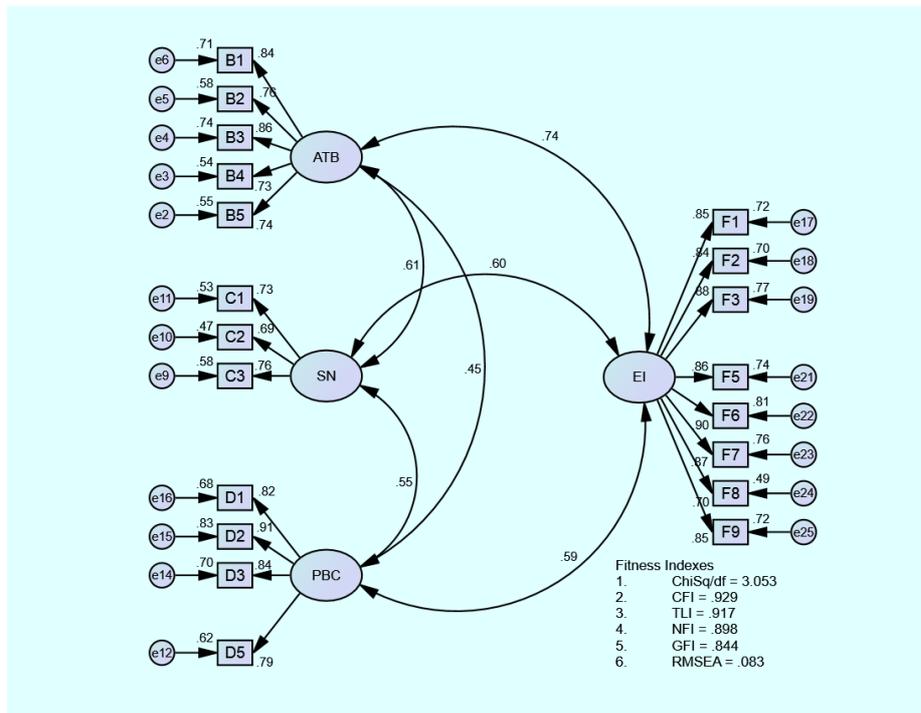


Fig. 3. The New Measurement Model After Deleted Item F4

Fig. 3 shows that the new measurement model after item F4 was deleted. The value of fitness indexes still does not satisfy the required level. Therefore, the value of MI was observed again.

Table 5. Modification Indices (MI) After Deleted F4

| | Value of MI |
|--------------|-------------|
| e22 <--> e23 | 46.182 |
| e18 <--> e19 | 15.452 |
| e16 <--> e23 | 17.993 |
| e15 <--> e16 | 19.167 |
| e3 <--> e5 | 29.313 |
| e2 <--> e3 | 17.113 |

Table 5 shows the value of MI after deleted F4. The MI value of 46.182 is the highest. The correlated measurement error here is between e22 and e23. The redundant item is between F6 and F7. The researcher decides to delete one of the two redundant items and run the new measurement model. Since that the factor loading for item F7 is lower than the factor loading for item F6, the item F7 should be deleted.

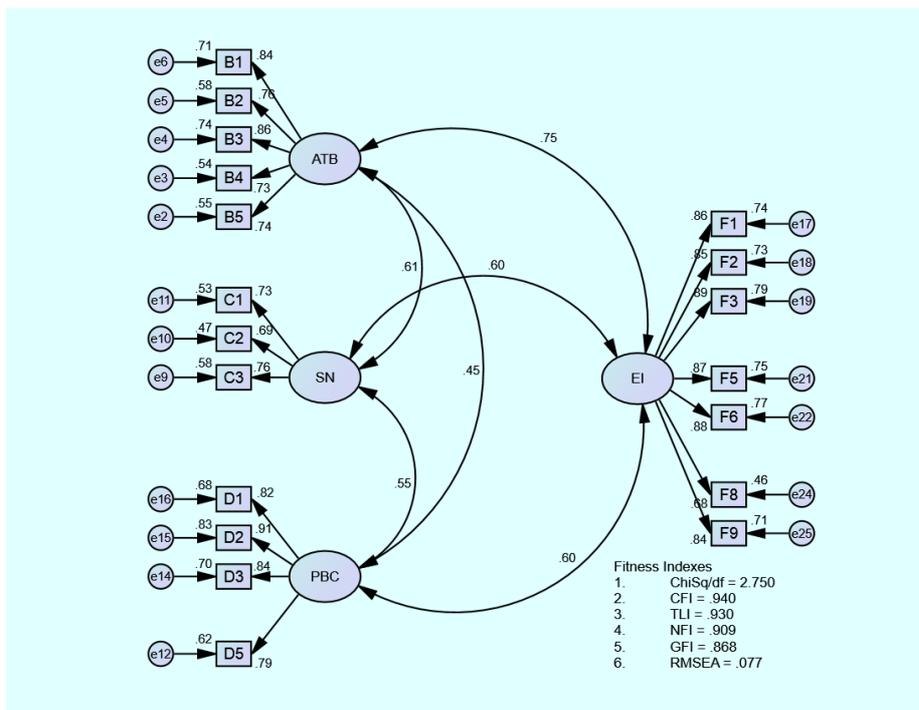


Fig. 4. The New Measurement Model After Deleted Item F7

Fig. 4 shows that the new measurement model after item F7 was deleted. The value of GFI still does not satisfy the required level. Therefore, the value of MI was observed again until all the value of fitness indexes achieved the level of acceptance.

