The Significance of Reliability and Validity analysis on Education Supply Chain Management Practices

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Abstract: Supply chain management practices (SCMP) have progressively emerged as a contingent factor in improving sustainable performance in universities. More and more organisations including the manufacturing and service sectors are making use of SCM to improve their performance. This study aims to develop an effective instrument to measure SCM practices with reliable predictors to enhance product quality and business performance in education industries in Malaysia. The study measures administrative staff's response and perceptions regarding SCM practices and its impact on performance in their universities. One hundred and thirty responses were received and the data was analysed using SPSS. The validity and reliability of the instruments used in determining SCM practices were tested using exploratory factor analysis (EFA) and Cronbach's alpha. Twenty seven items from five competencies comprising: supplier partnership, customer partnership, information sharing, information technology and innovation competencies were designated for the initial instrument. Exploratory factor analysis (EFA) revealed that five factor-structures of the instrument of education SCM practices explained 68.76% of the variance in the pattern of relationships among the items. All five factors had high reliabilities at or above of Cronbach's > .80. Twenty two items remained in the final questionnaire after deleting five items which cross-loaded on multiple factors. The fiver-factor structure of the education SC practice instrument was confirmed through this study. Thus, practitioners may use such instruments in order to gain a better understanding of the level of contribution of the stated factors towards SCM practices to determine overall university performance and key competencies.

Key Words: *Supply Chain Management, Malaysian Private Unversities, Exploratory Factor Analysis.*

1. Introduction

1.1. Supply Chain Management

The most substantial revolution in the paradigm of the contemporary business environment is that individual businesses may no longer compete solely as sovereign entities, but rather as supply chain networks [1].

The concepts of Supply Chain Management (SCM) are expected to overcome all the challenges and issues in the contemporary management of an organization [3]. Hence supply chain management has become a potentially valuable way of securing competitive advantage. Resource Based View (RBV) theory has supported that SCM is the ultimate resource which may enable organizations to compete in a dynamic global market [36]. Moreover, in the past two decades, SCM dimensions of performance and organizational competitiveness have been analysed under the premise of the resource-based view [36].

With the advent of rigid competition among industries, SCM has gradually been incorporated as a recognized managerial approach in achieving profit, positive growth and sustainable performance [4]. This concept is not only confined to improve business operations in the manufacturing sector, but also applies to the service industry by focusing on the service based supply chain [5]. Service sectors have always been the motivating forces of economic growth in every developed country in the 21st century [6]. Services represent about 70 percent of the job market in advanced economies including education, which is more than the manufacturing and agricultural representation [7]. Hence service industries can benefit through some of the best concepts adopted from the manufacturing industry such as SCM. However the nature of these industries demands a more flexible and versatile approach such as service based supply chain management [8].

The dynamic nature of supply chain management may be applicable to the education industry. An education institution's operations comprises a process that converts inputs into outputs, as any other operation [9]. The major difference between the education

International Journal of Supply Chain Management
IJSCM, ISSN: 2050-7399 (Online), 2051-3771 (Print)

industry and other industries is the final product, tangible or intangible. However the strategy to manage these organizations is almost similar. As the goal of education is to provide value to the world by producing high quality graduates and research outcomes, it is necessary for education institutions to be sensitive with their management approach [10]. Since education institutions demand some collaboration with their partners such as schools, colleges, students, university staff and employers and its graduates as a team, it needs a network or integrated strategy. Thus SCM may be the appropriate method to meet this purpose [5].

Author [11], highlighted the presence of relationship between SCM practices and performance improvement precisely. Accordingly the impact of SCM practices on performance was not visible in service industries as in the manufacturing [11],[10]. This proves that, the time has come for researchers to shed light on education SCM aspects for sustainable university performance. Moreover these studies analyzed organizations performance or competitiveness under the perspective of resource -based view (RBV). According to this theory the competitiveness of any organization is established on the resources and its capable core competencies. This proves that, the sustainable performance of a university will be seriously influenced by the way it manages its resources such as growth of the disciplines, student satisfaction, job opportunities, recognition and facilities [12].

