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## AN ANALYSIS ON INTEGRATED SUPPLY CHAIN MANAGEMENT IN ACADEMIC UNIVERSITY LIBRARY



DOCTOR OF PHILOSOPHY UNIVERSITI UTARA MALAYSIA 2022



Awang Had Salleh Graduate School of Arts And Sciences

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#### Abstrak

Pengurusan rantaian bekalan telah digunakan secara meluas dalam industri pembuatan dan dibuktikan oleh para penyelidik dan pengamal sebagai amalan terbaik. Ia boleh memuaskan pihak berkepentingan, meningkatkan hasil, dan mengurangkan jumlah kos. Walau bagaimanapun, sangat sedikit industri perkhidmatan, terutamanya perpustakaan akademik, telah melaksanakan pengurusan rantaian bekalan. Beberapa masalah yang berkaitan dengan rantaian bekalan perpustakaan akademik harus ditangani, seperti cara memodelkan entiti dan fungsinya untuk amalan umum rantaian bekalan perpustakaan akademik, dan hubungan antara entiti ini sebagai model bersepadu. Penyelidikan ini membangunkan model rantaian bekalan perpustakaan akademik bersepadu, yang boleh digunakan untuk perancangan strategik perpustakaan akademik. Ia mengenal pasti entiti dan fungsinya untuk rantaian bekalan perpustakaan akademik, membina model konsep rantaian bekalan bersepadu perpustakaan akademik, dan menganalisis hubungan antara entiti model yang baru dibangunkan. Penyelidikan ini menggunakan pendekatan kualitatif dan kuantitatif untuk mencapai objektif kajian. Proses mengenal pasti entiti dan fungsinya dalam rantaian bekalan perpustakaan akademik telah dicapai dengan menggunakan teori kajian literatur dan teknik analisis kandungan. Model konsep rantaian bekalan yang dicadangkan telah dibangunkan berdasarkan kaedah pemikiran sistem. Akhirnya, ia telah disahkan melalui kaedah Fuzzy Delphi, iaitu satu teknik pertimbangan pakar. Tiga model konsep rantaian bekalan perpustakaan akademik telah berjaya dibangunkan: Model Rantaian Bekalan Perpustakaan Akademik secara Pandangan Holistik, Model Membuat Keputusan Pembelian Bahan dan Model Rantaian Bekalan Perpustakaan Akademik Bersepadu. Ketiga-tiga model ini telah disahkan oleh pustakawan akademik. Penyelidikan ini memperluaskan pengetahuan tentang teori rantaian bekalan, terutamanya dalam rantaian bekalan perpustakaan akademik. Ia juga menyumbang kepada pengurusan perpustakaan akademik dalam merancang dan merangka pelan hala tuju perpustakaan bagi meningkatkan perkhidmatan berkualiti untuk semua pihak berkepentingan.

**Kata kunci:** Rantai bekalan, Rantai bekalan perkhidmatan, Perpustakaan akademik, Kaedah pemikiran sistem, Kaedah Fuzzy Delphi

#### Abstract

Supply chain management has been widely used in manufacturing industries and proven by researchers and practitioners as a best practice. It can satisfy stakeholders, increase revenues, and decrease the total costs. However, very few service industries, particularly the academic library, have implemented supply chain management. Several problems related to the academic library supply chain should be addressed, such as how to model the entities and their functions for the general practice of an academic library supply chain, and the linkage among these entities as an integrated model. This research develops an integrated academic library supply chain model, which can be used for the strategic planning of the academic library. It identifies entities and their functions for the academic library supply chain, constructs a conceptual model of the integrated supply chain of the academic library, and analyzes the interrelationship among the newly developed model entities. This research used both qualitative and quantitative approaches to achieve the research objectives. The process of identifying the entities and their functions of the academic library supply chain was accomplished by using a theoretical literature review and content analysis techniques. The proposed conceptual supply chain model was developed based on the system thinking method. Eventually, it was validated through the Fuzzy Delphi method, an expert judgment technique. Three conceptual models for the supply chain academic library were successfully developed: The Holistic View of Supply Chain Model for Academic Library, the Material Purchasing Decision Making Model, and the Integrated Academic Library Supply Chain Model. These three models were validated by the academic librarians. This research expands the knowledge of supply chain theory, particularly in the supply chain academic library. It also contributes to the academic library management in planning and formulating a roadmap for the library to increase its quality services for all stakeholders.

