

The Effect of ICT & Digital Supply Chain (DSC) in Higher Education Institutions

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Abstract— The study identifies the effect of the implementation of information and communication technology-driven digital supply chain (ICT-DSC) model in education institutes. Besides that, the study defines the integration and evaluation criteria of the Digital Supply Chain model in the academic industry. Finally, an integrated model for educational institutes in Bangladesh is developed through the study. This ICT application-based DSC model would formulate a requirement roadmap to express a guideline for the educational technology impact. It would fulfil all relevant stakeholders desire to diminish risks and increase understanding to overcome drawbacks. The study would also propose a systematic methodology that initiates a considerate process for all relevant stakeholders within an academic institution. Technology Acceptance Model (TAM) was adopted as a theoretical framework. To conduct the study, primary data have been collected from 276 stakeholders of academic-industry in Bangladesh who were interviewed about their interest and performance ICT-DSC in educational institutions. As a statistical tool, SPSS was used for pilot test and PLS for data analysis. To elaborate on the current ICT-DSC execution in the academic infrastructure of Bangladesh. Also, this research outcome is to produce an integrated theoretical model for educational institutions in Bangladesh. This is one of the most recent research studies on academic institutions in Bangladesh.

Keyword— *Education supply chain, DSC*

1. Introduction

Supply Chain Management (SCM) is a network of interconnected components that are involved in providing packages of products and services required by end-users in the supply chain [10]; [13]. Management of the supply chain focuses movement and storage of raw materials, stock in progress and finished products to the origin point of consumption. Also, SCM is planning, designing, implementing, controlling and supervising the activities of the supply chain to create net value, build a competitive infrastructure for business and education industry [15]; [19]; [26]; [28]. An evolutionary progression

of supply chain management study with its conceptualization and incorporation in different industries has been observed over the years. Pathik and Habib (2019) conducted a similar research in the format of a case study analysis to conceptualize educational supply chain management based on their survey [1]; [2]; [3]. With chronological advancement, eventually came up with a model named Integrated Tertiary Education Supply Chain Model (ITESCM) through an empirical model, and consequently, [1]; [5]; [8] revised and redesigned that ITESCM model to increase its understandability and make it more user-friendly to aid practical applicability in academic industry.

The identification, implementation and evaluation of Digital Supply Chain (DSC) require a framework to build. Many benefits of digitization are offered for the education industry. The digital education supply chains are still unexploited because critical organizational changes or management are frequently neglected. It aims to provide the basis for future research in this area. In this context, this study provides a framework for development and connect digitization in academic supply chains. To start with the task of implementing and verifying the DSC, it is necessary to determine its importance stages, which are not only essential for supply chains to manage its works best (as a complete DSC conversion), but also vital for a typical supply chain to capture functional switching to DSC.

Concepts of digital supply chain management in education are not yet recognized adequately for implementing in the real world [29]. Academic and industrial researchers suggested various types of approaches to assess the potential possibilities of DSC. Still, so far, not substantial number of studies have been conducted on how to build a complete conceptual or conceptual framework of DSC. This study analyses the benefits of converting DSC to guide researchers and industry experts in the organization to visualize, and research on DSC for

the future. DSC model is an empirical academic supply chain model that focuses on the theoretical part of Education Management in the educational institutes [30]. It establishes quality graduates and authentic high impact research findings as its outcomes. DSC has theoretically identified the essential components and stakeholders to produce these outcomes [31].

Nevertheless, its implementation has not yet been researched [32]. An analysis from stakeholder's perspective would identify the need for digitization of the Academic SCM. With the established concept of Industry 4.0, it is already a fact that regardless of type of organizations, ICT driven operations positively impact on their productivity and efficiency [6], [33]. But neither any research has been done, nor any existing model demonstrates the correlation between ICT and Academic Supply Chain management [32]. The integration of ICT can ensure collaboration among SCM's external and internal entities [7]. This integration can increase the performance and implement-ability of Academic SCM [30]. Hence, an ICT enabled digital supply model can provide a specific guideline for academic institutes to ensure seamless collaboration among their stakeholders and help achieve the goal of producing quality graduates and authentic high impact research findings [16]. Consequently, there is a need to explore the real implementation of ICTDSC model by the universities and the possibilities of ICT integrating with the model DSC.