The objective of this study is to develop a specific instrument designed to measure universities' performance through SCM practices focused on supplier partnerships, customer partnerships, information sharing, information technology and innovation competencies. The development of an instrument to measure these practices is significant for the future of universities operation as it will provide useful and practical propositions for administrators, educators and shareholders. First, by using the existing literature related to SCM and performance as a guide, an instrument is to be developed to measure the SCM practices from the universities' administrative point of view. Second, the reliability and validity of the developed instrument employed will be evaluated. The specific research questions addressed in this study are:

1. Which set of items should appropriately be included in the final instrument based on analyses of psychometric properties that measure supplier partnerships, customer partnerships, information sharing, information technology and innovation?
2. Is there evidence of the reliability and validity of the instrument developed to measure these practices?

2.0. Literarure Review

2.1. Malaysian Highr Education Scenario

The Malaysian Higher Education Institutions (MHEIs) have played a substantial role in the growth of the nation's workforce and economy [13]. The service sector such as MHEI has been the main source of GDP, which contributed to 58% in 2016 and expanded by 6.8% per annum [14]. This proves that the service sectors are beginning to gain more importance than other sectors in the Malaysian economy [15]. Also, MHEI has gained the attention of policymakers, educationists, and administrators as well as various stakeholders of the education industry to endure its performance in the long term [5],[16]. Currently, Malaysia is known as one of the centers of educational excellence and recognized as an education hub in the Asia pacific region [13]. This has triggered the Malaysian government to support the privatization of higher education since 1996 in order to provide an expanded access for higher education [13]. This led to the creation of local private corporations and foreign university campuses. Multi-national companies consider Malaysia as a worthy region for the access of graduates of higher education [17].

In the midst of such growth in the education industry especially private universities (PUs), the boards, shareholders and stakeholders have started to worry about the sustainable aspects of private universities (PUs) [37]). As the importance of PUs is rising, the challenges, uncertainties and distortions are also on the rise. The performances of the PUs are diverse as some of them sustain very well while others have been known to fail [3].

In the Malaysian Setara Ranking, 2013 [18] good universities are in the top and rank as "Excellent and Very Good" where student enrollment reaches 10,000 and above. On the other hand, the remaining PUs are listed in the medium and lower ranks with student enrollment less than 2000 and 1000, respectively. Student enrolments in some PUs are very poor and the distributions among them are uneven. PUs in higher ranking (high achievers) obtain a larger number of students, while on the other hand lower ranking PUs (low achievers) obtain a lesser number of students [37]. Consequently the lower achievers with lesser number of students may struggle to sustain in the industry due to financial difficulties [37]. Funds are needed to meet the overhead costs to run the universities. Lack of funds

may lead to other problems such as quality issues, social issues and mismanagement [19], [37]. The performances of these universities are very unpredictable and they are unable to sustain in the long run [19], [37].

So the rising issues are about the leading causes for the differences in their performances. Although, every university claims that it is equipped with all the basic amenities, facilities, functional departments, SOPs, shareholders and stakeholders, they are unable to obtain a good number of students or sustain their performances either [19]. Generally speaking, most of the universities lack in positioning their resources righteously such as being inconsistent in their partner relationships, shaking in their communication system, outdated information technology and with expired innovation [20]. According to the RBV theory the competitiveness of any organization is established on the resources and the competencies it possesses [12]. Accordingly, the sustainable performance of a university will be seriously influenced by the way it manages its resources such as growth of the disciplines, student satisfaction, job opportunities, recognition and facilities. These fundamental resources are a portion of the supply chain management practices and they have not been polished by practitioners for a decade [37]. Hence this study tends to analyze these SCM practices and related instruments for the betterment of universities' operations.

2.2. Supply Chain Management (SCM) Practices

SCM practices are approaches that are useful in managing integration and coordination of supply, demand and relationships in order to satisfy the final customers in a more effective and profitable manner [21]. SCM practices are those managerial actions undertaken to improve performance of the integrated supply chain network [22]. SCM practices are also referred to as the complete set of activities for effectiveness in the internal supply chain [21]. Accordingly SCM practices include the organization's planning, strategy and collaboration among the internal functions as well as coordination of their supply chain across companies.

According to [2], the central meaning of SCM is that businesses in a supply chain have to establish a collaborative atmosphere where reciprocal trust, sharing of risks and rewards and a wide-range of information sharing, should optimize the supply chain. Moreover [2], suggested that collaboration will lead to more integrated supply chains where independent companies act together as one single entity and work towards jointly agreed goals. In order to achieve the best of supply chain management, its practices are needed to be associated [23]. This would increase the supply chain competitive advantage and lead to better organizational performance [23]. Among the numerous determining strategic practices, SCM practices have been observed as one of the most dynamic determinants to develop educational organizational performance [15].

