An Empirical Study of Educational Supply Chain Management for the Universities

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Abstract

The exploratory study addresses education supply chain and research supply chain as major constituents in the educational supply chain management model for the universities. Model constructs were identified and confirmed by 493 respondents, representing university administrators, faculty and staffs, employers, and graduates. The resulting model was subsequently evaluated for accuracy and validity by multiple linear regression (MLR) analysis and the structural equation modeling (SEM) technique. The research model furnishes stakeholders of the supply chain with appropriate strategies to review and appraise their performance toward fulfillment of ultimate goals, i.e. producing high-caliber graduates and high-impact research outcomes for the betterment of the society.

Keywords
Education, research, supply chain management, SCM, universities

1. Introduction
The goal of supply chain management (SCM) is to integrate and optimize activities within and across organizations for all stakeholders' satisfaction. Typically, supply chains may consist of manufacturers or service providers receiving inputs from suppliers, processing these inputs, and delivering them to customers. SCM in academia, which is called Educational SCM, aims at uplifting the societal values by producing quality graduates and research findings. In the academia, one of the primary suppliers of process inputs is customers themselves. They provide their bodies and souls, minds, belongings, or information as inputs to the service processes [1]. Supply chain management is needed for various reasons: improving operations, better outsourcing, increasing profits, enhancing customer satisfaction, generating quality outcomes, tackling competitive pressures, increasing globalization, increasing importance of E-commerce, and growing complexity of supply chains [20].

Based on findings from literature review, the researchers found a large number of papers and articles in supply chain management. Most of them investigated supply chain management in the manufacturing sector [9-18, 22]. Only a few addressed issues in SCM for the service industry [2-7]. Very few focused on educational supply chain management. Just two papers [8, 9] were found to be relevant to educational supply chain management. Reference [8] proposed an educational supply chain as a tool for strategic planning in tertiary education. The study was based on a survey among employers and students. Survey findings revealed that integration and coordination among students and employers should have been promoted. Reference [9] also investigated an educational supply chain in different aspects. According to the reference [9], the development of two separate supply chains, namely a "student" supply chain and the "research" supply chain.

One of the main goals of an educational supply chain is to improve the well-being of the end customer or the society. To achieve this goal, educational institutions need to have a certain degree of knowledge about the partners in their supply chains including suppliers, customers, and the consumer. The performance of the supply chain management depends on the seamless coordination of all supply chain stakeholders to ensure attainment of desirable outcomes [31].

2. Methodology

The researchers design the educational supply chain management for the universities. A supply chain involves co-ordination and information sharing up and down the process. For providing the clear conception of the conceptual framework, the researchers depict holistic view of educational supply chain in Figure 1.
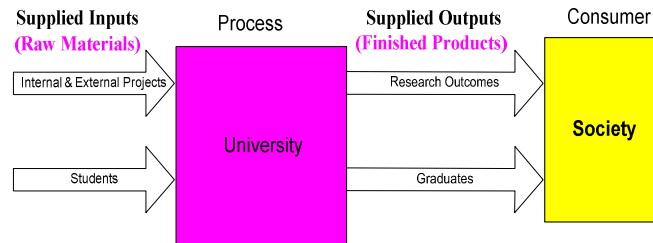

Figure 1: Holistic view of educational supply chain

Though it is very difficult to determine the supplier and customer of the intangible product in the service industry, the researchers identified suppliers, customers, the service provider, and the consumer in this paper. This exploratory study also identifies supplied inputs, supplied outputs. In this supply chain, raw materials are students as well as internal and external projects. Finished products are graduates and research outcomes [31]. The aforementioned holistic view of an educational supply chain may be elaborated through a more detailed illustration in Figure 2 that illustrates an education supply chain and a research supply chain, which together form the educational supply chain management for the universities. The researchers represent two entities, which are students and research projects in this conceptual model [30]. Both entities eventually become graduates and research findings in the educational supply chain. The final outcomes of this supply chain, graduates with desirable quality and quality research outcomes will be delivered to the end customer, i.e. the society by the education supply chain and research supply chain respectively [19]. The three decision levels including strategic, planning and operating level for the universities have been explored in this research model [32].

