Prospect of ITESCM (integrated tertiary educational supply chain management) model based on ICT application

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Abstract: This research exhibits the prospect of ITESCM (Integrated Tertiary Educational Supply Chain Management) model through ICT (Information and Communication) application. The ITESCM model was developed by Dr. Mamun Habib in 2010 for tertiary academic institutions which addresses the integrated form of supplied inputs, supplied outputs, education supply chain, research supply chain and educational management for universities [17]. Four main activities, includes education development, education assessment, research development, and research assessment in four aspects, namely Programs Establishment, University Culture, Faculty Capabilities, and Facilities were investigated at three decision levels. Model structures were defined and confirmed by 493 respondents, representing University administrators of world-ranking universities, faculty and staffs, employers, and graduates. The resulting structure was subsequently evaluated for accuracy and validity by multiple linear regression (MLR) analysis and the structural equation modeling (SEM) technique. This empirical study represents two contributions in terms of human resource contribution and research contribution to the end customer, i.e. the society. The ICT application of ITESCM model provides a novel approach for prospective investors or current administrators of the universities to review and appraise their performance with comparing other universities toward fulfillment of ultimate goals, i.e. producing high-competent graduates and significant research outcomes for the well-being of the society.

Keywords: ICT Application of ITESCM Model, University Performance Evaluation, SCM Evaluation for Universities, ITESCM Model

1. Introduction

Today's organizations are increasingly dependent on information and communication technologies for achieving their strategic and operational objectives. Over the past decade alone, enterprise systems have been expanded to provide secure, electronic linkages with suppliers and customers, and the Internet has become a mainstream channel for communications and business transactions. As a result, decision making about ICT resources has also become even more visible as the roles and accountabilities of the IS function have become important not only operationally but also strategically.

Computers and communication networks enable companies to compete in two primary ways:

- Low Cost—competing with other businesses by being a low-cost producer of a good or a service
- Differentiation—competing with other businesses by offering products or services that customers prefer due to a superiority in characteristics such as product innovativeness or image, product quality, or customer service

The fundamental concept of ICT incorporates different components i.e. hardware, software, networks, data management and Internet-based technology. An ICT Application uses the above components based on the organization's Information System strategies to deliver information and functions to the stakeholders effectively and

efficiently.

Creative and innovative applications of ICTs have long been seen as important tools to enable educational reform processes, with the potential to improve both the access to and the quality of education. The Internet explosion that occurred in the 1990s, the emergence of a variety of low-cost computing devices, and the increased diffusion of computers throughout society ushered in a wave of ICT and education policies and projects around the world. In recent years there has been a good amount of interest in how computers and the Internet can best be harnessed to improve the efficiency and effectiveness of education at all levels. Information and Communication Technology (ICT) can contribute to global access to education, the delivery of quality learning and teaching, teachers' development and more efficient education management, governance and administration. In case of Higher Education, the essential elements of ICTs (hardware, software, connectivity, the Internet) is structured with applications four main activities, namely education development, education assessment, research development and research assessment.

2. The ITESCM Model

One of the main goals of an educational supply chain is to improve the well-being of the end customer, i.e. 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. [7], [22], [21]

An integrated supply chain involves co-ordination and information sharing up and down the process. However, it is very difficult to determine the supplier and customer of the intangible product in the service industry. Suppliers, the service provider, customers, and the consumer have been identified in this research. ITESCM also identifies supplied inputs, customer-consuming output (O/P), customer-supplying input (I/O) and finally supplied outputs. Some of the graduates would be added in the service provider as the supplied input. On the other hand, some graduates would be acted as the supplied output to the end customer. Therefore, graduates were identified as the supplying input customer in that supply chain. [21], [11], [13]

2.1. Three Decision Levels of SCM

According to the concept of three decision levels in SCM, this concept would be adopted in ITESCM model [34]. In educational management, three decision levels are involved in the process of the university:

Phase 1: Strategic Level
Phase 2: Planning Level
Phase 3: Operating Level

i   *Strategic Level (SL):* Strategic level decisions are the highest level. Strategic level decision concerns general direction, long-term goals, philosophies and values.

These decisions are the least structured and most imaginative; they are the most risky and of the most uncertain result, partly because they attain so far into the future and partly because they are of such significance.

ii *Planning Level (PL):* Planning level decisions support strategic decisions. They tend to be medium range, medium importance, with moderate outcomes.

iii *Operating Level (OL):* Operating level decisions are every day decisions, used to support planning level decisions. They are often made with little thought and are structured. Their impact is immediate, short term, short range, and usually low cost. The outcomes of a bad operating level decision will be minimal, although a series of bad or sloppy operating level decisions can cause harm. These decisions can be pre-programmed, pre-defined, or set out clearly in policy manuals.

