Measuring Value –Based Productivity: A Confirmatory Factor Analytic (CFA) Approach

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Abstract

Productivity affects many organisations to survive in the rapidly progressing business environment. In this paper, productivity is viewed from the other side of coin which is through values as intangible enabler in fuelling it. Values play significant role for this reason. Therefore, this paper expounds the value-based productivity that is related to the performance of the organisation based on the literature review and expert's view. This study aimed at testing the psychometric properties of the questionnaire of value-based productivity items of performance measurement based on the Value-based Total Performance Excellence Model. 600 questionnaires were distributed to the selected Institution of Higher Learning (IHL) i.e the public university of Malaysia. The data collected was analysed using predictive analytics software (PASW) and AMOS, both version 18. Structural Equation Modeling technique i.e. the confirmatory factor analysis (CFA) approach was employed to test the 6-factor hypothesized model of the value-vased productivity which consisted values of efficiency, collectiveness, non-exploitative, economy of scale, frugality, timeliness. The result of the CFA suggested that the 6-factor hypothesised model to be revised and yielded a 4-factor measurement model of productivity values. The revised CFA measurement model indicated fit statistics that are adequate with normed chi-square = 2.190, CFI = 0.990, TLI = 0.974. GFI = 0.969 and RMSEA = 0.080. In conclusion, the revised model fitted the data well and there is no proof that the 4-factor measurement model is incorrect. Implications of the study was significant to the university for empowering value-based productivity approach. This is vital in ensuring that university is gearing up for achieving total organisational excellence as emphasized in 1Malaysia concept – 'performance first' i.e. to prioritize the organisational achievement.

Keywords: *value-based productivity, efficiency, collectiveness, non-exploitative, economy of scale, frugality, timeliness and Value-Based Total Performance Excellence Model (VBTPEM)*

1.0 Introduction

According, Vrat et al. (2009), efforts to increase productivity started from business management. Most organizations fail to understand the meaning of productivity and in its implementation due to the organizational emphasis on the reduction of input and at the same time want to produce more output (Baines, 1997a). Technically, the productivity can be defined as a measure of the amount of output obtained from a certain amount of input (Mokhtar et al., 2003; Kapyla et al., 2010, Baines, 1997b; Sahay, 2005, Johnston & Jones, 2004; Vrat et al. , 2009). It can also be interpreted as the use of various resources or inputs in the organization to achieve the planned or desired results (outputs).

Factors affecting the productivity index should be understood (Baines, 1997a) and in the context of this study involves core values that support productivity that focused in the organization. Vrat et al. (2009) & Taiwo (2010) said that there were several factors that affect the productivity improvement such as human factors, organizational factors and technological product factors. In addition, Taiwo (2010) added that general factors contributing to the productivity level that involved geographic factors affecting the climate of raw materials, credit and fiscal policy, the appropriateness and adequacy of public utilities and infrastructure facilities. All these factors suggested are more more towards tangible factors alone. The need to measure the productivity of any organization is somewhat different to the measurement of productivity in the manufacturing sector that attracted the attention of many researchers (Sahay, 2005). Therefore, the purpose of this paper is to identify core values that best explained the organisational productivity.Also, to test the psychometric properties of the questionnaire used for measuring the value-based productivity in the selected organisation using confirmatory factor analysis (CFA) approach.

2.0 Review of Literature

Indeed, measuring the productivity can be complex (Baines, 1997b, Sahay, 2005, Johnston & Jones, 2004), but its importance in the organization cannot be denied (Baines, 1997b). There is a gap in the literature review that did not discuss the specific issues of values that support the productivity of the organization. Mainly focused on the definition of productivity and method of its execution only (Johnston & Jones, 2004) as measured by labor productivity, and capital gains only (Baines, 1997b). A study by Sahay (2005) in the service organization revealed the multi-factor productivity model which involved only static factors, dynamic and development parameters in calculating the overall productivity of the organization.Besides that, issues such as effective communication, involvement in decision-making and providing feedback is important in productivity (Baines, 1997). Literally, the amount of output produced in excess of the same amount of input is said to be having increased productivity. In short, the quality is associated with a service or product, but productivity is related to the size of the effectiveness of human resources in an organization. Omar (2010) also reiterated that productivity is more just and appropriate in evaluating the performance of services, as the issue of productivity assessment is given less attention in the services sector (Sahay, 2005, Johnston & Jones, 2004).