Due to the amazing advantages, SCM practices have attracted the attention of many researchers today [23]. Researchers claim that SCM offers a number of advantages towards organizational performance such as it increases suppliers' just in time capabilities; participates in sourcing decisions; geographical proximity of decisions; formats information sharing agreements; improves the integration of activities; reduces response time and enables on-time delivery [10]. Besides that, researchers have found that SCM practices are depicted from different perspectives with a goal of improving organizational performance. Ref. [24] summarize SCM definitions into three various subjects, such as activities, benefits and components. The first theme of SCM definitions regards activities, contains the flow of materials and information, and networks of relationships, focusing on both internal (within organization) and external (outside the organization) environment. Second the benefits resulting from effective implementation of SCM strategies may add value and increase customer satisfaction. Third, components of SCM are about organizations' functions and processes which involve the supply chain.

In general, SCM practices are classified into demand management, customer relationship management, supplier relationship management, capacity and resource management, service performance, information and technology management, service supply chain finance, and order process management [23]. This study proposes that SCM practices be classified as customer relationship management, supplier relationship management, information sharing, information and technology management, and innovation; Table1, below shows the classified SCM parameters that the instruments will be based upon [3].

Hence, the main purpose of this research phase is to examine the appropriateness of the items and the internal structure of the SCM constructs that the instrument measures. For these reasons, an exploratory

factor analysis was first conducted to evaluate the factor structure of the scale. Secondly, a reliability analysis on pilot items was conducted to test the internal consistency of the preliminary questionnaire set.

Table 1: Measurements of Supply Chain Management practices

SCM Practices	
Parameters	**Meaning**
Customer Relationship	Relationship with customers, such as students and parents, employers and society.
Supplier relationship	Relationship with supplier and customers, such as schools and colleges, parents, employers, society and government.
Information Technology	Embracing technology and equipment's for enhancements
Communication	Sharing information with university stakeholders.
Innovation	New and marketable programs/courses.

3.0. Methodology

The sample consisted of selected Malaysian private universities as a unit of analysis. Nine private universities were chosen from three categories; Category A (High Achievers), category B (Medium Achievers) and category C (Low Achievers). Three universities were selected from each category. The stratification was based on the Malaysian Setara[13] ranking, expert opinions and public's perceptions. The respondents were selected from senior management personnel, managers, department heads, divisional administrative staff and lecturers as a unit of analysis. These respondents were chosen because they were the ones who were most likely to engage in the day to day operations and administrative activities of the universities' supply chain.

The research was conducted by survey questionnaire. A cross sectional design was employed. Experts view was taken from ten individuals and changes were done to the draft questionnaire as necessary. Preliminary reliability analysis was conducted after modifying the questionnaires through a pilot study with twenty respondents. Cronbach's Alpha score of 0.70 was achieved, which was sufficient to justify the internal consistency of the questionnaires. The questionnaires for the study consisted of 27 items eligible for the proposed dimensions of SCM practices.

The questionnaires were distributed to the respondents by post, email and whatsApp to cover the geographical area. A total of 500 questionnaires were sent to the selected 9 private universities in Malaysia. After several reminders, 130 completed questionnaires were received. This represented 23.33% of the total adequate sample of potential participants. The rate was consistent with the anticipated response from a mail survey and adequate for statistical analysis. Out of these, 4 questionnaires were eliminated because of missing data; the remaining sample size (130) was still large enough to permit Exploratory Factor Analysis (EFA).

3.1. Data Analysis Technique

3.1.1. Exploratory Factor Analysis (EFA)

The Exploratory Factor Analysis (EFA) was employed as the selected method of analysis. The purpose of EFA in the current research study was to reduce the entire data, purify the scale and to ascertain whether the survey questions loaded on their respective dimensions [26]. The study acknowledged three steps in conducting exploratory factor analysis.

A number of concerns were considered in using the exploratory factor analysis which were relevant to multivariate analysis techniques [26]. These concerns pertain to the sample size, factorability of R, strength of the relationship among the variables, missing data, outliers, linearity, normality, multicollinearity and homoscedasticity [29],[26].