2.2. Different Aspects in the Universities

To accomplish proper teaching and research works in the universities; different aspects have to need analyzed. Four aspects, namely faculty capabilities, facilities, programs establishment, university culture [12], [7], [8], [19], [20] would be demonstrated in this section.

Programs Establishments (PE): Programs establishment would be occurred for the education and research in terms of development and assessment in the universities. Universities design different programs, to enhance the diversification in education development and establish various programs to assess the development. Universities also intend different programs to increase the diversification in research development and research assessment. Universities have to attempt product differentiation, i.e. programs establishment. Hands-on experience, industrial placements, social demand, provision of IT facilities, and innovative academic methods all demonstrate attempts to differentiate programs establishment [16].

University Culture (UC): The concept of organizational culture would be applicable for the universities by the name of University Culture. However, the type of the university culture will fully depends on the university management or administrator. In fact, university culture is the personality of the university [13].

Faculty Capabilities (FC): Faculty members establish good communication, provide rich environment for classroom observation, model best practices, create opportunities for reflection, and support students' participation in curriculum planning, teaching and research. Traditionally, university faculty members are evaluated according to the three major criteria: teaching, research, and services [14].

Facilities (FA): Universities offer a wide range of modern facilities to their students. These include state of the art lecture halls, libraries, laboratories and IT services to ensure that students are provided with an environment in which they can learn, both successfully and comfortably. Lecture rooms are principally conducted using state-of-the-art distance learning technology, online education, e-learning via Internet. Online databases, e-journal, digital library, etc. represents modern

research facilities in the universities [15].

Researchers identified four main activities for the universities namely Education Development, Education Assessment, Research Development and Research Assessment in order to produce quality graduates and research outcomes.

Table 1. Examples of Education Development (E_d) for the Universities [6], [9]

Decision Level	Programs Establishment (PE)	University Culture (UC)	Faculty Capabilities (FC)	Facilities (FA)
Strategic (SL)	School of Engineering, School of Business, School of Arts	Academic good governance by University council	Professors, associate professors	University's academic and supportive facilities
Planning (PL)	Department of Electrical Engineering, Department of Finance, Department of Linguistics	Academic good plans by deans/program directors	Professors, associate professors, assistant professors, senior lecturers	School's academic and supportive facilities
Operating (OL)	Majors in power systems, instrumentation and control, robotics	Academic good operations by faculty members	Assistant professors, lecturers	Department's academic and supportive facilities

Table 2. Examples of Education Assessment (E_a) for the Universities [6], [9]

Decision Level	Programs Establishment (PE)	University Culture (UC)	Faculty Capabilities (FC)	Facilities (FA)
Strategic (SL)	University's academic assurance program	Management by objectives (MBO), University's academic excellence	University's academic faculty performance evaluation	University's academic and supportive facilities quality assessment
Planning (PL)	School's academic assurance program	School's academic excellence	School's academic faculty performance evaluation	School's academic and supportive facilities quality assessment
Operating (OL)	Department's academic assurance program	Department's academic excellence	Department's academic faculty performance evaluation	Department's academic and supportive facilities quality assessment

Table 3. Examples of Research Development (R_d) for the Universities [6], [9]

Decision Level	Programs Establishment (PE)	University Culture (UC)	Faculty Capabilities (FC)	Facilities (FA)
Strategic (SL)	Engineering research programs, business research programs, social research programs	University's research orientation	Professors, associate professors	University's research and supportive facilities
Planning (PL)	Electrical engineering, mechanical engineering, finance, operations research projects	School's contract research programs and joint research programs	Professors, associate professors, assistant professors, researchers	School's research and supportive facilities
Operating (OL)	Research topics - supply chain management, artificial intelligence	Innovative academic research projects enrollments by departments	Assist. professors, lecturers, researchers	Department's research and supportive facilities

Table 4. Examples of Research Assessment (R_a) for the Universities [6], [9]

Decision Level	Programs Establishment (PE)	University Culture (UC)	Faculty Capabilities (FC)	Facilities (FA)
Strategic (SL)	University's research quality assurance program	University's research findings quality assessment, research excellence	University's research faculty performance evaluation	University's research and supportive facilities quality assessment
Planning (PL)	School's research quality assurance program	School's research environment assessment	School's research faculty performance evaluation	School's research and supportive facilities quality assessment
Operating (OL)	Department's research quality assurance program	Department's research excellence	Department's research faculty performance evaluation	Department's research and supportive facilities quality assessment

2.3. Education & Research Activities in the Universities

2.3.1. Education Development (E_d) and Education Assessment (E_a)

Education development could be performed in terms of four aspects, namely programs establishment, university culture, faculty capabilities and facilities through launching the new programs based on the local and global demands, values of the university, faculty enrichment by teaching, research and community service, state of the art teaching facilities.