Table 6. Modification Indices (MI) After Deleted F7

| | Value of MI |
|--------------|-------------|
| e15 <--> e16 | 18.618 |
| e3 <--> e5 | 28.955 |
| e2 <--> e3 | 16.937 |

Table 6 shows the value of MI after deleted F7. The MI value of 28.955 is the highest. The correlated measurement error here is between e3 and e5. The redundant item is between B2 and B4. The researcher decides to delete one of the two redundant items and run the new measurement model. Since that the factor loading for item B4 is lower than the factor loading for item B2, the item B4 should be deleted.

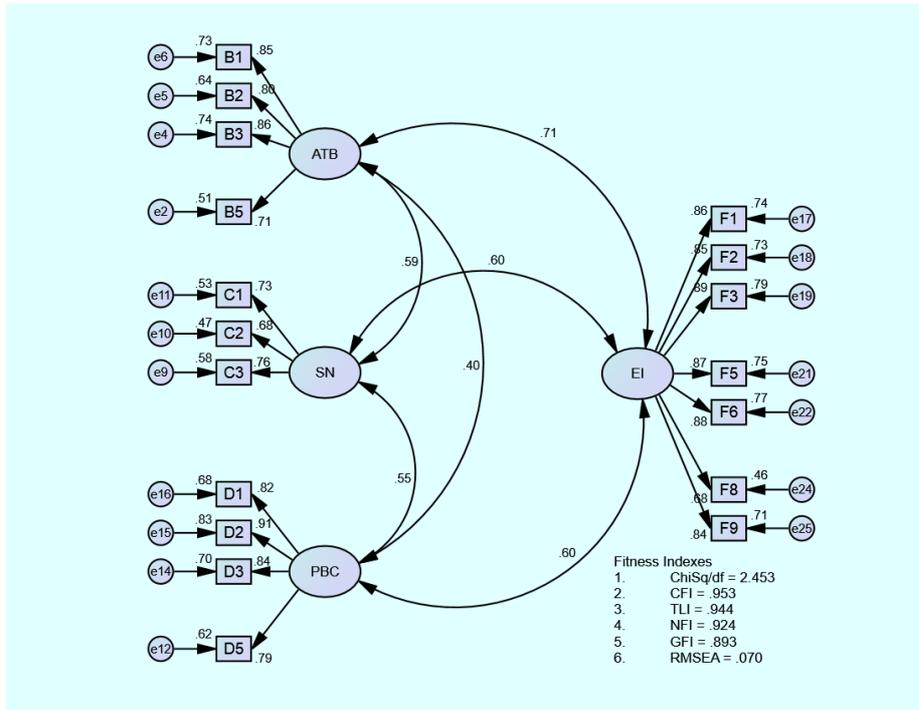


Fig. 5. The New Measurement Model After Deleted Item B4

Fig. 5 shows that the new measurement model after item B4 was deleted. The value of GFI still does not satisfy the required level. Therefore, the value of MI was observed again until all the value of fitness indexes achieved the level of acceptance.

Table 7. Modification Indices (MI) After Deleted B4

| | Value of MI |
|--------------|-------------|
| e15 <--> e16 | 18.618 |

Table 7 shows the value of MI after deleted B4. There is only one pair of item that are redundant. The correlated measurement error here is between e15 and e16. The redundant item is between D1 and D2. The researcher decides to set these two correlated measurement errors of redundant items as a “free parameter”.