Thus, the factor of productivity refers to initiatives to improve the employees' productivity for organizations to function more productively. Use of information technology is one example of initiatives that lead to improved performance of employees within the organization (Mokhtar et al., 2003). The process of upgrading from time to time in all its aspects is necessary in the organizational transformation. (Sahay, 2005). This is also consistent with the Islamic notion that emphasizes the principles of achieving greater success (Mokhtar et al., 2003).A set of values are capable of causing the organization to function more efficiently by setting goals for the entire organization (Pratt & Kleiner, 1989). Achieving high productivity is the goal of each organization (Kleijnen et al., 2009). Organizational values are important in improving productivity (Pratt & Kleiner, 1989; Aqeel Akbar Husain & Khan, 2010). To improve productivity, it should be measured (Vrat et al., 2009) and in this context in terms of intangibles indicator of core values. Besides that, the ability to manage and coordinate the existing potentials in each individual employees can also increase productivity (Nik Mustapaha, 2003).

Many studies were conducted on values on different context and separate issues. From the arbitrary findings, to the extent of the reseacher's knowledge, we did not come across to list of the specific values that are assigned for productivity that are common for organisations. Hence, this article tried to specify the specific core values for this reason as ample of research only address the values in the specific issues and not really meant for performance measurement. We have come to arrive at 6 core values that are relevant to be embedded with the productivity values in the organisation. As a result from a thorough discussion with expert panel in the field we specify *efficiency*, *collectiveness*, *non-exploitative*, *economy of scale*, *frugality* and *timeliness* to represent the productivity values. These 6 core values are deemed appropriate to represent value-based productivity in the organisation of the Malaysian context. Although, there might seemed some reservations to most reseachers on this specification of values, this effort is of great importance on realising value-based productivity in the organisation for achieving organisational excellence. Along with this, we offer operational definition for each core values that we have specified in order to give a clear definition of what the specified core values meant to measure. In short, the following Table 1 derives the core values that are deemed appropriate beneath the criteria of productivity with the corresponding value-based indicators or operational definition.

Table 1. Core values of culture and value-based indicators

Core values	**Value-based Indicators**
Efficiency	The degree of using the available resources without relying on external resources.
Collectiveness	The degree of cares cares about the productivity achievement at all levels and performing tasks in a collective manner.
Non-exploitative	The degree to which rights and welfare of the staff are not ignored and reward/incentives are given with the effort/work done.
Economy of scale	The degree to which the University carries out various efforts to increase the number of quality graduates and number of academic and scholarly activities.
Frugality	The degree of which various campaigns carried out to pay attention on the operational cost saving and incentive/reward is given to individual/division/ faculty who demonstrate cost-saving effort.
Timeliness	The degree of academic system in the University that ensures all students can complete their studies within the stipulated period and regular monitoring system is in place in a timely manner.

3.0 Methodology

In VBTPEM, it incorporates a well-defined set of organisational core values in each of the performance criteria *(see Nooreha et al., 2001 & Fazli et al., 2003)*. The role of the core values as the dominant belief that specify what is important to (cherished by) individual, group or organisation. In addition, core values create a cultural glue or bond within the organisation. Besides that, it forms a uniform or consistent behaviour among people as desired by the organisation and on top of that, it creates a true identity for the people in the organisation (Mokhtar et al., 2003). The issue that arises here probably on the measurement aspects of core values. Core values are the abstractions whose measnings are imprecise i.e. that cannot be measured exactly and vary considerably among people (i.e. subjective). It is considered as theoretical concepts or constructs. However, in order to measure, we need some measurement process in place.

Therefore, we must quantify values in such a way that it could produce some statistical indicators for analysis. Mokhtar et al., (2008) defined the statistical indicators as a label, concept, term or name representing the set of operations defining how the measurement was or would be undertaken. It could be either quantitative or qualitative. Thus, the core values would be translated into statistical indicators and measurement via questionnaires by referring to the operational definition as in Table 1. Hence, in this part, the researcher discussed the sampling technique, instrumentation and the data screening procedure before proceeding to the confirmatory factor analysis (CFA) technique in testing the hypothesized model.

3.1Sampling

This study employed simple random sampling method to staff at the selected university which consists of academic and non-academic staff across 26 departments and faculties. This is also referred as convenient sampling procedure and in general, 519 questionnaires were distributed to about 1500 staff and the researcher managed to obtain 210 questionnaires only. This accounted for 40% of response rate which is considerably accepted for the purpose of this study. The number of questionnaires distributed was believed to be representative to the total population at the selected university as based on Krejcie and Morgan table (1970).