A. Suppliers

In the conceptual model, the researchers identified two major parts in the suppliers, namely education suppliers and research suppliers for the universities [20, 28].

Education Suppliers: Suppliers of the student (High school/college), suppliers of the faculty (Other universities), Self funding students, source of fund – Family (Parents, siblings), relatives, etc. government and private organizations (scholarship), suppliers of assets or equipment (furniture, computer, networking equipment, etc.), suppliers of educational materials (stationery, instruction materials, etc.)

Research Suppliers: Suppliers of internal research projects (university self-funding), suppliers of external research projects (external research funds, Ministry of education, private organizations, etc.)

B. A Service Provider

A university is regarded as a service provider in this paper. The researchers identified four activities, including education development, education assessment, research development and research assessment in the university as illustrated in Figure 2. Through proper educational management, the university can produce quality outcomes for the society. Figure 2 represents educational supply chain management for the universities in four aspects, including programs establishment, university culture, faculty capabilities, and facilities, are considered for development and assessment in both education and research part. The final outcomes of the university, i.e. graduates with desirable quality and quality research outcomes are delivered to the society. Some examples are provided to depict clear ideas regarding the four aspects for both education and research in the universities [26]:

Programs Establishment: Establish faculties, departments, declare the majors etc. for academic, and research development, different academic and research quality assurance programs for the assessment

University Culture: Management by objectives (MBO), good governance, academic and research excellence, contract and joint research programs etc.

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Faculty Capabilities: Faculty's academic and administrative rankings, researchers, academic and researchers performance evaluation etc.

Facilities: Academic and research supportive facilities, quality assessment facilities etc.
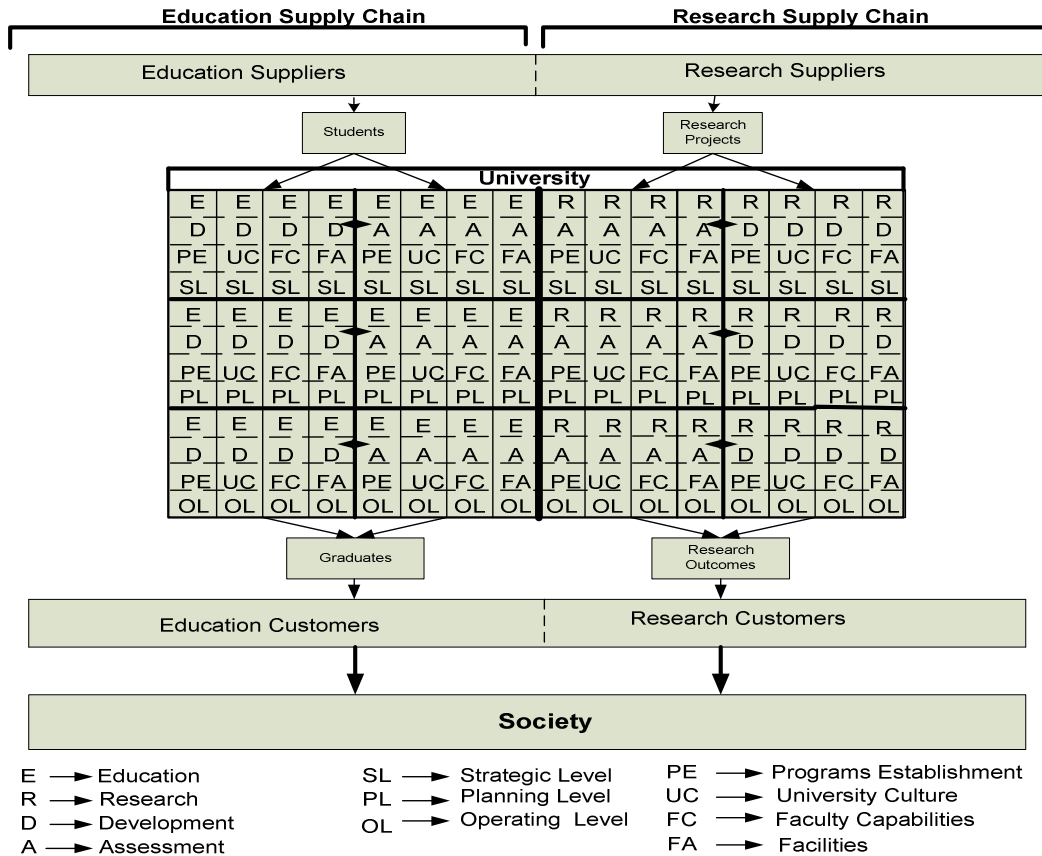