The overall goal of assessment is to improve student learning in terms of education. Assessment provides students, parents or guardians, and teachers with valid information concerning student progress and their attainment of the expected curriculum.

Assessment measure whether or not learning and/or learning objectives are being met. Assessment requires the gathering of evidence of student performance over a period to

measure learning and understanding. Effective faculty members will use assessment techniques regularly and on a daily basis to improve student learning and to guide instruction.
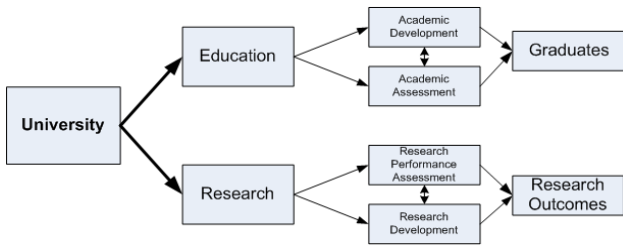

Figure 1. *Education & Research Activities in Universities*

2.3.2. Research Development (R_d) and Research Assessment (R_a)

Research development would be occurred through launching innovative internal and external research projects, promoting research environment by the university key personnel, recruiting research expertized faculty members, modern research facilities.

Assessment for research would be a review of conference and journal entries, written work, presentation, research papers, essays, story writing, tests, exams etc. and will display a sense of more permanent learning and clearer picture of a student's ability.

For assessing university education and research quality, different performance indicators may be developed to give information about the performance of an educational institution in different aspects of input, process, and outcome. Fig. 1 represents education and research development and assessment activities in the universities.

2.4. Modules of ITESCM Model [9]

In ITESCM model, students as well as internal and external projects are identified as raw materials. In contrast, graduates and research outcomes are recognized as finished products [10]. An integrated supply chain for the universities is illustrated in Fig. 2.
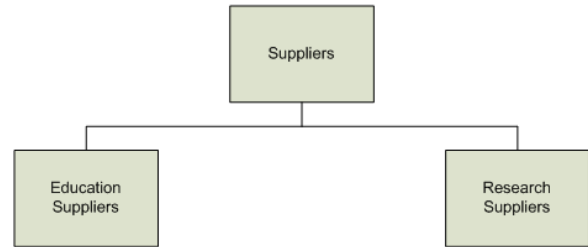

Figure 2. *Suppliers of the Universities*

2.4.1. Suppliers

In the conceptual model, the researcher identified two major parts in the suppliers, namely education suppliers and research suppliers for the universities [2], [11].

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.).
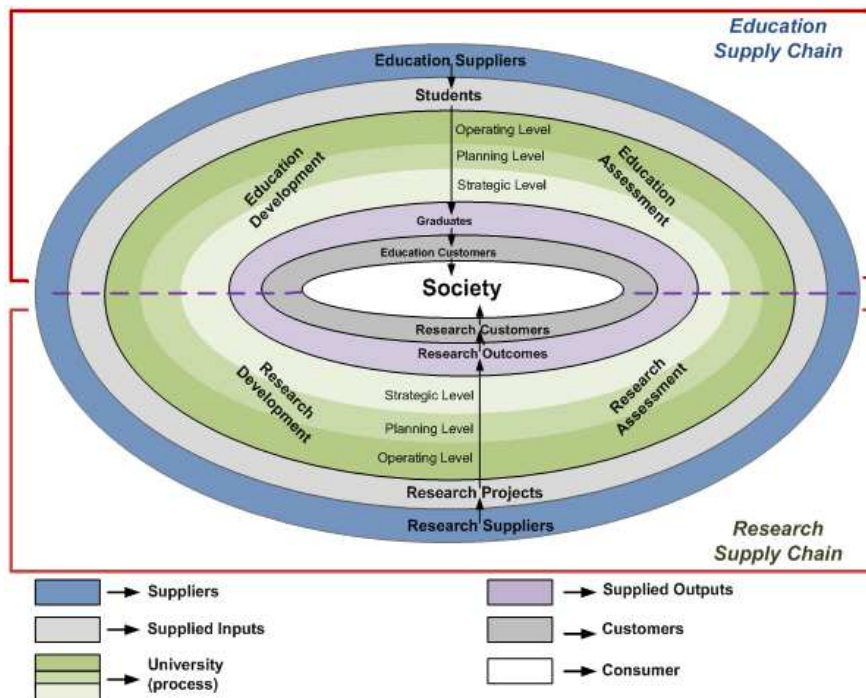

Figure 3. *An Integrated Supply Chain for the Universities*

2.4.2. Service Provider

A university is regarded as a service provider in this paper. The researcher identified two major wings including development and assessment for both education and research in the university. Fig. 3 represents educational supply chain 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 segment. The final outcomes of the university, i.e. graduates and research outcomes are delivered to the society [10].