3.2 Instrument

The instrument was developed in a focus group through a thorough discussion with the expert panel from ADMACS Consultancy (M) Sdn. Bhd., a prominent consultant in the field of organisational performance measurement and several lecturers who directly involved in this study from the Center of Modeling and Data Analysis, Center for Mathematical Sciences, Faculty of Science and Technology, National University of Malaysia. Several meeting had been conducted to come out with the questionnaire so as to produce a good quality items based on the framework of Value-Based Total Performance Excellence Model (VBTPEM). The original instrument was written in dual languages which were Malay Language and English Language. Both languages were used in order to accommodate the respondents who were not Malaysian such as foreign lecturer that are currently working in the selected university. This instrument focused on the culture values revolved around an organisation that should be incorporated and internalised as discussed in the literature part. It consisted of 12 items from 6 core values and this means every core values consists of 2 corresponding items each. The core values of cultures which were identified were *efficiency*, *collectiveness*, *non-exploitative*, *economy of scale*, *frugality* and *timeliness*. The data obtained was keyed in the Predictive Analytics SoftWare (PASW) version 18.

3.3 Data Screening and Analysis

The 210 dataset are coded and saved into PASW and analyzed using AMOS version 18. During the process of data screening for outliers, 22 dataset are deleted due to Mahalanobis distance values more than the $\chi 2$ value (χ^2=42.31; n=12, p<0.001) leaving a final 188 dataset to be analyzed. Several statistical validity tests and analysis are then conducted such as reliability test and validity tests using confirmatory factor analysis (CFA) for construct validity and discriminant validity for multicollinearity treatment, composite reliability, and average variance extracted, testing the fit for the hypothesized CFA model and the revised model.

3.3 Assessing validity and reliability

Hair et al. (2010) defined reliability as an assessment of the degree of consistency between multiple measurements of a variable. This study assesses the consistency of the entire scale with Cronbach's alpha and its overall reliability of each factor of productivity values. All values yielded alpha coefficient exceeded the values of 0.70 suggested by (Hair et al., 2006). *(See Table 2)*. From this result of Cronbach's alpha coefficient value, this questionnaire was accepted and admissible. In short, it proved to be reliable. In order to validate the instrument, this study also considered construct validation using analysis of moment structures software (AMOS) with maximum likelihood (ML) to analyse the data.

This approach is called as confirmatory factor analysis which is more advanced as the hypothesized are based on the underpinning theory (Hair et al., 2010) as discussed in the next section. Table 2 also shows the mean and standard deviation scores of the items. Despite high standard deviation, the results show that the respondents agree that the core values are important for organisational productivity values.

Table 2. Internal Consistency of the constructs

Construct	Mean	SD	Cronbach's alpha
Efficiency			
• Available resources are sufficient to carry out planned activities without relying on external resources.	6.49	1.83	0.79
• The university gives priority to teaching and learning processes that will increase the number of quality graduates.	7.33	1.62	
Collectiveness			
• University cares about the productivity achievement at all levels.	7.21	1.59	0.89
• Performing tasks in a collective manner has become a norm in this university to ensure maximum productivity.	7.22	1.49	
Non-exploitative			
• The rights and the welfare of the staff are not ignored although the management stresses the need for increased efficiency.	6.98	1.62	0.91
• The management provides reward/incentives that commensurate with the effort / work demonstrated by highly efficient staff.	6.84	1.74	
Economy of Scale			
• University carries out various efforts to increase the number of quality graduates without incurring additional highly cost /expenses.	7.09	1.74	0.80
• University stresses that the number of academic and scholarly activities (e.g. research and publication) are considered meaningful if they generate quality output and at reasonable cost.	7.22	1.32	
Frugality			
• Various campaigns carried out by the University to make the staff realize the need to pay attention on the operational cost saving measures at various levels.	6.79	1.63	0.81
• The management gives incentive/reward to any individual/division/ faculty who successfully demonstrate their operational cost saving.	6.11	2.10	
Timeliness			
• The academic system in the University ensures all students can complete their studies within the stipulated period.	6.98	1.54	0.91
• Regular monitoring system is in place to ensure that academic activities (e.g. research) are completed in a timely manner.	6.97	1.54	

4.0 Confirmatory Factor Analysis (CFA)

In this study, confirmatory factor analysis was used to determine the construct validity of the survey items. It means how well is the construct explained the variables under the construct (Hair et al., 2010). In other words, whenever the correlation of the items within the same construct is relatively high it is said to have the construct validity. Also, the factor loading or the regression weight and the squared multiple correlations (SMC) of the items are significantly correlated to the specified construct would also contribute to the construct validity comprehension.

