A Structural Equation Model for the Study of Sustainable Performance by Private Universities in Malaysia

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Abstract **- This empirical study employed structural equation modeling (SEM) to investigate the impact of sustainable practices on sustainable performance of higher education institutions. Firstly, the sustainable performance survey is designed to investigate its main influencing factors among the pool of constructs includes; economic, environment, social and top management support factors. Secondly, based on the SEM, the levels of sustainable performance of the universities are quantified in accordance with factors. The findings were supported by empirical evidence, as the study established that only economic and environment factors have significant positive relationship and impact sustainability performance. This paper provides a greater understanding of the interactions between key elements of sustainable practices associated with university performance provision.**

Keywords: *SEM, Sustainability, sustainable performance, higher education, education SCM.*

1.0. Introduction

The use of Structural Equation Modeling (SEM) in research has increased in various field of disciplines and becoming of greater interest among social science studies [1]. Scholars of logistics and supply chain management network were attracted by this versatile modeling tool. SEM is an extension of the general linear model (GLM) that enables a researcher to test a set of regression equation simultaneously. It is a technique used for specifying and assessing models of linear relationship among variables [2]. Structural Equation Modeling (SEM) is a powerful collection of multivariate analysis techniques, which specifies the relationships between variables through the use of two main sets of equation thus measurement equations and structural equations [3]. The measurement model defines the relationships between observed variables and latent (unobserved) variables. The latent variables are hypnotized to be measured within the measurement model. Further, the measurement model allows the researcher to evaluate how well the observed variables associate to identify the underlying hypothesized constructs through confirmatory factor analysis (CFA) [4]. On the other hand structural model deals with the nature and magnitude of the interrelationships among constructs [2]. This is the interrelationship between the latent variables which are hypnotized to be measured. SEM includes four phase [5]: However, to serve the study purpose, EFA is not included in the current research.

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- Estimation of Exploratory Factor Analysis (EFA) to allow the researcher greater precision in determining potential problems with the measurement model;
- Testing of the confirmatory factor analysis (CFA);
- Simultaneous testing of the measurement and structural equations model and;
- Finally testing of preceding hypotheses on specified parameters.

In this study SEM incorporates AMOS 23 software to extant its graphical model presentation. Recently a great number of researchers employed AMOS graphic to model and analyze research problems in their field such as medical, tourism, logistics, social science and education [6], [7]. Among them, engagement of AMOS in educational research has become a necessity. Ref [8], [9], introduced researchers in education to the application of SEM with Amos. According to ref [6], Amos graphic could be engaged in modeling and evaluating the role of educational institutions to evaluate the influence of infrastructure facilities, academic facilities, program schedule, students' performance, students' satisfaction and overall universities performance more effectively.

The SEM technique carries several advantages such as; the ability to estimate multiple and interrelated dependence relationships; characterize unobserved conceptions in relationships; and its capability to correct measurement errors in estimation processes. It is also capable of identifying a model by describing the whole set of relationships, [10]. This research paper aims at contributing essential knowledge of the SEM approach in data analysis, unveiling its attributes, application and importance in supply chain management through sustainable practices in private universities in Malaysia.

2.0. Literature Review

2.1. Sustainable practices and performance

Sustainability is synonymous with sustainable performance. It is a process of steering the company towards its goals. Sustainability has become an important issue for universities worldwide. Ref [11], defines sustainability as a business approach that creates long-term shareholder value by embracing opportunities and managing risks deriving from economic, environmental and social developments. In recent years, sustainability has turned into the central part of the corporate social responsibility plan [12]. It is realized that sustainability is a social ideal and business necessity. Being sustainable is a source of competitive advantage and a matter of business survival. University shareholders and CEOs embrace sustainability as their main concern in their mission and vision statements. Ref. [13], points out that, recently there has been a wave of interest in sustainability by senior managers and interested organizational stakeholders. There is also a growing awareness in society and the business community of the need for sustainable organizations.

Ref [30], believes that a firm's sustainable performance is a multi-dimensional concept which is not directly assessable and necessitates a set of indicators to be evaluated. Thus, this study introduces sustainable practices which are commonly employed in organizations. Sustainable (principles) practices are defined as a set of ideas labored to organize and accomplish sustainability in organizations. In the previous literature, "Triple Bottom Line" approach which comprises of economic, environment and social aspects were regarded as factors that determine the sustainable performance of an organization, [14]. However, the current study has revised the parameters by incorporating top management support in the

sustainability dimension. Literature on sustainability studies have also highlighted economic, environment, social and top management involvement [15], as vital indicators influencing universities performance. The identified constructs were further measured for their significance levels through rigorous statistical analysis.