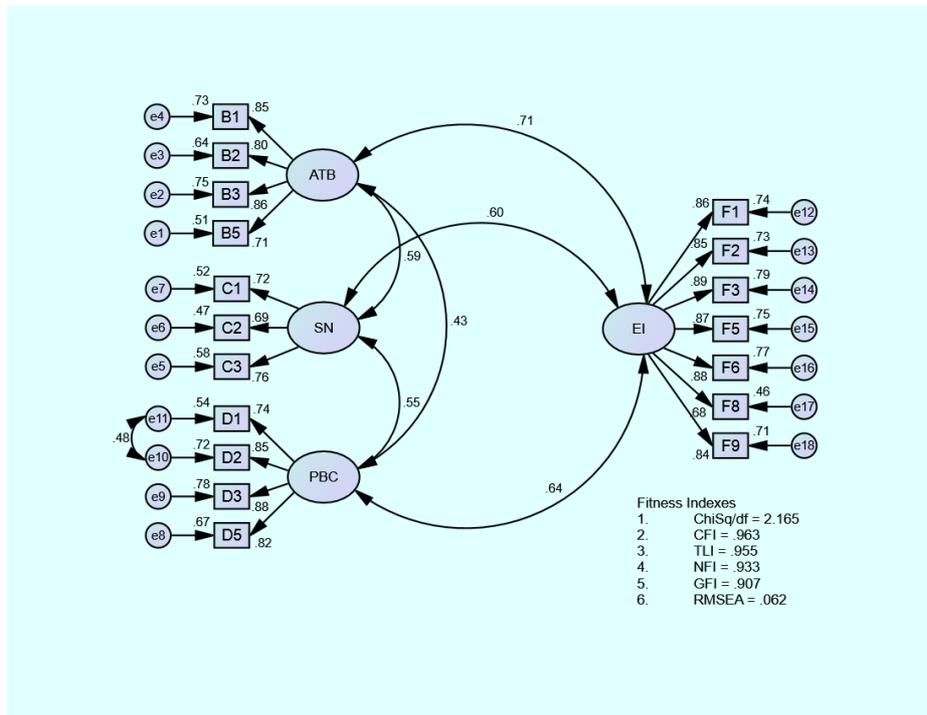


Fig. 6. The Last Measurement Model

Fig. 6 shows that the last measurement model. The fitness indexes have improved after the two redundant items are constrained in the model. All the value of fitness indexes has achieved the required level.

Table 8 shows that the summary of fitness indexes for the last measurement model.

Table 8. Summary for Fitness Indexes

| Name of Category | Name of Index | Index Value | Comments |
|------------------|---------------|-------------|-----------------------------|
| Absolute Fit | RMSEA | 0.062 | Achieved the required level |
| | GFI | 0.907 | Achieved the required level |
| Incremental Fit | CFI | 0.963 | Achieved the required level |
| | TLI | 0.955 | Achieved the required level |
| | NFI | 0.933 | Achieved the required level |
| Parsimonious Fit | Chisq/df | 2.165 | Achieved the required level |

Table 9. Summary for All Constructs

| Construct | Item | Factor Loading | Cronbach Alpha | CR | AVE |
|------------------------------------|------|----------------|----------------|-------|-------|
| Attitude Towards Behavior (ATB) | B1 | 0.85 | 0.879 | 0.882 | 0.652 |
| | B2 | 0.80 | | | |
| | B3 | 0.86 | | | |
| | B5 | 0.71 | | | |
| Subjective Norm (SN) | C1 | 0.72 | 0.767 | 0.767 | 0.524 |
| | C2 | 0.69 | | | |
| | C3 | 0.76 | | | |
| Perceived Behavioral Control (PBC) | D1 | 0.74 | 0.901 | 0.894 | 0.679 |
| | D2 | 0.85 | | | |
| | D3 | 0.88 | | | |
| | D5 | 0.82 | | | |
| Entrepreneurial Intention (EI) | F1 | 0.86 | 0.943 | 0.944 | 0.708 |
| | F2 | 0.85 | | | |
| | F3 | 0.89 | | | |
| | F5 | 0.87 | | | |
| | F6 | 0.88 | | | |
| | F8 | 0.68 | | | |
| | F9 | 0.84 | | | |

Table 9 shows that the summary of confirmatory factor analysis (CFA) for all constructs in the last measurement model. Based on the table above, the value of Cronbach Alpha is higher than 0.70. Other than that, the value of Composite Reliability (CR) are greater than 0.6. The value of Average Variance Extracted (AVE) is above 0.5.

4 DISCUSSION

The result shows that all fitness indexes of the measurement model achieved the required level. In the category of absolute fit, the value of RMSEA is 0.062 which is lower than 0.08. The value of GFI is 0.907 which is greater than 0.90. In the category of incremental fit, the value of CFI, TLI and NFI are 0.963, 0.955 and 0.933 which are higher than 0.90. In the category of parsimonious fit, the value of χ^2/df is 2.165 which is lower than 5.0. All the value of fitness indexes satisfied the level of acceptance.

The value for Cronbach Alpha for four construct are 0.879, 0.767, 0.901 and 0.943. All the value of Cronbach Alpha are greater than 0.70. The values of Average Variance Extracted (AVE) for all constructs are greater than 0.50 which are 0.652, 0.524, 0.679 and 0.708. Other than that, all the value s of Composite Reliability (CR) for all constructs are greater than 0.60 which are 0.882, 0.524, 0.679 and 0.944.

5 CONCLUSION

The researcher can conclude that the model is fit to the data since that the fitness indexes for the measurement model achieved the level of acceptance suggested by the literature. Other than that, the value of Cronbach Alpha for Attitude Towards Behavior (ATB), Subjective Norm (SN), Perceived Behavioral Control (PBC) and Entrepreneurial Intention(EI) are greater than 0.70 as suggested by Reference [13]. Besides that, the values of Average Variance Extracted (AVE) for all constructs are greater than 0.50. Other than that, the values of Composite Reliability (CR) for all construct in this study are greater than 0.6 as recommend by Reference [14]. The measurement model is accepted. It can be assembled into the structural model for further analysis.

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