All the necessary conditions for performing EFA were met, as discussed below: First, the study sample size of 130 was sufficient to conduct EFA according to [27]. Second, an inspection of the correlation matrix (see Table 5) shows evidence of coefficients for most of the items were around 0.3 which means that the condition of factorability of R (strength of the inter-correlations among the items) was met [26]. Additionally, Bartlett's test of sphericity was significant and consequently supported the factorability of the data set showing non-zero correlation among the items and high level of homogeneity among variables [28]. Bartlett's test of sphericity for SCM practices showed an approximate Chi square of 2328.044 with 351 df and significant at 0.000 level (see Table 4.8). The overall measure of sampling adequacy (KMO) was 0.816 which was higher than the cut-off point of 0.6 as recommended by [28] and [29]. Overall, these data satisfied the fundamental requirements for factor analysis [29](see Table 4.8).

Third, the assumptions which concerned missing data and outliers were met. Fourth, the results of data linearity and multi-collinearity were satisfactory (see the preliminary analysis section 4.2). Although, the data deviated from normality but it was not severe. Overall, the data satisfied the fundamental requirements for factor analysis.

The current study employed the most common approaches for factor extraction, known as principal component analysis [29]. For factor rotation, varimax orthogonal rotation was employed to get the best solutions [27]. This rotation is probably the most commonly used orthogonal rotation in the social science studies [30]. Kaiser's eigenvalue criterion (eigenvalue value of 1.0 or more), percentage of variance (satisfactory cut-off point 60%), and scree plot (checking the plot to locate a point at which the shape of the curve changes path) were employed to support the decision regarding the number of factors to maintain and the communalities [27],[26] and [29].

The reliability of an instrument or questionnaire is concerned with the consistency, stability, and dependability of the scores [31]. For this reason, the internal consistency was tested using Cronbach's alpha for each competency in SPSS. If the alpha value is higher than 0.8, the internal consistency is excellent, and if it is at least higher than 0.7, the internal consistency is acceptable [32]. Excellent internal consistency means that the survey items tend to pull together. In other words, a participant who answers a survey item positively is more likely to answer other items in the survey positively [31].

4.0. Results

4.1. Descriptive Statistics

Table 2 shows the respondents profile. The respondents consisted of 44.4% male and 55.6% female. Of these, 28.6% of respondents were management executives and 71.4% consisted of staff and lecturers. About 36.5% of respondents were 26 to 35 years old, followed by 47.6% between 36 and 45. While 15% of the respondents were above 46 years old. The age of the respondents were chosen because of their knowledge and experience in the day to day activities of the administrative jobs in the universities.

Table 2: Descriptive statistics of respondents

Demographic	Description N=126	Total respondents	Percentage (%)
Gender	Male	56	44.4
	Female	70	55.6
Age	26-35	46	36.5
	36-45	60	47.6
	46-55	15	11.9
	56 Above	5	3.9
Job Title	Managers &Executives	36	28.6
	Staff and Lecturer	90	71.4

Table 3 shows the descriptive statistics, including the means and standard deviations of the five proposed factors of the SCM practices of the instrument. It revealed that information technology measures had a high level of influence on SCM practices (M = 4.21), strategic supplier partnership (M = *3*.79), innovation (M = 4.05), strategic customer partnership (M =3.97 and information sharing (M= 4.06).

Table 3: Descriptive statistics of each factors of SCM practices

Factors and Items	Descriptive Statistics		N
SCM Practices	M	SD	
Information Technology	4.21	.75	130
Strategic Supplier Partnership	3.79	.73	130
Innovation	4.05	.80	130
Strategic Customer Partnership	3.97	.82	130
Information Sharing	4.06	.85	130

4.2. Exploratory Factor Analysis (EFA) for Validity

An exploratory factor analysis was conducted on the 27 items with a varimax rotation using SPSS. Exploratory factor analysis is a statistical method employed to increase the reliability of the scale by identifying inappropriate items that can be removed and the dimensionality of constructs by examining the existence of relationships between items and factors when the information of the dimensionality is limited [33]. The Kaiser's eigenvalue criterion and scree plot test (Refer Figure 1, and Table 4) has suggested five factor dimensions: customer relationship management,

supplier relationship management, information sharing, information and technology management, and innovation in this study. These five factors were used to determine the pattern of the structures in the 27-items of SCM practices in the instrument [34],[35].