The reputation of a University's sustainable performance is usually composed and analyzed based on secondary or survey data. Thus this information provides supportive evidence for managers and decision-makers to allocate capital resources logically when their planning is activated for controlling universities performance. These responses may be compressed in a distinct measure, named as sustainability performance index and it is critical to detect the indicators that could impact it [16].

The study further recommends that private universities initiate their quest towards sustainability as early as possible in a convenient manner by implementing sustainable practices internally which are easier to move in the short run and extend the initiatives externally through the university's entire supply chain in the long run. Naturally supply chain management and sustainability concepts are correlated and always work together to harvest optimum results. In the current sustainability study the researcher incorporates integrated SCM network concepts to reach sustainability performance. In fact it is an efficient and effective move to achieve competitive advantage among competitors. As noted by ref [17], the major transformation in the paradigm of the contemporary business environment is that individual businesses may no longer compete solely as self-governing entities, but rather as supply chain networks to achieve maximum performance. In line with this statement, a research framework (Figure 1) has been established based on the Integrated Tertiary Education Supply Chain Management Model for Universities Sustainable Performance [18].

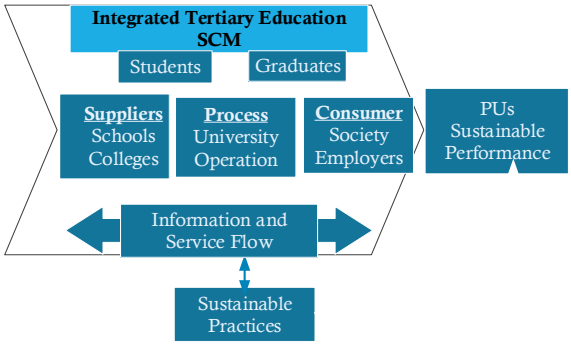

Figure 1: Integrated Tertiary Education Supply Chain Management Model for Universities Sustainable Performance

The objective of this research was to investigate the level of influence sustainable practices had on sustainable performance of PUs in Malaysia. This study further used SEM to examine causal relationships among dimensions of sustainable practices and sustainable performance. The results of this study will help universities identify factors that contribute the most to performance. Therefore based on the literature and the objectives the following hypotheses were proposed.

H1- Social factor has significant impact on sustainable performance of PUs

H2- Economic factor has significant impact on sustainable performance of PUs

H3- Environment factor has significant impact on sustainable performance of PUs

H4- Top management support factor has significant impact on sustainable performance of PUs