Figure 2: Educational supply chain management model for the universities

C. Customers
In the conceptual model, the researchers identified two major parts in the customers namely education customers and research customers for the universities [20, 29].

Education Customers: Graduates, family (parents, siblings, relatives, etc.), employers of government and private organizations

Research Customers: Funding organizations of research projects, research outcomes (researchers, research publications, findings etc.), Others (research professional organizations - IEEE, INFORMS, ACM, Society of manufacturing engineers etc. and Trade associations - American trade association, Grocery manufacturers association, etc.)

D. Consumer
The researchers identified the society as the end customer or the consumer in this educational supply chain. As universities are the part of the society, the final outcomes of this supply chain, including graduates with desirable quality and quality research outcomes are delivered to the society.

From the research model, the following hypotheses are established [20]:
   H_1: There is a relationship between education suppliers and students in the universities.
   H_2: There is a relationship between research suppliers and research projects in the universities.

H$_3$: There is a relationship between graduates and education customers.
H$_4$: There is a relationship between research outcomes and research customers.
H$_5$: There is a relationship between education customers and the society.
H$_6$: There is a relationship between research customers and the society.

From the hypotheses, the structural equation modeling (SEM) has been utilized to answer the research questions. The growing interest SEM techniques and recognition of their importance in empirical research are used to test the extent to which the research meets recognized standards for high quality statistical analysis [21, 22]. The respondents were asked to indicate the level of significance after supply chain implementation using five-point Likert scale (1 = strongly disagree, 5 = strongly agree) [23]. The researchers conduct a survey among stakeholders, including experts in university administration, faculty, staff, employers, graduates, etc.

3. Results

In the scale reliability test, the Cronbach's alpha value is 0.961, which means the scale is excellent reliable [33]. Validity of the variables was confirmed by practitioners, as well as academicians. The questionnaires were pre-tested to check the content validity and revised where necessary to ensure the content validity. In pretest, all the respondents were academicians of different universities in the world. For the large scale research, the surveys were collected, totally 493 from all stakeholders, out of 3421 respondents (14.41% are usable) to obtain maximum likelihood estimates of standardized regression weights, Multiple Linear Regression (MLR) equations [24] etc. Among them, 174 respondents were experts in university administration, faculty and staff, 166 respondents were graduates, and 153 respondents were employers. Educational supply chain management consists of supplied inputs to the university and supplied outputs of the university. The authors represent model A and model B in this section. Model A stands for supplied inputs for the university and model B represents supplied outputs of the university.

