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Accessing the Construct and Content Validity of Uncertainty Business Using Sem Approach- An Exploratory Study of Manufacturing Firms

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Abstract - Construct and content validity is necessary to provide purified data for any exploratory research study. The commonly widely used in any exploratory research study is Cronbach Alpah to analyze data validity. However more robust analysis like Confirmatory Factor Analysis (CFA) in Structural Equation Modeling provides more rigorous analysis of model power in relation to construct and content validity. This paper provides insight of this construct and content analysis using the CFA approach by analyzing the Business Environmental Uncertainty research variable. To achieve the intended research objective, the BEU is explored in the context of Malaysian manufacturing sectors. Detailed illustration of the validity, analysis using the CFA approach together with the Cronbach Alpah was provided. The result analysis indicates to improve the model power in relation to the validity any manifest variables below the threshold require to be dropped. Moreover the Cronbach Alpah value is not much affected although some of the manifest variables do not significantly contribute to the research variable. In conclusion, a recommendation was give for future research to test the data validity.

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Abstract - Construct and content validity is necessary to provide purified data for any exploratory research study. The commonly widely used in any exploratory research study is Cronbach Alpah to analyze data validity. However more robust analysis like Confirmatory Factor Analysis (CFA) in Structural Equation Modeling provides more rigorous analysis of model power in relation to construct and content validity. This paper provides insight of this construct and content analysis using the CFA approach by analyzing the Business Environmental Uncertainty research variable. To achieve the intended research objective, the BEU is explored in the context of Malaysian manufacturing sectors. Detailed illustration of the validity, analysis using the CFA approach together with the Cronbach Alpah was provided. The result analysis indicates to improve the model power in relation to the validity any manifest variables below the threshold require to be dropped. Moreover the Cronbach Alpah value is not much affected although some of the manifest variables do not significantly contribute to the research variable. In conclusion, a recommendation was give for future research to test the data validity.

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I. Introduction

It is common in exploratory study for the survey instrument to be subject to reliability and validity examination (Collis & Hussey, 1995). Reliability reflects the stability and consistency of an instrument in measuring the concept (Page & Meyer, 2000; U. Sekaran, 1992, , 2003). Numerous exploratory research studies focus on Cronbach alpha to test reliability. This method is commonly used to assess the reliability of each measure. The threshold for Cronbach alpha, is the higher the coefficient alpha values indicate the reliability of measurement instrument, the better. Nunnally and Berstein (1994) suggested that 0.70 to be an acceptable reliability coefficient level. In a similar view, Sekaran (2000) asserted the Cronbach's alpha measure above 0.70, indicates that the instrument has the internal consistency reliability.

Lately, research studies examine the reliability and validity of survey instruments using more robust approaches such as SEM technique. Under this technique, data reliability is verified using the Confirmatory Factor Analysis (CFA) approach. The CFA analysis provides standardized loading factor of each indicator where the research variable is quantified from a series of statement known as manifest variable. The standardized loading factor (regression weight) indicates the contribution of each indicator to the respective research latent variable. According to Hair et al., (2006) a good standardized loading factor of each measurement latent variable of which quantified from manifest variable should be above 0.5and ideally 0.7 or higher. Data validity is also tested using the Variance Extracted (VE) approach. The average percentage of Variance Extracted (VE) is a specific Confirmatory Factor analysis testing the convergent validity. According to Hair et al., (2006) the VE of 0.5 or higher as a rule of thumb is good, suggesting adequate convergence.

The objective of this research study is to explore the construct and content analysis using the SEM approach. To illustrate this research objective, the study focuses on uncertainty of business environment research variable. For this purpose the study concentrates on firms operating in manufacturing sectors in Malaysia. This paper is organized into four main sections - the first section provides literature of business environmental uncertainty. The second section provides methodology to quantify the uncertainty as well as analytical expression to test the validity of uncertainty research variable using the SEM approach. The third section provides descriptive statistics of firms in the sample study. This is followed by result output of construct and content analysis using the SEM approach. This section also includes discussion of the result output. The final section provides the conclusion and future research recommendations.