**Keywords:** Supply chain, Service supply chain, Academic Library, System thinking method, Fuzzy Delphi method

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## List of Abbreviations

SC	Supply Chain
FDM	Fuzzy Delphi Method
GSCF	Global Supply Chain Forum
APQC	American Productivity and Quality Center
PCF	Process Classification Framework
SCC	Supply Chain Council
CSCMP	Convocation of Supply Chain Management Professionals
SSC	Service Supply Chain
ISCP	Innovative Supply Chain Practices
SCOR	Supply Chain Operations Reference
AHP	Analytic Hierarchy Process
ANP	Analytic Network Process
MCDM	Multi-Criteria Decision Making
DEA	Data Envelopment Analysis
IFSM	Integrated Fuzzy-Stochastic Modelling
DES	Discrete Event Simulation
DM	Delphi Method
OPAC	Online Public Access Catalog
ILS	Integrated Library Systems
TFNs	Fuzzy Triangular Numbers
IALSC	Integrated Academic Library Supply Chain

#### CHAPTER ONE

#### **INTRODUCTION**

#### **1.1 Research Background**

#### 1.1.1 The Overview of the Supply Chain Network

Over the last 30 years, Supply Chain (SC) has been increasingly recognized as a vital source of competitive advantage (Chen, 2019). The supply chain system of any business enterprise helps it to strive in the active and complex world market (Manavalan & Jayakrishna, 2019). The core goal of SC is to deliver profits to supply chain stakeholders by improving their quality of service and providing a competitive price to their customers (Cooper, 2017). Besides that, supply chain management can develop finale customer satisfaction, increase supply chain member revenues and decrease total costs (Hugos, 2018). Moreover, some researchers have found connections between supply chain achievement and decrease in waste, enhancement of constant procedure, and excellent management of the material flows alongside the supply chain (Vanalle et al., 2017; De Steur et al. 2016). Nevertheless, there is a need for the evolution in SC to improve operations and outsourcing levels as well as reduce costs and competitive pressures due to globalization, the growing importance of e-commerce, and the intricacy of the supply chain (Stevenson, 2020; Reid & Sanders, 2019).

One of the issues being studied in the evolution of SC study is the complexity of the structure of the supply chain network (Nair & Reed-Tsochas, 2019; Govindan, Fattahi & Keyvanshokooh, 2017). In general, the structure of the supply chain network and its process may consist of producers or service providers gathering inputs from traders, sorting out these inputs, and transporting them to clients, as



illustrated in Figure 1.1 (Hugos, 2018 and Bäckstrand & Fredriksson, 2020).

*Figure 1.1* The general structure of a supply chain network.

Meanwhile, a complete description of the supply chain network is exemplified in Figure 1.2 and explained as follows. The supply chain network is a wide set of activities, which includes external supply chain members, internal functions, managers, personnel, and involvement in various process integration efforts. This supply chain network focuses on integrating and augmenting tasks within and around organizations for stakeholders' satisfaction (Fernandes et al., 2017; Bastas & Liyanage, 2019).



Figure 1.2 A supply chain network structure with different types of product flows

Today, the SC has now moved into the period of inter-system challenges. The accomplishment of an organization will be influenced by the administration's skill to integrate the organization's intricate linkage of trade relations. Other than manufacturing, the necessity of functional supply chain management is getting more critical for service companies too. To maximize competitive advantage via effective supply chain management, all service trades pursue original tactics to gain reorganization, restructuring, reengineering, and redesigning applications for the industry system processes. Moreover, supply chain management is also an important factor even for non-profit organizations. Managing a successful profit corporation differs significantly from managing a non-profit organization due to conflicting aims (Michalski, Botella, & Figiel, 2018). The non-profit organization's profits would mostly be used to balance the organization's expenditures.

Therefore, the efficacious management of service trades mostly necessitates an integrated supply chain management approach, with the high connection of each node in the supply chain and productive relations with both the suppliers and the clients, to advance the synergy advantage of cooperation in the chain (Mehdikhani & Valmohammadi, 2019; Irani et al. 2017).