2.4.3. Customers

In the conceptual model, the researcher identified two major parts in the customers namely education customers and research customers for the universities [5], [12].

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.).
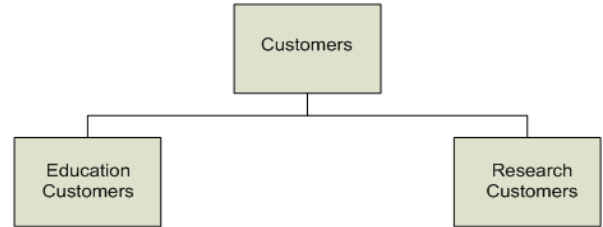

Figure 4. *Customers of the Universities*

2.4.4. Consumer

The researcher identifies 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 [1], [3], [4], [8].
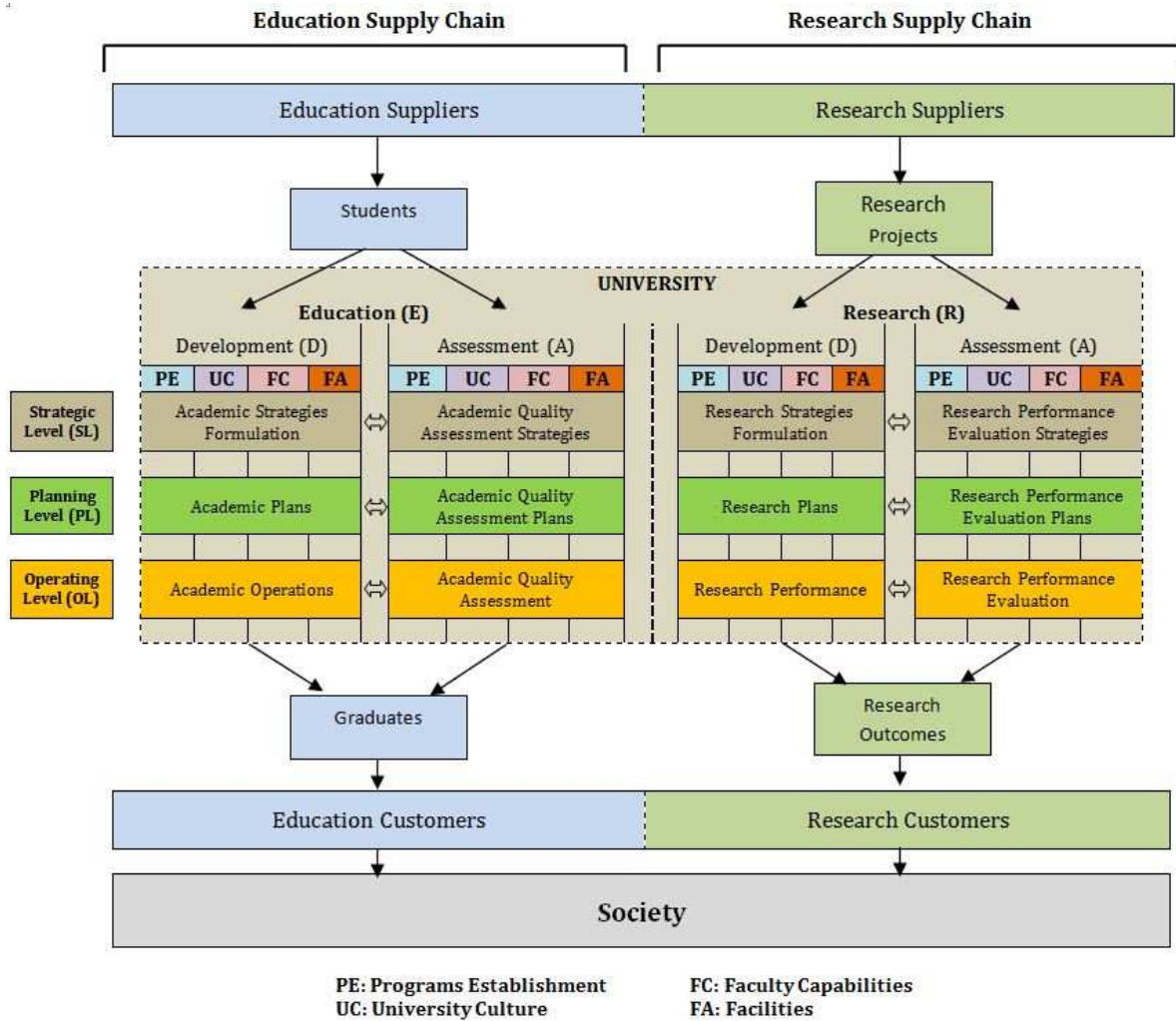