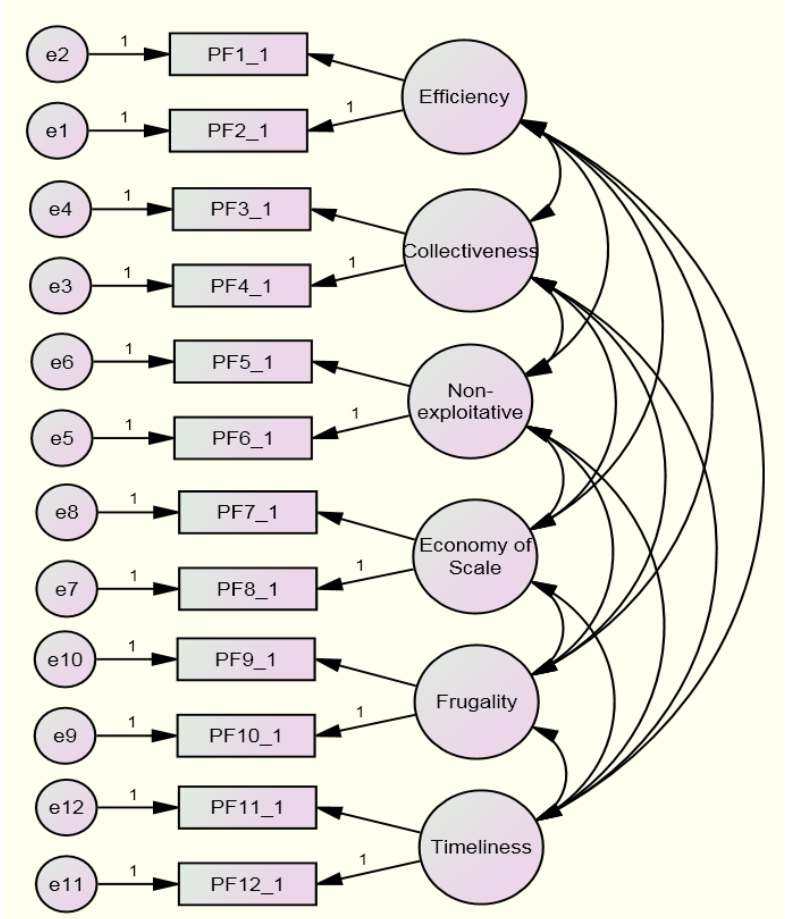

Figure 2: Hypothesized model of factorial structure for productivity values

4.1 The hypothesized model and modeling strategy

The CFA model of productivity values hypothesizes a priori that the responses to the items in the questionnaire can be explained by 6 factors, in this case values i.e. *efficiency*, *collectiveness*, *non-exploitative*, *economy of scale*, *frugality* and *timeliness*. Secondly, each item has a nonzero loading on the culture values it was designed to measure and zero loadings on all other factors (values). Thirdly, all six values are correlated and the error/uniqueness terms associated with the item measurements are uncorrelated. A schematics representation of this model is shown in Figure 2.

Hair et al. (2010) stressed 3 distinct types of modeling strategy i.e. confirmatory modeling strategy, competing models strategy and model development strategy. Each of these three represents a bit different approach in modeling. The confirmatory approach is the most straightforward strategy as the name implies the confirmatory approach that the researcher specifies a single model composed of a set of relationships and apply SEM to assess the model adequacy. In other words, to find support whether the model fits the data. Secondly, competing models strategy revolves around testing several models i.e. the alternative models through overall model comparisons. The asessment of all models would yield the best model that could represent the data collected which is much stronger than a test of a single model alone. The last one is the model development strategy that begins with the basic model framework and following the adequacy and reasonableness of improving the framework through modifications of the structural or the measurement models. It starts with model that is built based on theoretical judgement that will be empirically tested using SEM. Following this, the model can be modified based on the reseacher's judgement or suggestion given by the modeling software used and this re-specification must also be theoretically viable. In this study, the model development strategy was employed.

5.0 Analysis of Data

From the initial findings of CFA in Figure 2, the hypothesized model yielded many offending estimates. The offending estimates occur for the inter-factor correlation and the regression weight which should be in the range of 0 and 1. This resulted in a non-fit model of single order measurement model of productivity values. Therefore, careful checking is done to the model by deleting the values that are of offending estimates.