#### **1.1.2** The Service Supply Chain

Management is now in the era of inter-network rivalry and the decisive success of an organization depends on the management's skill to integrate the complex network of business relationships. The supply chain for the service industry has taken us to new dimensions in the network of organizations. Most academics develop supply chain models for for-profit organizations, for example, in the manufacturing industry

(Ondieki, 2016; Khokhar et al., 2020) and quite a few tackled the issues regarding supply chain for the service industry (Liu et al. 2019; Leksono, Suparno & Vanany, 2017; Hussain, Khan & Al-Aomar, 2016). The service supply chain exists for meeting customer satisfaction where it creates profit for itself through the process of satisfying customer demand (Huda et al., 2014). For a better understanding, Figure 1.3 illustrates a simple example of a basic supply chain of a service industry.



Figure 1.3 The Basic Supply Chain of the Service Industry (Habib, 2017)

#### 1.1.3 Library Management

One of the institutions that offer services to customers or clients is a Library. Ages ago, the library is a common place for people to go for learns to read or study and have enjoyed the programs that the library offers. Some examples are individuals seeking new employment could learn skills to benefit them to develop a resume or students can have some quiet time and fast access to material for research in the library. Nowadays, the main goal of the library is not just providing a physical place for users, but it also plays the role to provide resources and services, to meet the needs of library members for information, education, and personal improvement, including leisure and recreation (Rubin, 2017). It also has a significant part in the improvement and maintenance of a society and it also gives the individual access to a wide and varied collection of knowledge, ideas, and opinions (Cottrell, 2019).

For any institution of higher learning, like university and college, the library, which is also known as the academic library is considered the most vital source for knowledge in academia. Academic libraries vary in size, from the modest resources found in small liberal arts colleges to the vast resources found at research universities (Hye, Nazri & Mustaffa, 2020; Beilin, 2017). According to Yang (2011), the functions of academic libraries are cultivating students' morals, developing students' scientific and cultural excellence, developing professional technical education, and providing encouraging environments for improving students' comprehensive excellence. In higher education institutions, the academic library has become a center of research activity where faculty members and students may desire to research along with other activities within some conceivable academic discipline. The resources of academic libraries usually reflect a huge range of interests and arrangements that directly or indirectly support the necessities of research and publication. Common service delivered by an academic library is closely related to customers/users (Kowalkowski et al. 2015). The academic library's general roles are classifying (selection), receiving (acquisition), forming (synthesis), conclusion (navigation), allocating (dissemination), serving (interpretation), educating (understanding), implying (application), and archiving (preservation) information in supporting the processes of teaching and learning as well as the activities of research and publication.

At the beginning of the 21st century, academic libraries start to initiate service improvements to upkeep a sequence of new ways to access information using advanced technology. The activities of improvement are innovative scholarly research and publication, further intensive practice plus supplying of digital resources, serving more and more diverse student population, ongoing high request from scholars for traditional resources and innovative styles of education, containing ICT-based and distance learning where libraries have had slight participation in the past. (Brophy, 2001). These new circumstances in the new era of IR 4.0 have had an academic library management team realize what academic library users want, along with the innovation in managing procedures of altering data content into valued data resources and other associated facilities.

Like the other profit-making organizations, for ages, the fundamental of a library's success depends on the quality of provided products, services, and information, needed by the library members (Waral, 2020). All these years, the academic library is evolving to do more with less, and the role of academic libraries becoming more sophisticated due to the evolution of IR 4.0. Library users' services preferences also have changed because of the emergence of digitalization, globalization, internationalization, and academic reputation.

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#### 1.1.4 Challenges of Academic Library Management

The current challenge of academic libraries is to cope with the digital era. In the process of converting a traditional library to digital status, numerous challenges will be faced by academic library management. Digitalizing the library for universities with large funding maybe will be not an issue, but this will be a drawback for universities with limited funding, especially those universities in underdeveloped or developing countries to invest in their academic libraries. Digitization is rather an exclusive venture which needs satisfactory planning and monitoring.

Firstly, universities and technical schools face the challenge of archiving periodicals and other technical literature. It is because data entry can be very difficult and expensive since it does not take care of local materials, resulting in the library management needing to digitalize the local materials on their own. During this process, developers need to consider materials' copyright regulations, while digitalizing or scanning, which requires permission from the publishers of materials (Cyriac, 2019). Moreover, electronic materials of archives must suit the application standard and the interface of the library management system should be user-friendly so that users can search for information with ease (Ahasanm & Haque, 2020; Ashton et al., 2019). Under the circumstance, it is of the time simpler and less expensive to give online links to existing advanced libraries, as opposed to beginning a computerized library all over again. The expansion in electronic uses in academic libraries is believed to be reflected in more online assets (Regazzi, 2012). A large quantity of electronic content saved on library websites (e.g., scientific papers in repositories and digital collections) will include a wide range of digital assets (Orduña-Malea & Regazzi, 2013).