Figure 5. *The Redesigned ITESCM Model [22]*

Fig. 5 illustrates an education supply chain and a research supply chain, which together form the tertiary educational supply chain for the universities to produce quality outcomes. The three decision levels including strategic, planning and operating level in the university have been explored in this research model. These three decision phases build up an integrated form of educational supply chain for the universities.
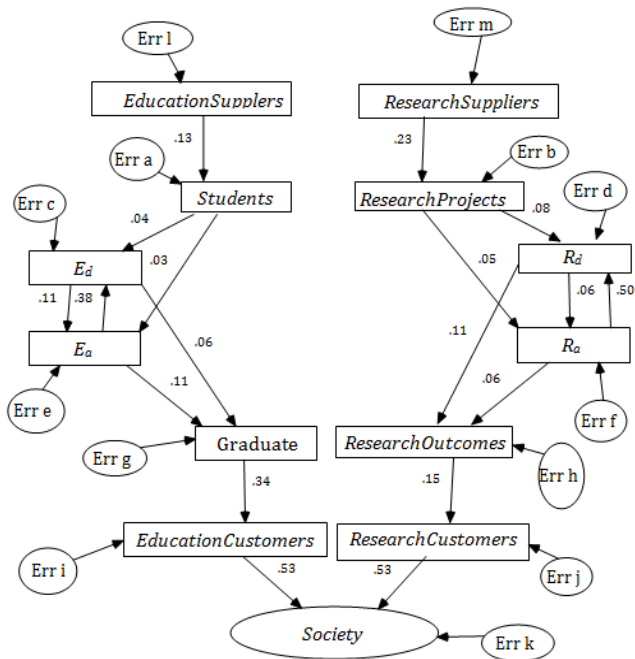

Figure 6. *AMOS Graphics Output of Overall Model (Standardized Estimates)*

2.4.5. Final Outcomes

(i) *Graduates with Desirable Quality*

Graduates with desirable quality is one of the final outcomes in the educational supply chain management. Benchmarking and value enhancement determinants are identified and incorporated in the process of the university to produce graduates with desirable quality.

(a) Graduates benchmarking includes knowledge (tacit or explicit), skills, competencies, capabilities, ethics, career development programs, etc.

(b) Graduates value enhancement includes source of fund (self-funding, scholarship, etc.), wisdom, faculty capabilities, facilities, Information & Communication Technology (ICT), research involvements, etc.

(ii) *Quality Research Outcomes*

The authors defined another final outcome of the educational supply chain management is quality research outcomes. The university develops strategic plans for multidisciplinary research to maintain an emphasis on research as an important component of the academic mission of the university. Research outcomes may include problem solution, pure theory, internal and external projects applications, thesis findings, research publications, or research findings, etc.

2.5. Multiple Linear Regression (MLR) Equations of ITESCM [6], [22]

The ITESCM consists of 8 separate models, namely Education Development, Education Assessment, Graduates, Research Development, Research Assessment, Research Outcomes, Supplied Inputs, and Supplied Outputs. The following Multiple Linear Regression (MLR) equations have been come up from there through AMOS (Analysis of Moment Structure).