Henceforth, the following is the re-specified model after the estimation using Maximum Likelihood is conducted

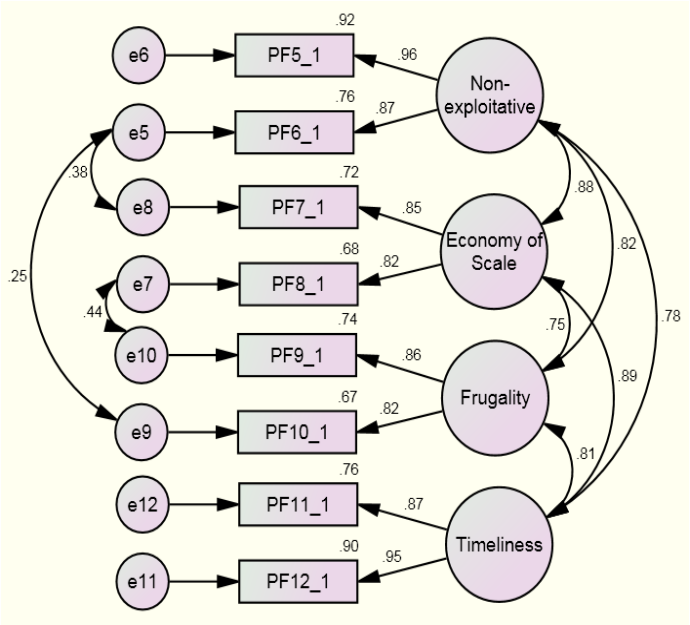

Figure 3. Respecified Model 1 of Productivity Values

From the confirmatory factor analysis result in Table 4, we observed that the factor loadings of all observed variables or items are adequate ranging from 0.82 to 0.96. The factor loadings or regression weight estimates of latent to observed variable should be above 0.50 (Hair et al, 2006; Byrne, 2010). This indicates that all of the constructs conform to the construct validity test which means that all items belonged to the specified core values. In addition to this, the item that best explained the construct is the items that have higher loadings on the same construct. Besides that, the correlations among the constructs could be well accepted but however the correlation betwwen the values of *non-exploitative* with *economy of scale* and *economy of scale* with timeliness were found to be greater than 0.85. This cautions the reseacher to proceed with the analysis cautiously. Next, in order to differentiate between the constructs, further test is conducted i.e. the discriminant validity as discussed in the next section.

5.2 Bayesian Confirmatory Factor Analysis (CFA)

Byrne (2010) argued that Maximum Likelihood (ML) estimation of Likert-scale items produces negligible effects of non-normal non-continuos data whenever each variable/item has at least 5 categories of response and large sample size. However, severe effects of non-normal non-continuos data occur whenever each variable has 4 or less categories of responses and smal sample size which is less than 200. Under this condition, this study could only use 147 questionnaire for analysis and therefore, Bayesian estimation is recommended for re-affirming the previously conducted CFA (Arbuckle, 2009) in section 5.1. The Bayesian CFA analysis was conducted in AMOS software to estimate the unstandardised weights produced by this analysis with the unstandardised loading obtained in the CFA using Maximum Likelihood procedure. The results of the comparative analysis is shown in the following table.

Table 8. Comparative Analysis (Maximum Likelihood and Bayesian Estimation)

Loading	ML	Bayesian
Non-exploitative > PF5_1	1.029	1.024
Non-exploitative > PF6_1	1.000	-
Economy of scale > PF7_1	1.354	1.352
Economy of scale > PF8_1	1.000	-
Frugality > PF9_1	0.819	0.812
Frugality > PF10_1	1.000	-
Timeliness > PF11_1	0.912	0.910
Timeliness > PF12_1	1.000	-

From the results, we can see only a small difference exist between the loadings generated from ML estimation and Bayesian estimation. This gives evidence that the CFA using ML estimation in this study is acceptable and re-specified model fits the data.

5.2 Discriminant validity of constructs

Table 5 shows the result of the calculated variance extracted (VE) to support discriminant validity of constructs. Average variance extracted (AVE) is the average VE values of two constructs (Table 6). According to Fornell and Larcker (1981), average variance extracted (AVE) should be more than the correlation squared of two constructs to support discriminant validity (compare Table 6 and Table 7).