The issue in digitalization is also closely related to the level of digital literacy among academic library providers and users. There is an issue of absence of specialized expertise, subsequently, most library digitization extends regularly run into issues. (Suciu & Fanea-Ivanovici, 2018). A high level of digital literacy is important for academic library management because it focuses on meeting customer expectations as technological and service prospects from academicians are increasing steadily (Forrest & Halbert, 2020). Furthermore, Meier (2016) theorizes that "organizational change in academic libraries is concerned primarily with changing titles and roles of existing positions and departments rather than with comprehensive reorganization". Some

added another scenario, which is endlessly decreasing levels of librarian role due to digitalization (Einasto, 2016). The assumptions from this study are digital platforms can accommodate the library users' needs and the role of the librarian focuses more on handling the digital resources, rather than entertaining the library users' needs.

Other than an issue of digitalization, there is an issue where the university's community looking at the library as a part of internationalization and globalization support systems (De Wit et al. 2017). Some of the academic libraries are currently adding to globally focused curricular activities, by supporting research and exploration abroad projects and global branch grounds, as internationalization proclaims on numerous grounds (Huang, 2016). Academic libraries are struggling to determine if and how they can help their universities' internationalization programs with their limited resources, and how they can integrate this work into their current range of services (Cooper, Kutner & Witt, 2015). Furthermore, academic libraries are contemplating how to strategically integrate internationalization into their missions, strategic objectives, and day-to-day operations.

A better grasp of how to accurately measure the scope of present efforts, understand needs, and build internationalization initiatives is required for academic libraries. Increasing internationalization in the academic world has captured the university management about the importance of university ranking (Zapp & Ramirez, 2019). University ranking plays an important role in quality and prestige as, by design, it is a signal of quality intended for the use of prospective students, parents, industries, and academics when selecting their university of choice (Basha, Sweeney & Soutar, 2019). Hence priority has been given to factors related to the concentration of research funding and publication.

While the issues of digitalizing, globalizing, and internationalizing the academic library are external challenges in nature, the common issue of the internal challenge is the process of determining the academic library material collection. The library assortment should give a wide scope of materials for users, all things considered, every single instructive level, and all economic foundations. To meet the partners of the libraries' interests, the library attests to the basics of scholarly opportunity and buys materials addressing different sides of a subject/theme whenever the situation allows. Even though sensible individuals may differ or have a problem with a specific perspective, the library management must address both (Finch & Flenner, 2017).

As a result of the extraordinary collection of resources, there are no single bunch of generally speaking standards that can generally be applied. A few things are made a decision about for the most part as far as creative worth or documentation of the occasions, while others are designated to fulfill the sporting and educational necessities of the library users. In this way, the material buying process and allocating the financial plan to purchase the material is quite possibly the most basic process, which requires a coordinated interaction (Appleton et al. 2018).

Given all these challenges, it is important for the management of the academic library to better manage its operation and take new roles by changing their common responsibilities by shifting the boundaries of offered services and reshaping their user interactions to a bigger perspective. For instance, the library's limited resources in many circumstances need essential solutions, which can be contained by rearranging the usual vertical group formation of the library. Meaning that the library's achievement and capability can be determined by management's skill to coordinate the linkage of connections and operations, which connects the library's internal and external supply chain stakeholders to fulfill the preferred facilities to the library members.

#### **1.2 Problem Statement**

The most common problems are on how to collect materials for an academic library, what to collect materials for an academic library and how to select suppliers for materials collections within their budget. As there is a great variety of resources, there is no sole set of overall criteria that can be always applied. These problems related to the chain of supplies, both hard and electronic materials, which they provided to the library users or customers (Ubogu, 2021). The academic library also needs other suppliers to maintain its working environment to provide the services (Dempsey, & Malpas, 2018).

Academic libraries now provide more than just reading resources to their users, they also assist with training, research, and publication (Kranich, 2017). So, there are tangible and intangible services provided by academic libraries now. Hence, academic library operations have become more complex, requiring the development of more up-to-date management guidelines to cope with the new era (Pinfield, Cox & Rutter, 2017). Therefore, entities and their functions in academic library management need to be identified, which can be used as a management tool, called an academic library supply chain.