2.5.1. Model A - Education Development (E_d)

$$E_{dPE} = 0.52E_{dPE_{SL}} + 0.49E_{dPE_{PL}} + 0.46E_{dPE_{QL}} \quad (1)$$

$$E_{dUC} = 0.63E_{dUC_{SL}} + 0.59E_{dUC_{PL}} + 0.57E_{dUC_{QL}} \quad (2)$$

$$E_{dFC} = 0.58E_{dFC_{SL}} + 0.63E_{dFC_{PL}} + 0.60E_{dFC_{QL}} \quad (3)$$

$$E_{dFA} = 0.55E_{dFA_{SL}} + 0.54E_{dFA_{PL}} + 0.50E_{dFA_{QL}} \quad (4)$$

2.5.2. Model B - Education Assessment (E_a)

$$E_{aPE} = 0.64E_{aPE_{SL}} + 0.57E_{aPE_{PL}} + 0.56E_{aPE_{QL}} \quad (5)$$

$$E_{aUC} = 0.60E_{aUC_{SL}} + 0.60E_{aUC_{PL}} + 0.55E_{aUC_{QL}} \quad (6)$$

$$E_{aFC} = 0.49E_{aFC_{SL}} + 0.51E_{aFC_{PL}} + 0.484E_{aFC_{QL}} \quad (7)$$

$$E_{aFA} = 0.63E_{aFA_{SL}} + 0.60E_{aFA_{PL}} + 0.58E_{aFA_{QL}} \quad (8)$$

2.5.3. Model C - Graduates

$$E_d = 0.63E_{dPE} + 0.70E_{dUC} + 0.65E_{dFC} + 0.65E_{dFA} \quad (9)$$

$$E_a = 0.68E_{aPE} + 0.74E_{aUC} + 0.69E_{aFC} + 0.66E_{aFA} \quad (10)$$

$$\text{Graduates} = 0.97E_d + 0.92E_a \quad (11)$$

2.5.4. Model D - Research Development (R_d)

$$R_{dPE} = 0.59R_{dPE_{SL}} + 0.47R_{dPE_{PL}} + 0.50R_{dPE_{QL}} \quad (12)$$

$$R_{dUC} = 0.64R_{dUC_{SL}} + 0.61R_{dUC_{PL}} + 0.62R_{dUC_{QL}} \quad (13)$$

$$R_{dFC} = 0.66R_{dFC_{SL}} + 0.62R_{dFC_{PL}} + 0.65R_{dFC_{QL}} \quad (14)$$

$$R_{dFA} = 0.63R_{dFA_{SL}} + 0.63R_{dFA_{PL}} + 0.63R_{dFA_{QL}} \quad (15)$$

2.5.5. Model E - Research Assessment (R_a)

$$R_{aPE} = 0.64R_{aPE_{SL}} + 0.60R_{aPE_{PL}} + 0.67RE_{aPE_{QL}} \quad (16)$$

$$R_{aUC} = 0.66R_{aUC_{SL}} + 0.63R_{aUC_{PL}} + 0.65R_{aUC_{QL}} \quad (17)$$

$$R_{aFC} = 0.53R_{aFC_{SL}} + 0.65R_{aFC_{PL}} + 0.62R_{aFC_{QL}} \quad (18)$$

$$R_{aFA} = 0.53R_{aFA_{SL}} + 0.68R_{aFA_{PL}} + 0.53R_{aFA_{QL}} \quad (19)$$

2.5.6. Model F - Research Outcomes

$$R_d = 0.60R_{dPE} + 0.71R_{dUC} + 0.63R_{dFC} + 0.67R_{dFA} \qquad (20)$$

$$R_a = 0.67R_{aPE} + 0.72R_{aUC} + 0.64R_{aFC} + 0.69R_{aFA} \qquad (21)$$

$$\text{Research Outcomes} = 0.99R_d + 0.89R_a \qquad (22)$$

2.5.7. Model G - Supplied Inputs

$F_{University}$ = 0.41 Students +0.38 ResearchProjects
= 0.41 [0.13 EducationSuppliers] + 0.38 [0.23 ResearchSuppliers]
= 0.05EducationSuppliers + 0.09ResearchSuppliers $\qquad (23)$

2.5.8. Model H - Supplied Outputs

$F_{Society}$ = 0.61EducationCustomers + 0.61 ResearchCustomers
= 0.61 [0.34Graduates] + 0.61 [0.15ResearchOutcomes]
= 0.21Graduates + 0.09ResearchOutcomes $\qquad (24)$

2.5.9. Overall Model

The equation of overall model (25) of ITESCM has been evolved after combining all equations (1 to 24) of eight separate models.

$F_{Society}$ = 0.61EducationCustomers + 0.61 ResearchCustomers
= 0.61 [0.34Graduates] + 0.61 [0.15ResearchOutcomes]
= 0.21Graduates + 0.09ResearchOutcomes
= 0.21 [$0.97E_d + 0.92E_a$] + 0.09 [$0.99R_d + 0.89R_a$]
= $0.20E_d + 0.19E_a + 0.09 \ R_d + 0.08R_a$

$F_{Society}$ = [$0.126E_{dPE} + 0.14E_{dUC} + 0.13E_{dFC} + 0.126E_{dFA}$] + [$0.129E_{aPE} + 0.141E_{aUC} + 0.131E_{aFC} + 0.125E_{aFA}$] + [$0.054R_{dPE} + 0.064R_{dUC} + 0.057R_{dFC} + 0.06R_{dFA}$] + [$0.054R_{aPE} + 0.058R_{aUC} + 0.059R_{aFC} + 0.055R_{aFA}$]