Table 5. Variance extracted of variables

Latent Construct	Observed variable	Std loading	SMC=R^2	error	CR	VE
Non-exploitative	PF5_1	0.958	0.918	0.082	0.911	0.836
	PF6_1	0.869	0.755	0.245		
Economy of scale	PF7_1	0.846	0.716	0.284	0.822	0.697
	PF8_1	0.824	0.679	0.321		
Frugality	PF9_1	0.863	0.745	0.255	0.830	0.710
	PF10_1	0.822	0.676	0.324		
Timeliness	PF11_1	0.871	0.759	0.241	0.907	0.831
	PF12_1	0.950	0.903	0.098		

Note: CR is Composite Reliability, VE is Variance Extracted

Table 6. Average variance extracted (AVE) matrix of exogenous variables

Construct	1	2	3	4
Non-exploitative (1)	1.00			
Economy of scale (2)	0.7665	1.00		
Frugality (3)	0.7730	0.7035	1.00	
Timeliness (4)	0.8335	0.7640	0.7705	1.00

Table 7. Correlation and correlation square matrix among constructs

Construct	1	2	3	4
Non-exploitative (1)	1.00			
Economy of scale (2)	0.879 (0.773)	1.00		
Frugality (3)	0.821 (0.674)	0.755 (0.570)	1.00	
Timeliness (4)	0.784 (0.615)	0.893 (0.797)	0.811 (0.658)	1.00

Note: Correlation is significant at 0.01 level (2-tailed), values in brackets indicate correlation squared.

Each AVE value is found to be more than the correlation square except for the correlation square of *non-exploitative* with *economy of scale* and *economy of scale* with *timeliness* which is higher than the AVE value and the difference is 0.0065 and 0.033. since the difference is too small and upon reseacher's discretion the we conclude that exist discriminant validity between the remaining constructs.

6.0 Discussions & Conclusions

The re-specified CFA model as in Figure 3 showed the results of the four factor CFA model of productivity values. The fit indices yielded a *p*-value = 0.012, normed chi-square = 2.190, CFI = 0.990, TLI = 0.974. GFI = 0.969 and RMSEA = 0.080. All fit indices are more than adequate to conclude that there is no proof to say that this re-specified CFA model is incorrect. In other words, it indicated that the model fits the data or there was no significant difference between the revised model and the observed model after re-specification or adjustment on the initial hypothesized CFA model after taking into consideration of the modification indices (MI) and several rules of thumbs in confirmatory factor analysis (CFA) approach. The loadings range was from 0.55 to 0.98 and succinctly the convergent validity for productivity values is also supported.

As a result of discussion, goodness of fit index results suggest that the proposed model did generate the observed covariance matrix. Simply said, the four-dimension productivity values fit the university value-based productivity of CFA model. From the overall re-specified model, we can simply say that the university productivity must focus these core values in order to bring the organisation especially the university for accelerated excellence.

Similarly, the value of RMSEA marks insignificant discrepancies between the observed covariance and implied matrices and thereby supporting the degree of fit. One purpose of the study was to validate the values for culture criteria as in VBTPEM framework as suggested by Mokhtar et al. (2003). This study offered evidence to those four-dimensions of CFA model that did generate the data collected from the university's staff in one of the university in east coast of Malaysia. Implicitly, this study hinted at earlier works that the values are important in driving the organisation towards excellence (Mokhtar et al., 2003; Mokhtar et al., 2008).

Clearly, the results of this study are relevant to theorists and practitioners such as university management to embrace the value-based productivity in the organisation. As this is important as stressed by Selznick (1957) that if an organisation wants to be institutionalised it must be infused with values. In addition, the instrument developed in this study can be used to measure the intangibles aspects of productivity values since the instrument is proven to be psychometrically sound against the 4 values of *non-exploitative*, *economy of scale*, *frugality* and *timeliness*. The results did not establish doubts to claim that this productivity values model is incorrect even in a different university. The findings could possibly pave the way forward for empowering value-based productivity especially at the Institution of Higher Learning (IHL) especially in Malaysia.

However, there were limitations that should be cautioned in conducting this research. The study only used one organisation. i.e. one university in east coast of Malaysia. Thus, generalisation could not be done and future research could expand this to a few universities in Malaysia to make it generalisable. Besides that, it could also concentrate on a second order model of culture values by using CFA analysis. Also, future researcher may also retest the productivity values as suggested by the hypothesized model as in Figure 1 that originally consists of core values of productivity in other sector such as in business organisation etc. Future research could also use partial least squares (PLS) for this purpose besides using structural equation modeling (SEM) procedure. In a nutshell, the survey items is beneficial in measuring the productivity values for university performance based on the VBTPEM framework as the endeavour for achieving success is greatly encouraged. That is why productivity are very important as this would bring the organisation to achieve the competetive advantage.

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