Even though supply chain management has the potential to improve stakeholder satisfaction, raise revenues, and decrease total costs, however, it is not often used in academic libraries as a management tool (Wang, 2017). An academic library also needs to be successful in providing quality products, services, and information within the library budget, which is needed by the library users or customers (Iwu-James, Haliso & Ifijeh, 2020). An academic library is a service provider, and the complexity of a service supply chain is typically more difficult to manage than the complexity of a manufacturing supply chain (Kress and Wisner, 2012). Hence, a general model of an integrated academic library supply chain could be constructed to visualize the supply chain network for academic library management.

Although there is research studied about academic library supply chain model, however, they have been conducted primarily focused on case studies without validating the model from the library employee's points of view. Hence, the previous studies were unable to develop a general idea for the academic library supply chain (Wang, 2017; Kress and Wisner, 2012; Wathen, 2009). Considering the opinions from the organization's employees or experts in validating the supply chain model is acceptable (Sutduean et al. 2019) as it is capable of increasing the functionality of the model developed. Thus, an analyzed and valid integrated supply chain model with the most common entities for the academic library is needed to be developed, for considering it as a management guideline for academic libraries to provide effective service for library stakeholders.

#### **1.3 Research Questions**

According to the problem statement discussion, academic libraries' common problem is related to supply chain-related issues. Therefore, it is important to summarize the study's scope into a few research questions that convey the study's aim. The following study questions are addressed in the following:

- i. What are the entities and their functions of an academic library needed for the general practice of an academic library supply chain?
- ii. How to link entities identified in (i) as a model, which can integrate academic libraries' customer needs and requirements with services offered by the academic library as an integrated academic library supply chain?
- iii. How to analyze the relationships between the academic library entities in the integrated model developed in (ii)?

# 1.4 Research Objectives Universiti Utara Malaysia

The following study objectives have been developed to facilitate the research questions:

- i. To identify entities and their functions in academic library management that can represent the general practice for an academic library supply chain.
- ii. To construct a conceptual model of an integrated academic library supply chain.
- iii. To analyze the interrelationship among the entities in the integrated model developed in (ii).

#### **1.5 Significance of the study**

This study aims to contribute to further research and execution in the field of academic library supply chain management, based on specified research objectives. The result's validity will be able to provide useful information for future study and execution in academic university libraries.

From the perspective of the scholar, this study may provide useful data and information that can aid in the development of relevant academic library supply chain management research. As a consequence of the extensive research, a scholar may be able to have a better understanding of the needs of academic library supply chain strategies in the long term. Academicians, particularly those who conduct research in academic libraries and have minimal experience with supply chain strategies in the context of library administration may consider this study beneficial. This study would spark scholars' interest in knowing the antecedents of academic library supply chain practices from the perspective of a service organization, and it may provide a comprehensive understanding of academic library operations.

From the perspective of the managerial application, this approach could help academic libraries become more aware of and knowledgeable about the needs of supply chain procedures for organizational purposes. This study could uphold the necessary data for the academic library supply chain model, for example, the entities/elements of an academic library supply chain network, the primary elements of an academic library chain organization, and the various sorts of interaction joins across an academic library supply chain network. This study could also illustrate a few specific inquiries involving certain elements of the academic library supply chain. This could also include the capabilities and segments that need to be improved in the academic library supply chain.

From the above point of view, supply chain research could be a basic instrument to make the library a more prosperous/thriving organization. Appropriately, this exploration should bring about a guide, which empowers to develop a total general supply chain model for an academic library and to dissect the exhibition of key elements inside the academic library supply chain towards improving its capacities and administrations. A proficient and extensive model for the academic library supply chain network would define a guide to guarantee quality assistance for the library clients and the partners.

A coordinated procedure that starts a circumspect interaction for all applicable partners inside a library maybe can help towards expanding the conception of beating likely downsides of the academic library. The library management should define the library's strategic direction and articulate its vision and be responsible for ensuring that the library is engaged with its users in a way that satisfies users' needs as well as accomplishing the mission of the library. Therefore, this study proposes to design an integrated supply chain model for the academic library, focusing on how to integrate the entities or departments involved in library operation to in line with the current trend of academic library's suppliers and users' requirements.