This study aims to explore the effects of ICT driven DSC model on the tertiary academic institutes in terms of enhancing the outcomes. The Objectives of this study are to integrate and evaluate ICT driven DSC model, and to develop an integrated DSCM model for the academic institutes of Bangladesh.

2. Literature Review

The study adds prior knowledge and identifying significant bases to develop the DSC further to help academics and lead practitioners to look for future DSC. [1], [3], [8] explored an idea of using industry models in higher education institutes, which specified a reference to the concept of academic supply chain management. The study was conducted on students and employers from various university to integrating the idea into a decision-making process. However, the outcome of the research did not contribute to any significant model which can be

due to the reason that enterprise-level systems were themselves in their early stages of conceptual formulation.

In this work, we intend to close this research gap. This literature review attempts to answer the question of "how" to integrate the current importance of scanning on the supply chain in the education industry. The answer to this question implies Develop a framework that can be used for identification, achieve and evaluate the benefits that DSC can bring. Instead of providing experimental results and the results of this comprehensive review. Consequently, [3], [8] conducted an extensive case study to conceptualize an education SCM for a university. That study consisted of a survey on the relevant stakeholders of the university's supply chain, like, employees, customers, suppliers, which eventually illustrated in a strategic supply chain model for that university [8]. In this study, two separate supply chains were identified – student and research. In the student supply chain, the student was shown as both- raw material as well as a finished product [10]; [16].

On the other hand, in the research chain, ideas for research were shown as raw material and outcomes as the final product [12]; [13]. Nevertheless, this case, study-based research was not possible to be generalized as a theoretical concept of academic supply chain [14]; [15]. Moreover, the findings were also not very specific and objective by nature as it was only used in one university which is not enough to be denoted as a standard model [16]; [17]; [18]; [19].

In ICTDSC model, students are identified as raw materials in the education supply chain, and internal and external research projects are identified as raw materials in the research chain [16]; [17]. In contrast, outcomes- graduates and research outcomes are recognized as finished products which would be delivered to the society [17]. The combined digital supply chain in the academic-industry model for the universities is demonstrated in this study [10]. Finally, [16], [27] adopted that model to construct in universities of Bangladesh.

This study represents a novel approach for tertiary educational institutions; though it is a limitation, however, it unlocks the further frontier for current university administrators and prospective investors to review their course of actions in terms of ICT-

based academic DSC for the well-being of the society. The study would concentrate on the core educational management activities of a university in Bangladesh.

ICT application-based ICT-DSC model would formulate a requirement of a roadmap to express a guideline for realizing the educational technology impact [26]. It would fulfil all relevant stakeholders desire to diminish risks and increase understanding to overcome drawbacks [28]. The study would also propose a systematic methodology that initiates a considerate process for all relevant stakeholders within an academic institution. Also, it attempts to fulfil the need to know what is around the next endeavors [28]. The theoretical significance of the study is to come up with a useful contemporary concept based academic supply chain model through ICT integration [29]. The application significance of the study would be to ensure the betterment of the university and eventually of the ultimate consumer, i.e. the society, with desired outcomes [3]; [8].

Like the idea of ‘lean thinking model’ that the Chief Engineer Taiichi Ohno of Toyota came up with for manufacturing industry, Morien compared it with the Higher Education Institutes where ‘wastes’ can be reduced introducing digitalization in its Academic Supply Chain [4]; [30]. Eight types of ‘wastes’ are categorized with explanation in Table 1.

Table 1: Waste of Education

Type of waste	Explanation
Overproduction	Many a times, a good amount of effort and time spent on irrelevant and excessive contents that are unnecessary for the course curriculum.
Waiting	The time gap between the knowledge learnt and real-life application. Many a times, the gained knowledge become outdated, unrelated, or volatile. Another form of waiting in least developed or developing countries is the time gap between students finishing their grade 12 studies and starting their higher education, often

Type of waste	Explanation
	referred as ‘session jam’, which has worsened due to covid-19 pandemic in HEIs lacking digital infrastructure.
Transport	Repeating common topics in multiple courses and the physical distance between classrooms are wastage of valuable resources, which delays availing the service of education.
Inappropriate processing	Manual processes of education excluding digitalization makes classroom knowledge unproductive and futile.
Inventory	Valuable resources are at always risk of being forgotten or lost (referred as leakage in Lean Supply Chain Management).
Unnecessary & excessive motion	High dependency on past knowledge and absence of comprehensive curriculum often causes students and instructors to experience higher level of unnecessary movements between topics and courses.
Defects	Trivial and insubstantial learning, volatility of knowledge, inability to grasp topics, adoption of unfair means, irrelevant and outdated curriculum.
Recognition of staff	Absence of acknowledgement and recognition of teacher’s and student’s capabilities, lack of proper feedback instruments and unavailable channel of materializing intellectual ideas.