3.1 Model A - Supplied Inputs:

Model A will test hypothesis 5 and hypothesis 6 in the supplied inputs of the educational supply chain management. In this model, there are two main inputs for the universities are students and research projects that have been evolved from education suppliers and research suppliers respectively. Model A is representing the inter relationships among different variables to justify the hypotheses 5 and 6 by structural equation modeling through AMOS 6.

$$F_{University} = 0.41\ f_{ST} + 0.38\ f_{RE\_PROJ}$$
$$= 0.41\ [0.13\ f_{ED\_SUPP}] + 0.38\ [0.23\ f_{RE\_SUPP}]$$
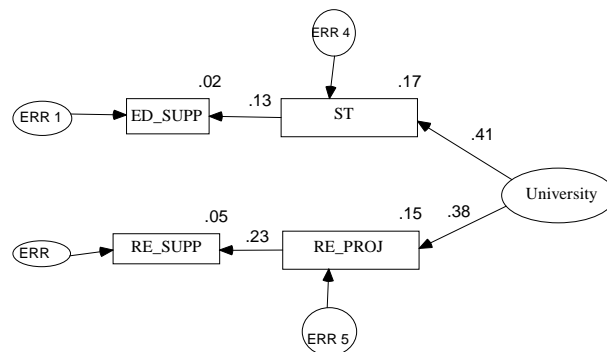$$= 0.05\ f_{ED\_SUPP} + 0.09\ f_{RE\_SUPP} \tag{1}$$

Figure 3: Graphics output of supplied inputs in AMOS 6

Model Fit Index:
CMIN = 17.886, Degrees of freedom = 3, Probability level = 0.000
CMIN/DF = 5.962 (Ratio of relative chi-square close to 5 indicate reasonable fit), [27], NFI = 0.720, CFI = 0.743 (NFI and CFI values close to 1 indicate a very good fit) [25]

From the research finding, university consists of students as well as research projects. The factor that highly contributed to the university is students. This equation also depicts the relation of education suppliers and research

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suppliers with the university. Research suppliers are the most significant factor in the university. Equation (1), graphics output in Figure 3 and above all statistical discussion on AMOS 6 states that there is a significant relationship (at the level 0.001 – two tailed) between education suppliers and students in the universities. It also proves that there is a significant relationship (at the level 0.001 – two tailed) between research suppliers and research outcomes in the universities. Therefore, research hypotheses 1 and 2 fail to reject.

3.2 Model B - Supplied Outputs:

Model B will test hypothesis 3, 4, 5 and 6 in the supplied outputs of the educational supply chain management. The main outputs of the universities, including graduates and research outcomes will be delivered to the education customers and research customers respectively. Finally, all outcomes will be generated for the betterment of the society. Model B is representing the inter relationships among different variables to justify the hypotheses 3, 4, 5 and 6 by structural equation modeling through AMOS 6.

$$F_{Society} = 0.61\ f_{ED\_CUS} + 0.61\ f_{RE\_CUS}$$
$$= 0.61\ [0.34\ f_{Grad}] + 0.61\ [0.15\ f_{RE\_OUT}]$$
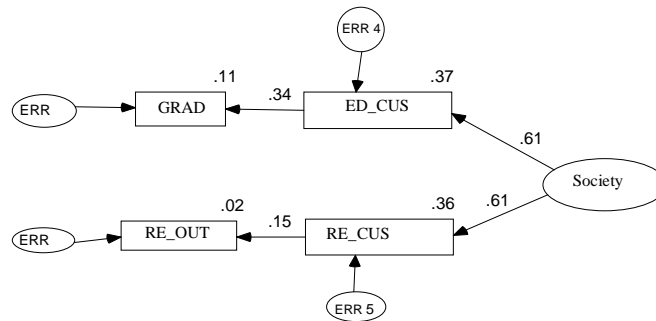$$= 0.21\ f_{Grad} + 0.09\ f_{RE\_OUT} \tag{2}$$

Figure 4: Graphics output of supplied outputs in AMOS 6

Model Fit Index:
CMIN = 16.481, Degrees of freedom = 3, Probability level = .001
CMIN/DF = 5.494 (Ratio of relative chi-square close to 5 indicate reasonable fit) [27], NFI = 0.896, CFI = 0.911 (NFI and CFI values close to 1 indicate a very good fit) [25]

From the research finding, the society consists of graduates and research outcomes. The equation (2) represents that graduates are highly contributed to the society. This equation also depicts that education customers, research customers are included in the society, and both have equal contribution to the society. Equation (2), graphics output in Figure 4 and above all statistical discussion on AMOS 6 states that there are significant relationships (at the level 0.001 – two tailed) between graduates and education customers; research outcomes and research customers. It also demonstrates that there are significant relationships (at the level 0.001 – two tailed) between education customers and the society; and research customers and the society. Therefore, research hypotheses 3, 4, 5 and 6 fail to reject.