#### **1.6 Scope of the Study**

This study explores the application of supply chain, particularly the service supply chain management to the academic libraries where this study focuses on the university libraries. This empirical study mainly focuses on proposing an integrated supply chain model for the academic university libraries, which focused on determining the entities and their functions as well as the structure of the supply chain that is suitable to be used in the model developed. The construction of the model has been guided with the knowledge of supply chain network theory, while to examine the significance of the model developed for academic library management, several scholarly references have been applied from the research areas of service supply chain performance and library management. To validate the significance of the model developed, the researcher opted for an expert judgment approach, whereby opinions from experienced library management personnel of various universities in the world have been used as the data input for analyzing the model.

#### **1.7 Structure of Thesis**

The structure of this thesis is as follows. Chapter 1 discussed the research background, problem statement, research objectives, research questions, the scope of research, and the significance of the research. The relevant literature has been reviewed in Chapter 2. The methodology for this study is described in Chapter 3. The modeling problems, formulations, and results will be discussed in detail in Chapter 4 which will cover the illustration of the development of conceptual Supply Chain Models for the academic library and present the validation process of the models. Finally, Chapter 5 presents the discussions of this study including the summaries of the academic supply chain proposed network and contributions in this thesis. The limitations associated with this study and implications for future work in this area will also be illustrated in that chapter.

#### **CHAPTER TWO**

#### LITERATURE REVIEW

#### **2.1 Introduction**

The goal of this study is to build the academic library supply chain model, which depends on findings on the entities of the supply chain model for the academic library, as mentioned in Chapter 1, for further improvement. As such, this portion of the thesis illustrates an inspection of previous studies and research on the aspects that relate to objective one and objective two, starting with how to model the library supply chain and ending with how to solve the problem of what are the essential functions and entities within the academic library supply chain. This chapter also clarifies the research gaps which are very crucial for this study.

#### 2.2 The Evolution of Supply Chain Research

The formation of the supply chain network concept started with logistic management. Before the time of the 1950s, logistics were understood for military use. It had been reflected since "dormant years" as an organization was disregarding, like a planned utility. Logistics worked for the maintenance, procurement, and transportation of military facilities (Mani & Delgado, 2019). Around the 1950s, the changes in how the organizations treated logistics tasks were categorized for the significant transformation. After that, the implication of logistics amplified by the distribution supervision in industrial organizations was acknowledged as a separate organizational utility (Munzenzi, 2019; Lori no, 2018). Due to this reason, in the 1960s and 1970s, the research and exercise for logistics and distribution accelerated (Hesse, 2020). The supply chain aims to coordinate processes around and within the supply chain (Grzybowska, & Kovács, 2017). For various factors, supply chain research is required, i.e. generating value outcomes, insightful processes, rising income, improving outsourcing, improving customer loyalty, increasing e-commerce rank, increasing globalization, and coping with supply chains' complexities (Irfan, Wang & Akhtar, 2019).

The supply chain had turned into one of the most widespread management concepts from the early 1980s with its introduction (Martins & Pato, 2019; Tien, Anh & Thuc, 2019). Oliver and Webber (1992) stated that "the supply chain must be viewed as a single entity and the strategic decision-making at the top level was needed to manage the chain in their original formulation". The view arises also split for the organizations and strait theoreticians for commercializing (Tamilia, 2019). Since the 1990s, the supply chain's evolution continued because of extreme global competition (Fujimoto, 2019). For example, Berry, Towill, and Wadsley (1994) described the supply chain network concept for UK's electronics business (Lin & Naim, 2019). Drucker (1998) had claimed that there was a standard change within the management literature. Drucker (1998) also stated that "One of the most significant changes in the paradigm of modern business management is that individual businesses no longer compete as solely autonomous entities, but rather as supply chains" (Sahibzada et al., 2020).

The supply chain's main goal is to integrate activities across and inside organizations to provide consumer satisfaction (Fernandes et al., 2017; Doan, 2020). Therefore, the supply chain helps organizations challenge the global market (Casson, 2018). Research in the supply chain is necessary for many reasons, such as clarifying procedures, generating value results, superior outsourcing, rising profits, improving customer pleasure, developing E-commerce position, growing globalization, and

allocating for the problems of the supply chain (Helmold & Terry, 2017; Habib, 2011). These are the evidence from several journal articles related to supply chain topic in manufacturing (Barber et al. 2017; Zuñiga, Wuest, & Thoben, 2015; Georgise, Thoben, & Seifert, 2014), distribution (Khan, Qianli & Zhang, 2017; Mangiaracina, Song, & Perego, 2015), marketing (Tamilia, Ferrell, & Hopkins, 2019; Jüttner, Christopher & Godsell, 2010), customer management (Pothukuchi, Gonzalez & Solera, 2018; Naoui, 2014), transportation (Dessouky et al. 2017; Ke et al. 2015) and integration (Yu & Huo, 2018; Näslund & Hulthen, 2012).