3. Conceptual Framework

This research introduces the “Technology Acceptance Model” theory of [29] as the leading underpinning theory. The theoretical framework of this study constructed as the following:

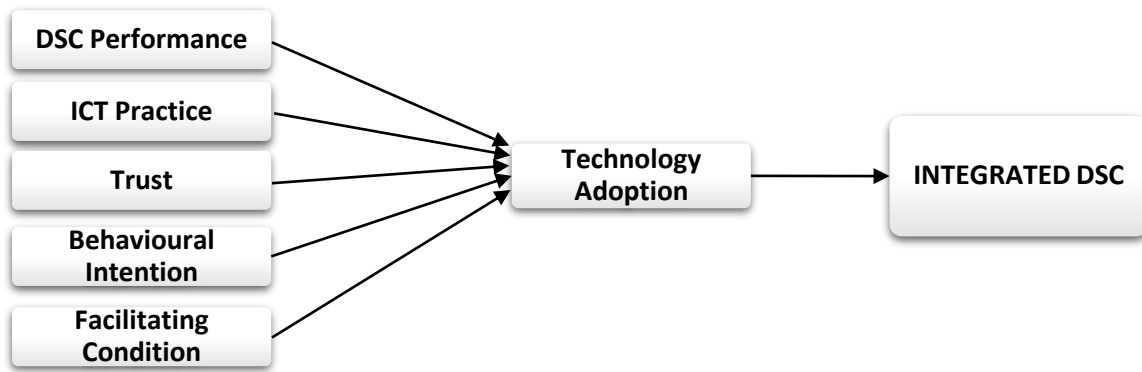


Figure 1. Conceptual framework of integrated ICT-DSC model

To test the relationships among the component of the conceptual framework of integrated ICT-DSC model, several hypotheses have been outlined as follows:

H1: *ICT driven practices positively effect the Technology Adoption in the education industry in Bangladesh.*

- **H1A:** *DSC performance has a positive effect on an integrated ICT-DSC model in the education industry in Bangladesh.*
- **H1B:** *ICT practice has a positive effect on an integrated ICT-DSC model in the education industry in Bangladesh.*
- **H1C:** *Trust has a positive effect on an integrated ICT-DSC model in the education industry in Bangladesh.*
- **H1D:** *Behavioral Intention has a positive effect on an integrated ICT-DSC model in the education industry in Bangladesh.*
- **H1E:** *Facilitating Condition has a positive effect on an integrated ICT-DSC model in the education industry in Bangladesh.*

H2: *Technology Adoption has a positive effect on an integrated ICT-DSC model in the education industry in Bangladesh.*

H3: *DSC performance, ICT practice, Trust, Behavioral Intention, and Facilitating condition has a positive impact on Technology Adoption moderation effect in integrated ICT-DSC model in the education industry in Bangladesh.*

4. Design & Methodology

Research design entails a sequence of rational decision-making alternatives. It is a planned process used in research, and the process expands the decisions from general assumptions through data

collection methods and analysis to findings [12]. The present research was correlational in nature as the researcher collected data relevant to the variables and analyzed the relationship, as stated in the conceptual framework. The researcher followed deductive reasoning, which is consistent with the positivist approach. The quantitative research approaches were observed in this research. The researcher developed the hypothesis based on the theory and relevant past literature, which were tested using statistical applications. Identically, the study used cross-sectional as data were collected at one point of time, and the conclusion was drawn from studying the specific location of time. For this, the data of the study were collected from the individual stakeholder in academia, student and management of university [2]; [3].

5. Results and Discussion

The results of the reliability analysis presented in Table 2. The value of Cronbach's alpha (α) must be equal to or greater than 0.7 for all scales. The results of the reliability test show that all values exceed 0.7. Therefore, it shows that all the elements are reliable to measure the opinion of the respondents.