4. Discussion

The researchers used AMOS 6, powerful statistical software, for Structural Equation Modeling (SEM) to analyze the reliability and validity of the data, Multiple Linear Regression (MLR) analysis and hypotheses developed. From the research findings of equation (1), students and research suppliers are highly contributed to the universities. Equation (2) represents that graduates are highly contributed to the end customer, i.e. the society. Education customers and research customers have equal contribution to the society. The authors defined the society as the function of graduates and research outcomes.

Society = f (Graduates, Research Outcomes)

Therefore, well-being society would be possible if quality graduates and quality research outcomes would be produced by the university through successful educational supply chain management.

5. Conclusion

Survey findings would be used to develop the educational supply chain management model for the universities to enhance operations within the supply chain. The interrelationships among all educational supply chain components are investigated and confirmed by Structural Equation Modeling (SEM) technique. The applicability of the model can be confirmed empirically. However, model evaluation by actual implementation is suggested for prospective investors or current university administrators. This paper provides a novel approach to developing and assessing SCM application in the academia. The research framework provides two contributions to the end customer, i.e. the society, including human resource contribution and research contribution.

References

[1] Christopher, M., 1994, Logistics and Supply Chain Management, Pitman Publishing, New York, USA.

[2] Dibb, S. and Simkin, L., 1993, "Strategy and tactics: marketing leisure facilities", The Services Industries Journal, vol. 13, no. 3, pp. 110-24.

[3] Sampson, S. E., "Customer-supplier duality and bidirectional supply chains in service organization", 2000 International Journal of Service Industry Management, Vol. 11 No. 4, pp.348-364.

[4] Nixon, M., 2001, "Innovations in logistic technology: generating top-line value and bottom-line ROI", World Trade, June, vol. 14, no.6, pp. 62-4.

[5] Sengupta, S. and Turnbull, J., 1996, "Seamless optimization of the entire supply chain", IIE Solutions, vol. 28, no. 10, pp. 28-33.

[6] Fernie, J. and Clive R., 1995, "Supply chain management in the national health service", The International Journal of Logistics Management, vol. 6, no. 2, pp. 83-92.

[7] Kathawala, Y. and Abdou, K. 2003, "Supply chain evaluation in the service industry: a framework development compared to manufacturing", Managerial Auditing Journal, vol. 18, no. 2, pp. 140-149.

[8] O'Brien, Elaine, M. and Kenneth, R., 1996, "Educational supply chain: a tool for strategic planning in tertiary education?", Marketing Intelligence and Planning, vol. 14, no. 2, pp. 33-40.

[9] Ballou, R., 1978, Basic Business Logistics, Prentice-Hall, Englewood Cliffs, NJ.

[10] Ballou, R. H., 2007, "The evaluation and future of logistics and supply chain management", European Business Review, vol. 19, no. 4, pp. 332-348.

[11] Heskett, J., Ivie, R. and Glaskowsky, N., 1964, Business Logistics, Management of Physical Supply and Distribution, the Ronald Press Company, New York, NY.

[12] Heskett, J.L., Glaskowsky, N.A. Jr and Ivie, R.M., 1973, Business Logistics, 2nd ed., Ronald Press, New York, pp. 14-21.

[13] Stevenson, W.J., 2002, Operations Management, 7th ed., McGraw-Hill/Irwin, NY.