The huge number of current supply chain articles published in various organizations show that the supply chain is a comprehensive set of activities, including external supply chain members, internal functions, managers, personnel, and involvement in multiple process integration efforts. The supply chain's primary goal is to deliver profits to supply chain stakeholders with improved quality, service, and pricing to customers (Christopher, 2016). The supply chain's everyday purposes are to develop finale customer satisfaction, supply chain member revenues, and decrease total costs (Perboli, Musso & Rosano, 2018). Moreover, some researchers have found connections between supply chain achievement and decline of waste, constant procedure of enhancement, and the management of the material flows alongside the supply chain (Ben-Daya, Hassini & Bahroun, 2019; Huo, Gu & Wang, 2019; Huo, Gu & Wang, 2019).

Today, the management of the supply chain has now moved into a period of internetwork challenges. An organization's success will be influenced by the administration's skill to merge the company's involved linkage relating to trade relations. An evolutionary progression of supply chain management study up to the year 2020, with its conceptualization and incorporation in different industries, which can be simplified in Figure 2.1.



*Figure 2.1* The Supply Chain Evolutionary Timeline (Habib and Hasan, 2019; Pathik and Habib, 2012)

#### 2.3 The Supply Chain Best Practices

There is a requirement for building theory or hypotheses and creating regularizing apparatuses and techniques for effective supply chain use. Hence, several significant frameworks have been used as the main reference to develop the academic library supply chain conceptual model in the study of this thesis. The frameworks are the Global Supply Chain Forum (GSCF), the American Productivity and Quality Center (APQC), and the Process Classification Framework (PCF).

The Global Supply Chain Forum (GSCF), a gathering of non-contending firms and a group of scholarly researchers, has been meeting routinely since 1993, intending to

enhance supply chain hypothesis or theory and methods. In 1994, the meeting was transformed and became the Exploration Roundtable of the International Center for Competitive Excellence, University of North Florida (UNF), headed by its researcher, Dr. Douglas M. Lambert. In 1996, this gathering moved with Dr. Lambert to The Ohio State University (OSU) and turned into The Global Supply Chain Forum. Starting in January 1999, the gathering was together engaged with OSU and UNF (Alkebaisi, 2018; Mohammadi and Mukhtar, 2017). The GSCF forum explains supply-chain organization as, "*the integration of key business processes from end-user through original suppliers that provides products, services, and information that adds value for customers and stakeholders*" (Lambert, 2017). One of the basic achievement components of the GSCF is the nonstop progression of data between providers, makers, and clients. Figure 2.2 represents this connection and is adjusted from data given by Lambert (2017).



Figure 2.2 The portrayal of the GSCF Framework
American Productivity & Quality Center (APQC) helps organizations work smarter, faster, and more confidently. It is the world's primary authority on benchmarking, finest practices, process and performance improvement, and knowledge management. APQC's exclusive structure as member-based non-profit marks it a differentiator in the marketplace. APQC partners with more than 500 members worldwide in all activities. American Productivity and Quality Center (APQC) assists organizations with working more confident, quicker, and more certain. It is the world's primary expert on benchmarking, finest practices, interaction and execution improvement, and information the board. APQC's select construction as a part-based philanthropic imprint is a differentiator in the commercial center. With more than 40 years of experience, APQC remains the world's leader in changing organizations. APQC's Process Classification Framework (PCF) is the most used practice framework in the world. (APQC's Process Classification Framework. 2017, November 24).

The APQC and its part organizations built up the Process Classification Framework (PCF) as an open norm to facilitate improvement through interaction with the executives and benchmarking regardless of little mind to industry, size, or geology. The PCF organizes working and the executive's measures into 12 endeavor level classes, including measure gatherings and more than 1,000 cycles and related exercises (APQC's Process Classification Framework. 2017, November 24). PCF is a widespread system that incorporates start to finish business measures. Intentionally excluded processes and attributes not directly connected to supply chain functions have been done by the Convocation of Supply Chain Management Professionals (CSCMP). The standards cover 10 of the 12 main types in the PCF that are supply chain-related or have processes that impact the supply chain are given in Figure 2.3.