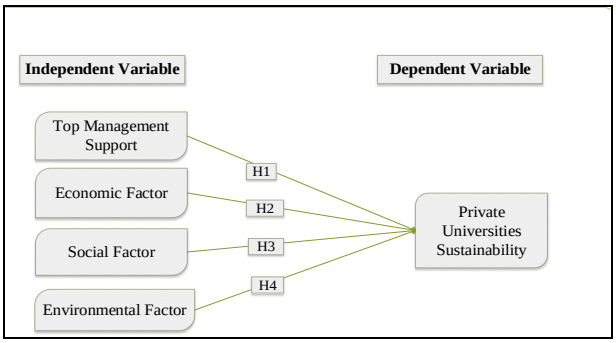

Figure 2: Conceptual Model and Hypothetical Path

3.0. Methodology

A set of questionnaire was developed for this study centered on the comprehensive literature on supply chain management theory based on sustainable practices and performance of private universities of Malaysia (Refer Appendix A). This was to set a measurement standard to construct the structural model for a fit. All the items in the questionnaire were identified with identification codes namely TMS1, TMS2, TMS3, TMS4, TMS5 and TMS6 for the Top Management Support factor. These exclusive codes were designed to ease the process of the structural model design in the confirmatory factor analysis (CFA) [3]. Each of these observed variables were linked to the latent variable. Moreover, SEM involves four stages thus, model specification, model estimation, model evaluation, and model modification. The analysis was carried out by using AMOS23, [3]. In the first stage (specification), the model had to be developed and tested. In the second stage (estimation), parameter estimation and model fit function were executed [2]. In the evaluation stage, the processes of evaluating a structural equation model with goodness of fit indices were executed. In the modification stage, adjustments had to be made to the model in order to fit the sample data, [19]. Various indicator indices had to be agreed upon among the researches to measure the fitness of the model [20]. Thus, the mode of theory testing appears to be justifiable as long as it can be safely assumed that the theoretical and empirical fits are perfectly matched. The better the empirical fit the better the significance of the parameter estimates in the theoretical model [3]. Besides that, modification indices in combination with theoretical considerations provided the basis for improvement of the original model in this study.

For this research, data analysis was carried out in accordance with a two stage methodology offered by ref [21]. Firstly, CFA was used to assess the adequateness of the measurement model. Secondly, structural equation modeling was conducted to confirm the structural model.

3.1. Structural Equation Modeling (SEM)

Structural Equation Modeling (SEM) is considered as one of the key techniques of data analysis that attracts researchers through different disciplines, more popularly in the social sciences [2]. Structural equation modeling stands on two important elements: First, the causal processes which are characterized by a series of structural (regression) equations between latent variables and indicators conducted through confirmatory factor analysis (CFA). CFA is a vital part for the measurement model in SEM as it is employed to attain the satisfactory model fit before modeling the structural model. Second, these structural equations (relations) allow a clearer conceptualization of the theory of the study [2]. Indeed, the current study used structural equation modeling not only to test the causal relationships between the research variables [3], but also to test whether the structural model (paths of the causal structure) of universities to identify the significant factors (practices) contributed to the sustainable performance of universities. Moreover, SEM is employed to analyze the multiple and interrelated relationships among the constructs for model construction, [2], [10], [3].

In fact, this is one of the only analyses that allow a comprehensive and simultaneous test of all relationships for a complex and multidimensional phenomenon, [10]. SEM permits a dependent variable in one equation to become an independent variable in another. Furthermore, SEM allows the representation of latent variables in the relationships between variables, while being concerned with the estimated measurement error associated with the inaccurate measurement of variables [20].

3.2. Model Fit

Model fit measures (Table 1), could be obtained to assess how well the proposed model captures the covariance between all the measures (items) in the model. At this stage, all redundant items which exist in the latent constructs should be removed. Factor loadings must achieve absolute, incremental and parsimonious fitness indexes to the acceptance level. The accepted fitness indices estimation is as follows [2].

Table 1: Suggested cut-off values for SEM fit indices

Fit Index	Cut-off Values	References
Absolute fit Measures:		
Chi-square/df	≤5.0 ≤	
SRMR	≤.0.08: ≤.05	
RMSEA	≤0.08	
Incremental fit Measures:		[3], [2], [28],
NFI	≥ .90	[29], [20].
CFI	≥ .90	
TLI	≥ .90	
Parsimonious fit Measures		
PCFI	>0.5	
PNF	>0.5	

Source: Adapted and Adopted from Hair et al., 2013.

3.3. Validity Analysis

3.2.1. Convergent Validity

Convergent validity is defined as the extent to which a specified set of indicators for a construct converge or share a high proportion of variance in common [22]. Convergent validity can be measured by using confirmatory factor analysis (CFA) by three main standards [23]. First, the factor loadings should be greater than 0.6 or higher and ideally 0.7 or higher; second, composite reliability should be above 0.7 and ideally 0.8 or higher. Third, average variance extracted (AVE) must be above the cut-off- value of 0.5 or greater to propose adequate convergent validity [2].

3.2.2. Discriminant validity

Discriminant validity is a measure, the degree to which scores on constructs do not correlate with other, which are not designed to assess the same variable [23]. Exogenous (latent) constructs must be independent to each other, in which, the correlation between them should not exceed 0.85 in order to achieve discriminant validity of the construct [22]. If the correlations are greater than 0.85, one of the highly correlated constructs must be removed or else multi-collinearity will exist as a problem.