[14] Cigolini, R., Cozzi, M., and Perona, M., 2004, "A new framework for supply chain management", International Journal of Operations & Production Management, vol. 24, no. 1, pp. 7-41.

[15] Oliver, R.K. and Webber, M.D., 1992, "Supply-chain management: logistics catches up with strategy", in Christopher, M. (Ed.), Logistics: The Strategic Issues, Chapman & Hall, London

[16] Lummus, R. and Robert, J. V., 1999, "Defining supply chain management: a historical perspective and practical guidelines", Industrial Management & Data System, vol. 99, no. 1, pp. 11-17.

[17] Gripsrud, G., 2006, "Suuply chain management – back to the future?"International Journal of Physical Distribution and Logistics Management, vol. 36, no. 8, pp. 643-659.

[18] Tan, K. C., Lyman, S. B. and Wisner, J. D., 2002, "Supply chain management: a strategic perspective", International Journal of Operations and Production Management, vol. 22, no. 6, pp. 614-631.

[19] Habib, M. and Jungthirapanich, C., 2008, "An integrated framework for research and education supply chain for the universities", Proceedings of the 4th IEEE International Conference on Management of Innovation and Technology, IEEE Computer Society, Piscataway, NJ 08855-1331, USA

[20] Habib, M. "An Integrated Tertiary Educational Supply Chain Management (ITESCM)", Ph.D. Dissertation, Graduate School of Information Technology, Assumption University of Thailand, December, 2009.

[21] Strub, D. W., Gefen, D., and Boudreau, M.-C. 2002, "SEM and Regression", AIS, USA, vol. 4, no. 7.

[22] Udomleartprasert, P., and Jungthirapanich, C., 2003, "The Operational Infrastructure Enhancing the Supply Chain Management", International Conference of Electronic Business, Singapore.

[23] Cutler, B, D., Moberg, C. R., Gross, A., and Speh, T. W.. 1998, "Identifying antecedents of Information exchange within supply chains", International Journal of Physical Distribution & Logistics Management, UK, vol. 32, no. 9, pp. 755-770.

[24] Arbuckle, J. L., 2005, Amos™ 6.0 User's Guide, Amos Development Corporation, USA.

[25] Bentler, P. M, 1990, Comparative fit indexes in structural models, Psychological Bulletin, vol. 107, pp. 238–246.

[26] Habib, M. and Jungthirapanich, C., 2009, "Research Framework of Educational Supply Chain Management for the Universities", IEEE International Conference on Engineering Management and Service Sciences EMS, China.

[27] Wheaton, B., Muthén, B., Alwin, D. F., and Summers, G. F., 1977, Assessing reliability and stability in panel models, *Sociological methodology,* D. R. Heise, ed. San Francisco: Jossey-Bass, pp. 84–136.

[28] Habib, M. and Jungthirapanich, C., 2008, "Integrated Educational Supply Chain Management (IESCM) for the Universities", Sixth AIMS International Conference on Management, India.

[29] Habib, M. and Jungthirapanich, C., 2009, "A Research Model of Integrated Educational Supply Chain for the Universities", INFOMS International Conference on Technology and Business Management, Dubai.

[30] Habib, M. and Jungthirapanich, C., 2009, "Research Framework of Education Supply Chain, Research Supply Chain and Educational Management for the Universities", International Journal of the Computer, the Internet and Management (IJCIM), Thailand, vol. 17, no. SP1, pp. 24.1-8.

[31] Habib, M. and Jungthirapanich, C., 2009, "International Supply Chain Management: Integrated Educational Supply Chain Management (IESCM) Model for the Universities", International Retailing: Text and Cases, India.

[32] Habib, M., and Jungthirapanich, C., 2009, "Integrated educational management for the universities", The Journal of China-USA Business Review, David Publishing Company, USA, vol. 8, no. 8, pp. 25-38.

[33] Ebel, R. L., 1951, Estimation of the reliability of ratings, *Psychometrika*, vol. 16, pp. 407-424.