II. Uncertainty of Business Environment

A general definition of business environmental uncertainty is "an individual's perceived inability to predict (an organization's environment) accurately" because of a "lack of information" or "inability to discriminate between relevant and irrelevant data" (Milliken, 1987). According to prominent researchers in

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management accounting like Chenhall.R.H (2003) and Head (2005), uncertainty is generally described as an information deficit and they define situations in which probabilities cannot be assigned to particular outcomes. Under this circumstances, elements of the environment are very unpredictable, for instance actions of other economic players like competitors, customers, suppliers, and regulators. M.Fleming et al., (2009) asserts that uncertainty makes it difficult for manages to predict the future.

According to Johnson and Scholes (1999), the extent of business environmental uncertainty is viewed as a function of the level of increase in environmental dynamism and complexity. Jabnoun (2003) noted there is a difference between dynamic environment and environmental complexity as explained below:-

- Dynamic environment is typified by change in environmental variables constituting the uncertainty dimensions such as technology, customer needs and tastes, demand and supply conditions, and competition. These changes generate uncertainty for the firm.
- Environmental complexity is summed up by the number and diversity of variables influencing the uncertainty dimensions in the environment.

According to Milliken (1987), perceptions of environmental uncertainty occur when executives are unable to predict future changes in components of the environment or possess an incomplete understanding of the relationship among components of the environment. According to the author there are three categories of uncertainty of business environment:

- Effect uncertainty which is an inability to predict the nature of the effect of a future state of the environment on the organization;
- Response uncertainty which is the inability to predict the likely consequences of a response choice and
- State uncertainty which is the perceived environmental uncertainty. The perceived environmental uncertainty occurs when administrators perceive an organization's environment to be unpredictable.

Research studies have concentrated extensively on the relationship between perceived environmental uncertainty and organizational characteristics such as firm size, strategy, structure, and performance measures (Gordon & V.K.Narayanan, 1984; Gul. & Chia., 1994); for instance, empirical studies by Gordon and Narayanan (1984), Chenhall and Morris (1986) and subsequently Gul and Chia (1994) found that perceived environmental uncertainty is associated with the characteristics of management accounting information. Thus, business environmental uncertainty is an important research topic of management accounting and performance measurement system (Gordon & D.Miller, 1976).

To achieve the research objective of this study, the uncertainty of business environment is explored using Desarbo et al., (2005) model. This model consist of three categories of uncertainty namely, market environment, technological environment and competitive environment as illustrated in the following figure. Using this model, data was collected from Malaysian manufacturing firms and tested for construct and content validity.