4.0. Analysis and Results

4.1. Assessment of the Measurement Model

All the constructs predicting sustainable performance were measured through confirmatory factor analysis (CFA). As shown in Figure 3, the modified model was tested with four sustainable practice constructs. There were four indicators measuring the economic factor (ECF1, EFC2, ECF3, ECF5), four items measuring top management support (TMS1, TMS2, TMS3, TMS6), four indicators measuring the social factor (SF1, SF3, SF4, SF6) and four indicators measuring the environment factor (EN2, EN3, EN4, EN5). The standardized estimated loadings for these

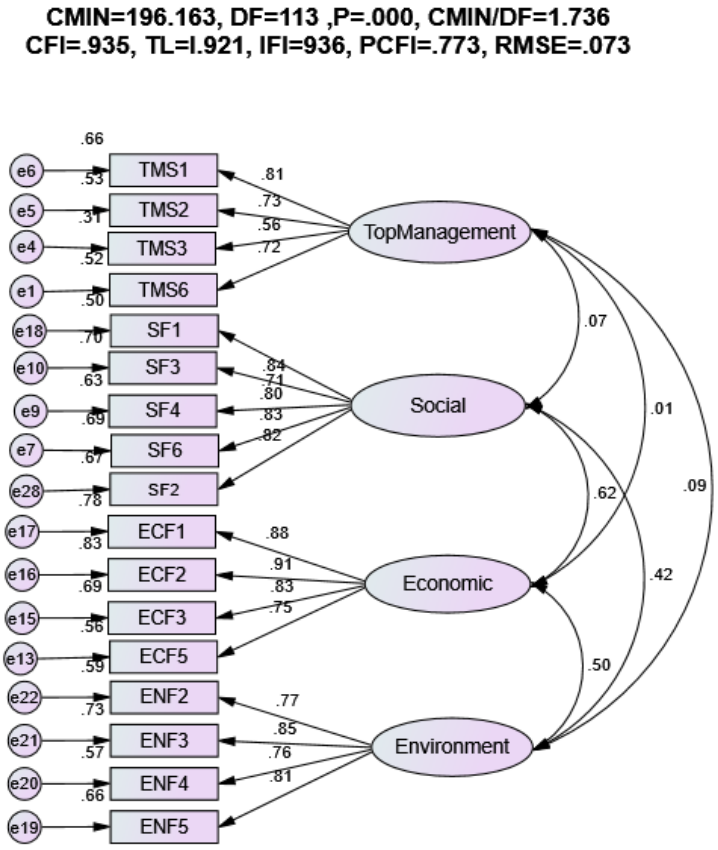

Figure 3: A CFA Measurement Model of Sustainable Practices

Table 2: Structural Model Fit Results for Category 'A' Universities

MODEL	CMIN	DF	P	CMIN/DF	IFI	TLI	CFI	RMSEA
Default Model	196.163	113	.000	1.736	.936	.921	.935	.076
Saturated Model	.000	0		0	1.000	1.000	1.000	
Independence Model	1409.716	136	.000	10.366	.000	.000	.000	.269

measures were reasonably good and higher than the suggested level of .60 (Figure 3). These specify that the standardized parameter estimates for these measures were statistically significant (P<0.001).

CFA was successfully performed by removing all redundant items. As the goodness of fit indices were improved, the modified model showed a better fit to the data ($x2$ = 196.163, df = 113, P = .000, N = 130). The IFI = .936, CFI = .935, TLI = .921, RMSEA = .076, and $x2$ /df = 1.736. Even though the chi-square was still significant, these values suggested that the model fitted the data adequately. As discussed before, it is commonly accepted that the chi-square estimate would potentially reject valid models when sample size is large [24]. Confirming that the model fitted the data adequately and the correlations between the underlying factors were less than 0.85 (see the values on the double-headed arrows in Figure 3), hence no further adjustments were necessary.

Table 3: Discriminant and Convergent Validity for Sustainable Practices

	AVE	TMS	Social	Econ	Env
TMS	0.51	**0.26**			
Social	0.64	0.05	**0.41**		
Econ	0.71	0.3	0.18	**0.51**	
Env	0.64	0.20	0.08	0.38	**0.41**

The discriminant and convergent validity table above proves the validity of SEM in this study. Accordingly [22], convergent validity is achieved when AVE estimates are greater than the constructs correlations, while discriminant validity is achieved when the square root of AVE estimates are greater than the constructs correlations [22], [23]. The bold diagonal values in Table 3, are square root of AVE's while other values are the correlation of constructs. In this way the convergent and discriminant validity of the constructs were achieved.