$$F_{Society} = [\ 0.067E_{dPE_{SL}} + 0.063E_{dPE_{PL}} + 0.059E_{dPE_{OL}} +$$
$$0.074E_{dUC_{SL}} + 0.069E_{dUC_{PL}} + 0.065E_{dUC_{OL}} +$$
$$0.078E_{dFC_{SL}} + 0.084E_{dFC_{PL}} + 0.08E_{dFC_{OL}} +$$
$$0.071E_{dFA_{SL}} + 0.069E_{dFA_{PL}} + 0.065E_{dFA_{OL}}\ ] +$$
$$[\ 0.084E_{aPE_{SL}} + 0.076E_{aPE_{PL}} + 0.074E_{aPE_{OL}} +$$
$$0.086E_{aUC_{SL}} + 0.086E_{aUC_{PL}} + 0.076E_{aUC_{OL}} +$$
$$0.065E_{aFC_{SL}} + 0.067E_{aFC_{PL}} + 0.063E_{aFC_{OL}} +$$
$$0.08E_{aFA_{SL}} + 0.078E_{aFA_{PL}} + 0.074E_{aFA_{OL}}\ ] +$$
$$[\ 0.032R_{dPE_{SL}} + 0.024R_{dPE_{PL}} + 0.026R_{dPE_{OL}} +$$
$$0.041R_{dUC_{SL}} + 0.039R_{dUC_{PL}} + 0.039R_{dUC_{OL}} +$$
$$0.037R_{dFC_{SL}} + 0.034R_{dFC_{PL}} + 0.036R_{dFC_{OL}} +$$
$$0.038R_{dFA_{SL}} + 0.038R_{dFA_{PL}} + 0.038R_{dFA_{OL}}\ ] +$$
$$[0.034R_{aPE_{SL}} + 0.032R_{aPE_{PL}} + 0.036R_{aPE_{OL}} +$$
$$0.038R_{aUC_{SL}} + 0.036R_{aUC_{PL}} + 0.038R_{aUC_{OL}} +$$
$$0.032R_{aFC_{SL}} + 0.039R_{aFC_{PL}} + 0.037R_{aFC_{OL}} +$$
$$0.029R_{aFA_{SL}} + 0.037R_{aFA_{PL}} + 0.029R_{aFA_{OL}}\ ] \qquad (25)$$

3. Methodology

The analysis of this research is based on secondary data, including books, journals, conference papers, online databases, digital libraries, etc. Extensive SCM research papers of academicians and practitioners are evolved from renowned international journals, namely PROQUEST, EMERALD, EBSCO, IEEE, ACM, JSTOR, Science Direct, etc. The research also considered the primary data which includes interviews and discussions with the creator of ITESCM model and researchers of the related field.

4. Discussion/ Prospect of ITESCM on ICT Application

Information and Communication Technology (ICT) can contribute to global access to education, the delivery of quality learning and teaching, teachers' development and more efficient education management, governance and administration. Application of plagiarism software, particularly *Turnitin* assess the research as well as students' assignments. Again, application of *Blackboard* represents education development through the application of ICT. In case of higher education, the essential elements of ICTs (hardware, software, connectivity, the Internet) can be structured with applications in the four key operational functions of ITESCM model namely program establishment, university culture, faculty capabilities and facilities.

Through the ICT application it would be easier to find out how many schools, departments or major subject have been introduced compared to previous year(s) to measure the educational development of the university. Similarly information related to academic good governance by university council, newly employed professors, associate professors and their background, university's newly included academic and supportive facilities could be kept on track through this application.

Assessment of education in terms of assurance of program, academic excellence, faculty's performance evaluation in terms of department, school or whole university, academic and supportive facilities quality assessment could be found out.

The development in research sector of the entire university as well as school or department wise can be notified using the application. Individual teacher's research contribution as well as the laboratory enhancement, establishment etc. are also can be demonstrated through the application.

Moreover, the ICT application based on ITESCM model can be designed to evaluate the quality assurance of research infrastructure establishment as well as the faculty performance on research sector in terms of all three decision levels namely strategic, planning and operating level.

5. Conclusion

It is an amazing fact that several researchers had developed supply chain management models mostly for improving business operations in profitable organizations. However, ITESCM, Integrated Tertiary Education Supply Chain Management, model links educational management with

general business management. The future goals of this research is to develop a software by which any university administrators can evaluate their performances based on the parameters of ITESCM which would be similar to ERP software. From a managerial point of view, the software application of this model could provide a novel approach to developing and assessing supply chain management application in the academia. Through it university outcomes in different stages would be derived through the equations 1 to 28 and expressed in terms of different scale for further improvement. Moreover, without using the equations, it is possible to apply ITESCM model by the software through ICT application.

Nomenclature

E_{dPE} : Programs Establishment in Educational Development

$E_{dPE_{SL}}$: Strategic Level decisions at Programs Establishment in Educational Development

$E_{dPE_{PL}}$: Planning Level decisions at Programs Establishment in Educational Development

$E_{dPE_{OL}}$: Operating Level decisions at Programs Establishment in Educational Development

E_{dUC} : University Culture in Educational Development

$E_{dUC_{SL}}$: Strategic Level decisions at University Culture in Educational Development

$E_{dUC_{PL}}$: Planning Level decisions at University Culture in Educational Development

$E_{dUC_{OL}}$: Operating Level decisions at University Culture in Educational Development