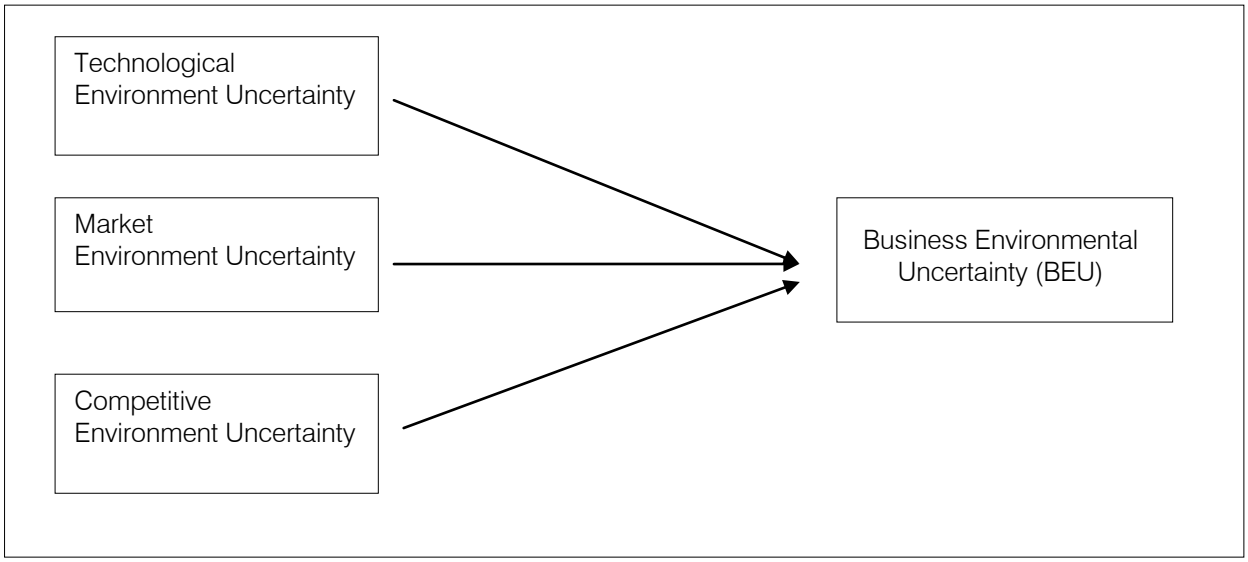

Figure 1.1 : Manifest variable of BEU latent endogenous variables.

III. Uncertainty Quantification

As depicted in figure 1.1 above, the environmental uncertainty survey instrument consists of 19 questions. The statement quantifying the market environment and the competitive environment is retained with some minor modification to the statements to improve understanding and to suit the current business environment. As for the Technological environment, the original instrument consisting of six questions has been reduced to five questions as one of the questions carries a similar meaning. Redundant questions are omitted not to confuse the respondent and also to prevent missing data problems if the majority respondents failed to answer. In replacement to this redundant question, a new question was added addressing obsolete statements. This is necessary as this issue has a significant impact on technological development, particularly in the current business condition. The respondents were asked, on a five-point scale ranging from 1 "Strongly Disagree" to 5 "Strongly agree", to indicate their organization's level of uncertainty in accordance the three categories. The firm environmental uncertainty level is determined based on research methods suggested by Desarbo et al., (2005) and Nimtrakoon and Tayles (2010). As recommended by Desarbo et al., (2005), first the summated mean score of the three environmental uncertainty categories i.e., Market Environment, Technological Environment and Competitive Environment are calculated. Using this summated mean scores the firms' environmental level is determined based on mean score range established in empirical study by Nimtrakoon and Tayles (2010) as follows:

- companies with stable (and low) environmental uncertainty are defined as firms whose average score was less than or equal to 3.5;
- companies with moderate environmental uncertainty are identified as firms whose average score was greater than 3.5, but less than 4.5; and
- companies with high environmental uncertainty are defined as firms whose average score was greater than or equal to 4.5.

The following analytical expression illustrates the methodology determining the firm's uncertainty level of business environment as explained above.

$$\omega_i = \begin{cases} \gamma_1 \quad if \quad 0 < \chi_{\eta j} \leq 3.5 \\ \gamma_2 \quad if \quad 3.5 < \chi_{\eta j} \leq 4.5 \\ \gamma_3 \quad if \quad otherwise \end{cases} \qquad (1)$$

Where: ω_i = Firm's uncertainty of business environment

γ = Level of uncertainty (1 – Stable, 2- Moderate, 3- high)

χ = Summated Mean Score

η = Three uncertainty of environment – Market Environment, Technological Environment and Competitive Environment

j = Respondent 1, …, K

As explained above, Uncertainty is quantified based on the three categories of environment. In SEM approach, the Business environment uncertainty is classified as endogenous while the other three categories of uncertainty are considered as exogenous. The Uncertainty endogenous quantified from the three exogenous manifest variables are statements in the questionnaire as discussed earlier. The following analytical expression depicts the manifest variables for Uncertainty endogenous latent variable.

Business Environmental Uncertainty manifest variable

$$x_{n\ldots k} = \lambda_{n\ldots k}\xi_{1BEU} + \delta_{n\ldots k} \qquad (2)$$

Where

$x_{n\ldots k}$ = Manifest variables in the questionnaire

$\lambda_{n\ldots k}$ = Manifest variables factor loadings

ξ_{1BEU} = Business environmental uncertainty

$\delta_{n\ldots k}$ = Manifest variables indicators error

As illustrated in the above formulae, the manifest variables factor loading or regression weight is calculated for all three categories of exogenous. The identified factor loading of each manifest variable indicates the significance of each manifest variable that quantified the endogenous variables. Any of the manifest variables factor loading below than the threshold level that is below 0.5 is purged to improve the model fit. As discussed earlier, the convergent validity is tested using the Variance Extracted (VE). The Variance Extracted (VE) value is indicated as Total Variance Explained presented together with the standardized manifest loading factors. The following segment provides the details of the firms analyzed followed by the result output of the construct and content analysis.