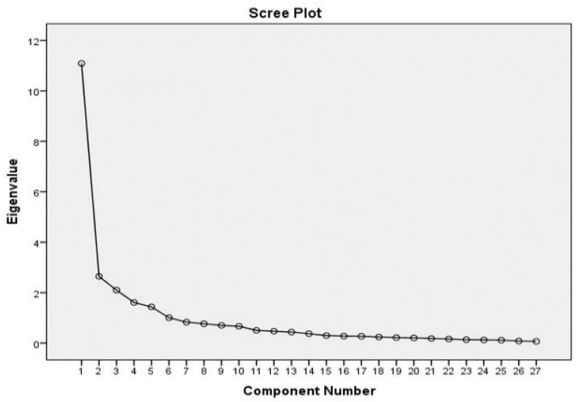

Figure 1: Scree Plot for the SCM Instrument

Table 4: Eigenvalues, Total Variances Explained for the Final Five-Factor Structure

Total Variance Explained						
Initial Eigenvalues		**Extraction Sums of Squared Loadings**			**Rotation Sums of Squared Loadings**	
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.80	32.12	32.12	2.85	15.80	15.80
2	2.15	11.89	44.01	2.40	13.29	29.09
3	1.94	10.74	54.75	2.72	15.05	44.14
4	1.52	8.41	63.16	2.24	12.41	56.55
5	1.01	5.60	68.76	2.21	12.21	68.76

4.3. Final Five Factor Structure

After deleting the five items which cross-loaded on three factors, the final five-factor structure in this study composed of 22 items. A total of five items for factor 1 represent information technology, five items for factor 2 represent supplier partnership competencies, four items for factor 3 represent innovation competencies, five items for factor 4 represent customer partnership competencies and three items for factor 5 represents information sharing (Table 4). The first item that was deleted was "We rely on schools /colleges as our main suppliers of students" because it had a factor loading of .331 on supplier partnership competencies and a cross loading of .432 on information sharing competencies. The second item that was deleted was "We and our trading partners exchange information to achieve success collectively" because the factor loading was under .32 [27]. Finally, this 22-item structure was found to explain 68.76% of the variance in the pattern of relationships among the items as shown in Table 6. The percentages explained by each factor were 32.12% (information technology), 11.89% (supplier partnership), 10.74% (innovation competencies), 8.41% (customer partnership), 5.60% information sharing, respectively. Moreover, three competencies in this study were highly correlated to each other (Table 5). The factor correlation between factor 1 (IT) and factor 5 (IS) was .32; the correlation between factor 2(SSP) and factor 5 (IS) was .53; the correlation between factor 3(INN) and factor 5 (IS) was .08.

Table 5: Factor Correlation Matrix and AVE

Constructs	**AVE**	**IT**	**SSP**	**IN**	**SCP**	**IS**
IT	0.72	1				
SSP	0.69	.31	1			
INN	0.75	.13	.18	1		
SCP	0.70	.36	.15	.07	1	
IS	0.68	..32	.52	.08	0.25	1

In the final five - factor structure of the SCM practices instrument, there was one item which was under .32 in factor loading (We rely on schools /colleges as our main suppliers of students). In fact, [27] suggested deleting those items under .32 factor loading

for a better interpretation of the factor structure. These items were not considered to load significantly. However, when it was decided to delete an item under .32 factor loading, this study also examined the Cronbach's alpha if the item was to be deleted. Although deleting items was associated with a decrease in alpha, nevertheless the item was deleted. The original Cronbach's alpha of factor 2 (supplier partnership) was .889 and if the item (We rely on schools /colleges as our main suppliers of students) was deleted, the Cronbach's alpha of factor 2 decreased to .884. However, the .005 decrease on the Cronbach's alpha was so minimal that it might not be considered as significant. In addition, this item was not strong and shared a potential cross-loading. For this reason, the item (We rely on schools /colleges as our main suppliers of students) was deleted in this study.

Table 6: The final five factor structure of SCM practices and measures after factor reduction procedures.

Factors and Items	**Factor loadings**				
	1	**2**	**3**	**4**	**5**
Factor 1- Information Technology					
Our IT in SCM is satisfactory	.90				
IT enabled and automated	.81				
IT based reply to suppliers and customers	.78				
IT is up to date	.77				
Our campus is WIFI friendly	.62				
Factor 2 - Strategic Supplier Partnership					
Establish long term relationship with suppliers		.85			
Quality as number one criteria		.84			
Involving suppliers in new program development		.81			
Include key suppliers in achieving vision		.77			
Help key suppliers		.65			
Factor 3 – Innovation					
Pay attention on innovation and creativity as a competitive advantage			.90		
Providing up to date facilities in teaching and learning			.89		
Introduce courses with marketable features			.75		
Use latest technology for new program development			.74		
Factor 4 - Strategic Customer Partnership					
Easy access for customer to seek program information				.81	
Measure and evaluate customer satisfaction frequently				.75	
Involving customer in program development/design				.75	
React to customer complaint				.72	
Frequently evaluate future customer expectation				.70	
Factor 5 - Information Sharing					
Trading partners share their organizations information with us					.85
Our trading partners keep inform us about issues					.83
We and trading partners exchange information for collective success					.76
Bartlett's Test of Sphericity	Approx. Chi-Square			2328.04	
	Df			351	
	Sig			.000	
	Total Variance Explained			68.76%	