E_{dFC} : Faculty Capabilities in Educational Development

$E_{dFC_{SL}}$: Strategic Level decisions at Faculty Capabilities in Educational Development

$E_{dFC_{PL}}$: Planning Level decisions at Faculty Capabilities in Educational Development

$E_{dFC_{OL}}$: Operating Level decisions at Faculty Capabilities in Educational Development

E_{dFA} : Facilities in Educational Development

$E_{dFA_{SL}}$: Strategic Level decisions at Facilities in Educational Development

$E_{dFA_{PL}}$: Planning Level decisions at Facilities in Educational Development

$E_{dFA_{OL}}$: Operating Level decisions at Facilities in Educational Development

E_{aPE} : Programs Establishment in Educational Assessment

$E_{aPE_{SL}}$: Strategic Level decisions at Programs Establishment in Educational Assessment

$E_{aPE_{PL}}$: Planning Level decisions at Programs Establishment in Educational Assessment

$E_{aPE_{OL}}$: Operating Level decisions at Programs Establishment in Educational Assessment

E_{aUC} : University Culture in Educational Assessment

$E_{aUC_{SL}}$: Strategic Level decisions at University Culture in Educational Assessment

$E_{aUC_{PL}}$: Planning Level decisions at University Culture in Educational Assessment

$E_{aUC_{OL}}$: Operating Level decisions at University Culture in Educational Assessment

E_{aFC} : Faculty Capabilities in Educational Assessment

$E_{aFC_{SL}}$: Strategic Level decisions at Faculty Capabilities in Educational Assessment

$E_{aFC_{PL}}$: Planning Level decisions at Faculty Capabilities in Educational Assessment

$E_{aFC_{OL}}$: Operating Level decisions at Faculty Capabilities in Educational Assessment

E_{aFA} : Facilities in Educational Assessment

$E_{aFA_{SL}}$: Strategic Level decisions at Facilities in Educational Assessment

$E_{aFA_{PL}}$: Planning Level decisions at Facilities in Educational Assessment

$E_{aFA_{OL}}$: Operating Level decisions at Facilities in Educational Assessment

R_{dPE} : Programs Establishment in Research Development

$R_{dPE_{SL}}$: Strategic Level decisions at Programs Establishment in Research Development

$R_{dPE_{PL}}$: Planning Level decisions at Programs Establishment in Research Development

$R_{dPE_{OL}}$: Operating Level decisions at Programs Establishment in Research Development

R_{dUC} : University Culture in Research Development

$R_{dUC_{SL}}$: Strategic Level decisions at University Culture in Research Development

$R_{dUC_{PL}}$: Planning Level decisions at University Culture in Research Development

$R_{dUC_{OL}}$: Operating Level decisions at University Culture in Research Development

R_{dFC} : Faculty Capabilities in Research Development

$R_{dFC_{SL}}$: Strategic Level decisions at Faculty Capabilities in Research Development

$R_{dFC_{PL}}$: Planning Level decisions at Faculty Capabilities in Research Development

$R_{dFC_{OL}}$: Operating Level decisions at Faculty Capabilities in Research Development

R_{dFA} : Facilities in Research Development

$R_{dFA_{SL}}$: Strategic Level decisions at Facilities in Research Development

$R_{dFA_{PL}}$: Planning Level decisions at Facilities in Research Development

$R_{dFA_{OL}}$: Operating Level decisions at Facilities in Research Development

R_{aPE} : Programs Establishment in Research Assessment

$R_{aPE_{SL}}$: Strategic Level decisions at Programs Establishment in Research Assessment

$R_{aPE_{PL}}$: Planning Level decisions at Programs Establishment in Research Assessment

$R_{aPE_{OL}}$: Operating Level decisions at Programs Establishment in Research Assessment

R_{aUC} : University Culture in Research Assessment

$R_{aUC_{SL}}$: Strategic Level decisions at University Culture in Research Assessment

$R_{aUC_{PL}}$: Planning Level decisions at University Culture in Research Assessment

$R_{aUC_{OL}}$: Operating Level decisions at University Culture in Research Assessment

R_{aFC}:   Faculty Capabilities in Research Assessment

$R_{aFC_{SL}}$:   Strategic Level decisions at Faculty Capabilities in Research Assessment

$R_{aFC_{PL}}$:   Planning Level decisions at Faculty Capabilities in Research Assessment

$R_{aFC_{OL}}$:   Operating Level decisions at Faculty Capabilities in Research Assessment

R_{aFA}:   Facilities in Research Assessment

$R_{aFA_{SL}}$:   Strategic Level decisions at Facilities in Research Assessment

$R_{aFA_{PL}}$:   Planning Level decisions at Facilities in Research Assessment

$R_{aFA_{OL}}$:   Operating Level decisions at Facilities in Research Assessment

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