IV. Uncertainty Validity Analysis

The target population of this study is Malaysian firms operating in the manufacturing sector. Majority of the respondents were from industry related to manufacturing products representing 50% (126 respondents). Respondents from the Electronic and Electrical products companies represented 24% (60 respondents). This is followed by respondents involved in manufacturing Medical products which consist of 11% (28 respondents).

Table 1.1 : Organization's primary business activity

Business Activity	No of Firms	Percent (%)
Agriculture Products	7	3
Manufacturing Products*	126	50
Electronic and Electrical Products	60	24
Chemical and Petroleum Products	11	4
Infrastructure Products	19	7
Medical Products	28	11
Other Products	2	1
Total	253	100

**Includes Food and Mineral, Furniture, Iron & Steel Products, Paper, Rubber, Souvenirs, Sport, Textile, Toys, Wood Products.*

The respondents' firm ownership structure analysis revealed that out of the 244 firms, 159 firms are Malaysian owned firm which represents 63% and 79 firms consisting of 31% are Foreign owned firms. A very small percentage of firms which is 2% (n= 6 firm) operates on the basis of joint venture business ownership structure. From the total of 253 firms, 9 (4%) firms failed to indicate their business ownership structure.

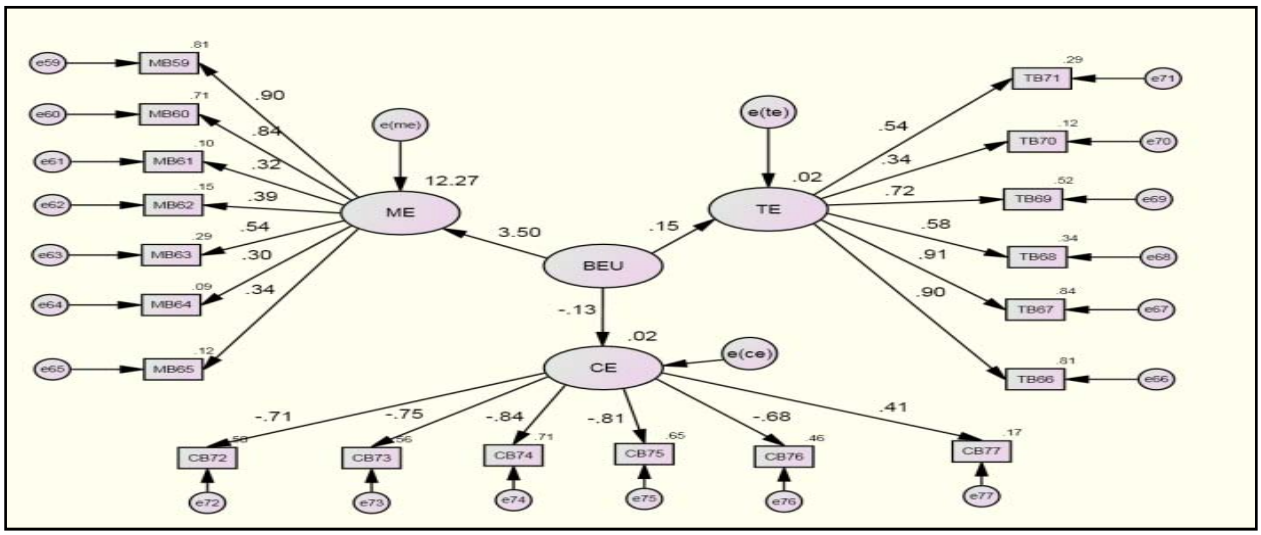

Figure 1.2 : SEM Diagram of Factor Loading for BEU

The standardized loading factor of the three exogenous- Market Environment, Technological Environment and Competitive Environment manifest variables values is provided in Table 1.2. In the table the Total Variance Explained is indicated together the Cronbach Alpha value. The analysis of factor loading presented in the SEM diagram is shown in Figure 1.2. The above SEM diagram depicts the standardized loading factor analysis of all manifest variable prior any modification.