Table 2: Reliability of Instruments

Scales	Items	Cronbach Alpha
DSC Performance	4	0.794
ICT Practice	4	0.745
Trust	6	0.821
Behavioral Attitude	4	0.745
Facilitating Condition	4	0.875
User Intention	5	0.832
Integrated ICT-DSC	5	0.798

Several authors have noticed that the context of the SCM might influence the relationships between ICT, DSC, and SC performance [22]. Different aspects have been proposed to investigate the influence of those factors, such as type of product replaceability, demand variability, or environmental munificence [24]. In the perspective of this paper, all variables that influences the behavioral intention to adopt technology among the stakeholders of tertiary education organizations are considered. Initially the study analyzed the existing research works that establishes the influence of digitization on SCM. Later, the variables that influences stakeholders to adopt technology and their correlation with the integrated DSC were studied [12].

Considering the above, there seems evidence to assume that our research model can be regarded as a representation of proven findings. The existing SCM model has four aspects, namely faculty capabilities, facilities, programs establishment, and university culture. Each aspect affects the organization in three layers of decision making categorically on four segments of the DSC model, which are education development, education assessment, research development and research assessment [8]. To integrate ICT with SCM in academia, the Digital SCM performance expectations and attributes effecting users' intention to adopt digitization in Academic SCM were studied and the correlations were positively supported.

6. Conclusion

The research contributed a piece of new information or knowledge to improve DSC model into ICT-DSC into a robust, unique model for better academic supply chain. This study explored the effects of ICT driven DSC model on the tertiary academic institutes from the perspective of the stakeholders, like, students, educators, administrators, guardians, and employers. enhancing the outcomes. The hypotheses have successfully established the correlation among the prime attributes, DSC Performance, ICT Practices, Trust, Behavioral Intention and Facilitating condition with users' technology adoption, and in turn with Integrated Digital Supply Chain Management for Higher Education Institutes (HEIs). This study will be a guideline to be adopted by Higher Education Institutions to explore the aspects of integration and

evaluation of ICT driven DSC model.

This study is a novel approach for HEIs; though it is a limitation, however, it unlocks the future frontier for the administrators and prospective investors to review their strategic decision in terms of ICT enabled academic DSC operation for the betterment of the society.

Besides that, this research can help education ministry to calibrate the ICT driven operations of the education system nationwide. It also helps the society to understand and implement proper education service and adaptability of modern education.

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Appendix A

Variables	Items	Adapted from
DSC Performance	I find DSC Performance useful in my daily life.	[12]
	DSC Performance is related to my chances of achieving tasks that are important to me.	
	DSC Performance is related to my accomplishment of tasks more quickly.	
	DSC Performance is related to my productivity increment.	
ICT Practice	I find ICT practice useful in my job.	[23]
	Using ICT enables me to accomplish tasks more quickly.	
	Using ICT increases my productivity.	
	If I use ICT, it will increase my chances of getting a raise.	
Trust	I believe that the digital supply chain is trustworthy.	[29], [20]
	I trust in the digital supply chain.	
	I do not doubt the integrity of digital supply chain.	
	I feel assured that legal and technological structures adequately protect me from problems on the digital supply chain.	
	Even if not monitored, I would trust the digital supply chain to do the job right.	
	The digital supply chain can fulfil its task.	
Behavioral Intention	I intend to use digital supply chain in the future.	[12]
	I will always try to use the digital supply chain in my daily life.	
	I plan to use digital supply chain in future.	
	I predict I would use a digital supply chain in the future.	
Facilitating Condition	I have the resources necessary to use DSC in the academic institution.	[29], [12]
	I have skills necessary to use DSC in the academic institution.	
	DSC is compatible with other technologies I use.	
	I can get help from others when I have difficulties using DSC in the academic institution.	
Technology Adoption	I believe the academic supply chain need proper technology adoption.	[11]
	Academic supply chain stakeholders need proper technology knowledge.	
	User manual can enhance the productivity of academic supply chain	
	Users of Academic supply chain management need guideline.	
	Organizations stakeholder need proper adaptability on technology adoption	
Integrated ICT-DSC	Integrated ICT-DSC provides me with information relevant to my needs.	[11]
	Integrated ICT-DSC provides me with enough information on academic supply chain.	
	Integrated ICT-DSC provides me with accurate information on the academic supply chain.	
	Integrated ICT-DSC provides me with up-to-date information on academic supply chain.	
	Integrated ICT-DSC will provide relevant information about the academic supply chain.	