4.2. Assessments of the Proposed Structural Model

4.2.1. Structural Model and Hypothesis Testing

Subsequently, the structural model which was the second stage and last step of the SEM, was executed. The corresponding hypotheses of the research model were analyzed by employing SEM. The evaluation of the hypothesized structural model was led by analyzing the hypothesized model, which specified the four casual relationships in Table 1. In the path diagram offered in Figure 3, the exogenous constructs consisting of the four variables, social, economic, environment and top management support factors with-single headed arrows pointing toward them were displayed. A basic assumption of SEM is that the exogenous variables must be correlated. The underlying reason is that the exogenous constructs correlation must be estimated, although no correlations are hypothesized in the analysis, [2], [25]. As shown in Table 5, all fit indices were greater than the corresponding suggested values, recommended by the goodness of fit for the model.

The structural model results (Figure 4; Table 5) show that this empirical study had achieved a stable fit model. The fit statistics of the proposed hypothetical research model were as follows; (x2 = 276.136, df = 177, P = .000, *N* = 130). The IFI = .941, CFI = .940, TLI = .928, RMSEA = .066, and *x*2 /df = 1.560. Overall, all fit indices were within the recommended levels as suggested by the model fit [2]. The structural equation model was analyzed further to test the hypotheses of this study to find the significance level of each path.

The results of hypotheses test are presented in Table 6, below. The path results show significant paths and significant levels of sustainable practices towards sustainable performance. Out of the four paths, two paths were found to be significant. They were economic and environment ($p < .05$). Social and top management support factors were insignificant.

Table 4: Squared Multiple Correlations (R^2)

Endogenous Variable	R^2
Sustainable Performance	.432

Further, Table 4, shows R^2 estimates for the structural model for sustainable performance. R^2 for sustainable performance showed an estimate of 0.432. Thus, 43.2% of the variance in sustainable performance was explained by the independent variables. Even though the R^2 was low, it was still within the acceptable level [25].