Analysis of standardized loading factor for Business Environmental Uncertainty (BEU) endogenous variables revealed some of the manifest variables values are below the threshold of 0.5. As shown in the table, the Market Environment exogenous variable recorded few manifest variables value below 0.5 compared to other two exogenous categories. The Technological Environment and Competitive Environment consist of manifest variable one each where the values are below 0.5. Due to the low manifest variable's loading factor, the convergent validity for business environmental uncertainty endogenous is severely affected. The Variance Extracted value 43% is below the recommended value of 50% although the Cronbach Alpa value is above the recommended level which is 0.7. As recommended by Hair et al., (2006) any manifest variable standardized loading factor below 0.5 is required to be eliminated in order to improve VE value of above 50%. Dropping manifest variables with loading factor below 0.5 is also necessary to remove errors in measurement. By removing this error, the researcher will only take the purified data to improve the overall SEM model fit.

Table 1.2 : BEU Standardized Regression Weight

Business Environment Uncertainty	Factor Loading
Market Environment	
Product preferences change quite often (MB1)	0.901
Customer look for new products (MB2)	0.844
Price-sensitive (MB3)	0.322
Price is relatively unimportant on some occasions (MB4)	0.391
Product-related needs (MB5)	0.494
Service existing loyal customers continuously (MB6)	0.299
Difficult to predict product changes/customer preference (MB7)	0.343
Technological Environment	
Technology rapidly changing (TB 8)	0.898
Technological changes provide opportunities (TB9)	0.914
Difficult to forecast future technology (TB10)	0.583
Technological breakthrough (TB11)	0.722
Technological development minor (TB12)	0.342
Technology becomes obsolete quickly (TB13)	0.539
Competitive Environment	
Price competition (CP14)	-0.705
Overall competition (CP15)	-0.746
Competitor offers (CP16)	-0.841
Promotion war (CP17)	-0.805
Competitive Move (CP18)	- 0.678
Competitors are relatively weak (CP19)	0.408
Total Variance Explained	**43%**
Cronbach' Alpha	**0.83**

The following table provides details of manifest variables that need to be purged. As seen in the table, the Market environment exogenous variables, a total of 5 manifest variables were removed. Among the Market Environment manifest variable, retaining the Product-related needs although closer to the loading factor of 0.5 still produce the VE value below 0.5. Thus, this variable was also purged to achieve the acceptable VE value. Under the Technological environment and Competitive environment exogenous variables as mentioned earlier, one each manifest variables are removed.

Table 1.3 : BEU Manifest Variables Purged

Manifest Variable	Loading Factor
Market Environment	
Price-sensitive (MB3)	0.322
Price is relatively unimportant on some occasions (MB4)	0.391
Product-related needs (MB5)	0.494
Service existing loyal customers continuously (MB6)	0.299
Difficult to predict product changes/customer preference (MB7)	0.343
Technological Environment	
Technological development minor (TB12)	0.342
Competitive Environment	
Competitors are relatively weak (CP19)	0.408