4.4. Item Analysis for Reliability

An item analysis was conducted to test the reliability of each factor of the SCM practice measurements. According to [31], satisfactory internal consistency ranges from 0.7 to 0.9. All five factors on this scale had a high rating for reliability. The Cronbach's alpha for information technology, supplier partnership, innovation, customer partnership and information sharing were .88, .88, .87, .85, and .85 respectively (see Table 7).

Table 7: Cronbach's Alpha for Each Element of the SCM practices

Factors and Items for SCM Practices	Reliability	Items retained
Information Technology	.88	5
Strategic Supplier Partnership	.88	5
Innovation	.87	4
Strategic Customer Partnership	.85	5
Information Sharing	.85	3

5.0. Discussion

Through the exploratory factor analysis (EFA), the study carried out to identify the underlying latent variables and measures that significantly determine the SCM practices to impact sustainable performance of private universities.

From the exploratory factor analysis (EFA), five factor structures of the instruments highlighting the SCM practices emerged. This explained 68.76% of the variance in the pattern of relationship among the items. All five factors had high reliabilities (Cronbach's alpha > .80). Twenty two items remained in the final questionnaire after deleting five items which were cross-loaded on multiple factors (information technology: 5 items, strategic supplier partnership : 5 items, innovation : 4 items, strategic customer partnership : 5 items and information sharing : 3 items). As a result, the five-factor structure of the SCM practice instrument was confirmed through this study.

From the evaluation, it could be seen that most of the items pertaining to SCM practices were least affected and were grouped as main components. These could be the critical factors and measures in evaluating the private universities performance [20]. According to [20], each of these variables with the measurement items proved to have influential features towards the Malaysian universities' performance. Practitioners and decision makers could adopt SCM and the related practices in their decision making process for an efficient operational and sustainable performance.

6.0. Implications

The findings of this study have both theoretical and practical implications for the future of education supply chain management in Malaysian private universities. Theoretically the study is expected to contribute to the advancement of knowledge on the importance of supply chain management practices to education institutions' performance. The study will be of assistance to the education industry in general and open doors to improvement of productivity and performance through the aid of good supply chain management practices. The study has built an education SCM platform for novices and scholars to investigate further on this area of interest.

7.0. Conclusion

In conclusion, the research sought to analyse the effect of supply chain management practices and its measures on Malaysian private universities' performance. It was observed that all the supply chain management practices and their measures had a positive effect on the universities performance. In order to improve performance, the university supply chain management must focus on relationships especially on information sharing from upstream to downstream in the supply chain for further enhancement. Ultimately performance would be measured through those measures such as cost reduction, response, return on investment, customer service and profitability or margins, however these measures need a support from SCM practices. Hence these measures could be eased through the dynamic capability of SCM and its practices. However, it was noted by means of the questionnaires that practitioners of universities were not well versed with some of the practices such as supplier and customer partnerships. It was also noted that some respondents disagreed with the implementation of SCM practices in education industry, while others were very optimistic and agreed to these very crucial practices as they had the potential to improve the individual stakeholder's value (supplier, customer and consumers) and morale. From the exploratory factor analysis, it may be concluded that the organizational performance of Malaysian private universities had improved with the implementation of the SCM practices.

For an organization to achieve a competitive advantage in the global environment, it has to embrace supply chain practices as its underlying resources. Resource Based View theory implies that an organisation's underlying success strongly correlated with its resources in hand. For instance partnership with supplier and customers contributed the main competitive advantage. This could be possible by complementing with other resources such as information sharing and information technology within and across the universities supply chain. Based on the research findings, the researcher recommends that decision makers and shareholders should pay serious attention to the relationship among supply chain

management partners and should have the right mix of practices that would lead to improved performance.

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