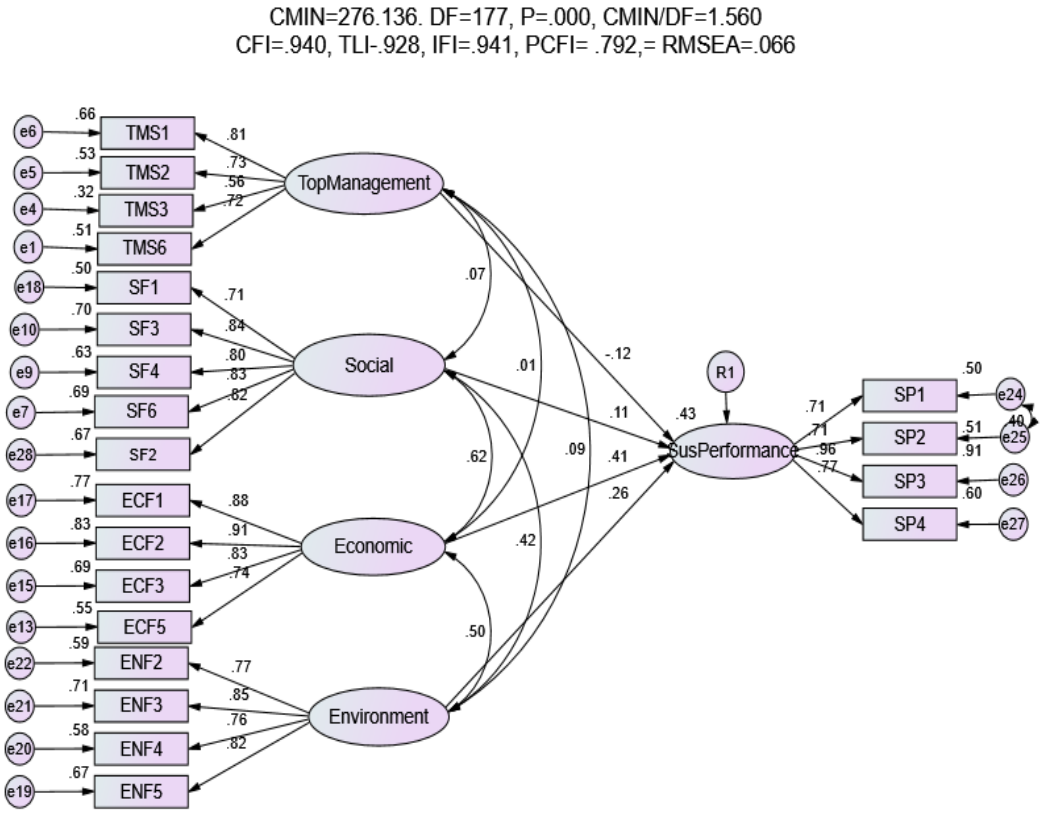

Figure 4: Structural Model of Sustainable Performance

Table 5: Structural Model Fit Results

MODEL	CMIN	DF	P	CMIN/DF	IFI	TLI	CFI	RMSEA
Default Model	276.136	177	.000	1.560	.941	.928	.940	.066
Saturated Model	.000	0		0	1.000	1.000	1.000	
Independence Model	1850.450	2100	.000	8.812	.000	.000	.000	.246

Table 6: Testing Hypotheses Using Standardized Estimates (Hypothesized Model for Sustainable Performance of PUs)

Hypothetical paths			Estimates	S.E.	C.R.	P
Sus Performance	<---	Top Management	-0.202	0.142	-1.421	0.155
Sus Performance	<---	Social	0.100	0.099	1.016	0.310
Sus Performance	<---	Economic	0.432	0.124	3.481	***
Sus Performance	<---	Environment	0.287	0.110	2.615	0.009

*p<0.10, **p<0.05, ***p<0.001.

5.0 Discussion

The primary aim of this paper was to answer the research objectives and to identify the significant hypothetical paths. Above all, the study was highlighting the ability of SEM procedures to generate an accurate and precise estimation in making predictions. The outcome obtained from the results proved that the strength of SEM to do a simultaneous test and the ability to determine the significance relationships between the observed variables and the respective latent variable was evident [26].

The results of the analysis construed that meaningful and differential effects exist in the universities sustainable performance. The test results provided support for the proposed relationships among the model's variables as well as a valuable understanding through which practices influence sustainability. It confirmed the existence of a very strong relationship between economic and environmental factors towards sustainable performance (refer table 6). However, social factor and top management support factor were not influence universities performance. These results contradicted the study by ref [31], [32], where the study pointed out that top management had played an important role in improving organizational outcomes.

The final structural model posed a number of implications for research and practices. First, the study proposed and tested a structural equation model that examined the interdependent relationships between sustainable practices associated with sustainable performance. This extended the knowledge contributed by previous studies on the application of SEM to research. Second, the findings confirmed the existence of relationships among practices and highlighted the importance of key constructs which may help in further studies in the field of sustainability.

The findings also have implications for university practitioners and decision makers particularly in Malaysian Private Universities. It also stressed that higher education industries were highly competitive with hundreds of private universities in the region, and sustainability issues have become inevitable in the framing of mission statements for most of them. In order to sustain among the rivals and do the check and balance in terms of their performance, an intensified and comprehensive analysis among universities was timely. The current empirical research magnifies the body of knowledge that revolves around sustainable performance of higher education by providing a better sense of understanding and the current state of university performance.

The limitations of the study are, there is a possibility of bias frolicking in the final outcome of this study due to the fact that data collected was based mainly on perceptions of administrative staff and practitioners in private universities of Malaysia. In a nutshell, to establish networking and collaboration with other universities to partner on the national level and at the international level, universities require a supply chain network to support sustainability in the long run. The bottom line of the study is that sustainability initiatives are necessary for universities to distinguish themselves from their contenders, reduce cost, and improve education standards and service quality.

6.0 Conclusion

So much of efforts have been made in this paper to explain what SEM is and its application in social science research especially sustainability aspects with examples. It is evidence that SEM can be of advantage

in sustainability concern research by allowing for morecomplex research questions and test multivariate models in a single study. The use of SEM involves the interaction of statistical procedures and theoretical understanding in organisation performance related study. Despite various benefits of the SEM, the paper also highlighted some of its shortcomings.

Besides that it is also suggested that researchers of sustainability performance disciplines should be encouraged to make more research based on education industry in terms of their performance from sustainability practices point of view. This paper will serve as eye an opener to the researcher in sustainability and SEM disciplines to have better understanding of the topic.

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