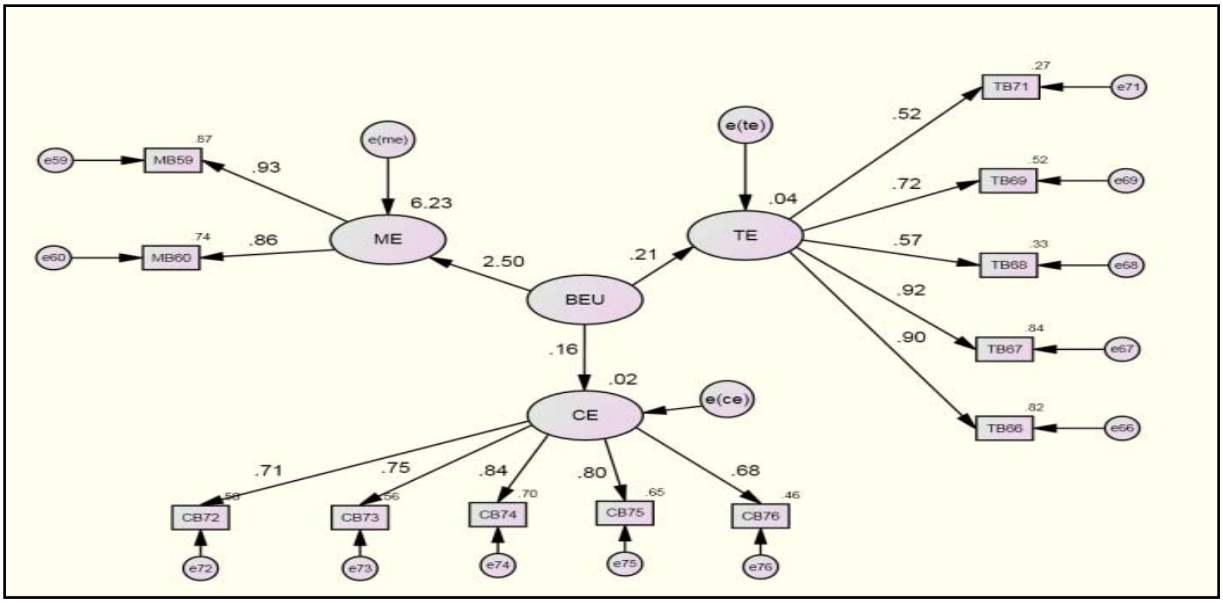

Figure 1.3 : SEM Diagram of Factor Loading for BEU after modification

As seen in the Table 1.4 below, the standardized factor loading of the three exogenous manifest variables are within the range of 0.5 to 0.9 with the highest recorded for Product preferences change quite often (0.932) from Market Environment exogenous variables and the lowest recorded for Technology becomes obsolete quickly (0.521) from Technological Environment exogenous. After removing the standardized loading factor, the overall percentage of Variance extracted (VE) improved from 43% to 58%. Thus the endogenous business environmental uncertainty after the modification provides greater convergent validity of data for further SEM analysis.

After removing the manifest variable with loading factor below 0.5, the Business Environmental Uncertainty endogenous comprised twelve manifest variables. According to Hair et al., (2006) as a rule of thumb, the number of manifest variable per latent variable must be at least three. The SEM diagram as shown in Figure 1.3 above indicates the BEU endogenous after the modification consists of 12 manifest variables above the recommended values. Thus the overall 12 items for Business environmental uncertainty measurement is now qualified for further SEM analysis.

Table 1.4 : BEU Standardized Regression Weight- After Modification

Business Environment Uncertainty	Factor Loading
Market Environment	
Product preferences change quite often(MB59)	0.932
Customer look for new products (MB60)	0.707
Technological Environment	
Technology rapidly changing (TB 66)	0.904
Technological changes provide opportunities (TB67)	0.917
Difficult to forecast future technology (TB68)	0.570
Technological breakthrough (TB69)	0.720
Technology becomes obsolete quickly (TB71)	0.521
Competitive Environment	
Price competition (CP72)	0.707
Overall competition (CP73)	0.750
Competitor offers (CP74)	0.836
Promotion war (CP75)	0.805

Competitive Move (CP76)	0.675
Total Variance Explained	**58%**
Cronbach' Alpha	**0.82**

V. Conclusion

A point to note on both analyses before the modification and after the modification, the Cronbach's Alpha coefficient value is well above the recommended level of 0.7. As seen in the table, the value before modification is 0.83 while the value after modification is 0.84. The overall Cronbach's Alpha analysis or even item by item analysis provide indication of the data reliability. However, the test of convergent and construct validity is further improved with SEM approach. One of the major advantages of the CFA approach under the SEM analysis is that it provides the researcher the power of model validity by indicating the Total Variance Explained. In summary the higher standardized factor loading and higher percentage value of VE of the endogenous variables enable the examination of the significance of research variables more precisely and improvement of the data analysis. Thus it is strongly recommended that any future study use the Confirmatory factor analysis together with the Cronbach Alpha to achieve better results to support the research study.

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