Figure 2.3 Process Classification Framework of APQC

The supply chain best-practice varies for different organizations, but not the general activities that all the organizations should practice if they wanted to foster the supply chain best practice in their management. A total of 10 specific aspects or activities should be embraced for supply chain best practice (Serdarasan, 2013) and listed as follows:

- i. Establish a governing council.
- ii. Manage the total cost of ownership.
- iii. Align and staff the supply chain organization.
- iv. Establish processes and controls.
- v. Utilize technology and procure to pay.
- vi. Manage compliance and risk.
- vii. Set the strategic sourcing strategy.
- viii. Optimize company-owned inventory
- ix. Establish key supplier alliances.
- x. Establish green initiatives and social responsibility.

The sequence order of these 10 activities does not specify or recommend a higher versus lower importance ranking. Still, it offers a systematic sequence when developing a scorecard of Effectiveness in building the best class supply chain for most not indicate or suggest a higher versus lower significance positioning. In any case, it offers a methodical grouping when building up a scorecard of Effectiveness in building the best class supply chain model for most organizations (Meredith & Shafer, 2019). The examples mentioned above contain most of the best supply chain practices, but not from all categories. Every organization would try to find the best practice from its point of view because all elements and their functions in the supply chain network may not be the same.

The emergence of supply chain best practices is also happening in library management, which is the main focus of this study. Today's libraries are studying to go even further for fewer, inspiring each other to explore new techniques to do works (Goleman, 2017). The performance and viability of libraries often rely upon organization capacity for organizing the system of partnerships, along with the procedure associated with the library's interior and exterior supply chain network (Baden, Peattie & Oke, 2020). The motivation is to give the library members the resources they want. As a non-economic business, a certain one secret to a ragbag's sustained productivity strike is the availability of high-quality items, facilities, and materials that satisfy library users (Callahan & Rogers, 2017). In conclusion, this section has helped this study to determine the features and requirements of a supply chain best practice, which was adopted in the process of constructing the conceptual framework, covering the second phase of the research process in this thesis.

### 2.4 Service Supply Chain (SSC)

Even though most of the researchers modeled the problems or issues related to supply chain models in the manufacturing industry (da Silva, Kovaleski & Pagani, 2019; Olatunji et al. 2019; Mirghafoori, Andalib & Keshavarz, 2017; Ondieki, 2016), there is some research had been done for the service organizations (Dutta & Nagurney, 2019; Fernandes et al. 2017; Sampson, 2012). Examples of Service Supply Chain (SSC) can be found in ventures like money exchange (Komulainen et al., 2018), telecommunication (Pramod, Banwet & Sarma, 2016; Ahmad & Saifudin, 2014), internet service (Xiang & Xu, 2019; Krithika, Kaur & Sekaran, 2012), tourism (Jena & Meena, 2019), and education (Pathik and Habib, 2012; Habib and Jungthirapanich, 2010). Some research work related to the supply chain in the service industry is summarized in Table 2.1.

# Table 2.1

Studies	on Ser	vice	Industr	y Suppi	ly Chain
---------	--------	------	---------	---------	----------

Author(s) and Date	Application Area	
Fernie and Rees (1995)	National Health Service.	
O'Brien and Kenneth (1996)	Higher learning education institutions.	
Sampson (2000)	Customer and supplier contrast in the general service organizations.	
Kathawala and Abdou (2003)	General service organizations.	
Cigolini, Cozzi and Perona, (2004)	Services are offered in the grocery, automobile, book publishing, and computers industries.	
Lau (2007)	Higher learning education institutions. A case study in the City University of Hong.	
Habib and Jungthirapanich (2010a, 2010b, 2010c)	Higher learning education institutions. Introduced an "Integrated Tertiary Educational Supply Chain Management (ITESCM)" model.	
Pathik and Habib, (2012a, 2012b, 2012c,	Redesigned ITESCM model	
Kress and Wisner, (2012)	Designed the Lied library supply chain framework.	
Pramod, Banwet & Sarma, (2016); Ahmad & Saifudin, (2014);	Telecommunication operational flow framework	
Komulainen et al. (2018)	Money Exchange information flow framework	
Xiang & Xu (2019); Krithika, Kaur & Sekaran, (2012)	Internet service supply chain framework	
Jena & Meena (2019)	Tourism supply chain framework	

There is a crystalline difference between SSC and the manufacturing supply chain due to one main cause: the SSC focuses on service and in contrast, the manufacturing supply chain focuses on physical products. Martinsuo, Laine, and Momeni, (2020), illustrate the facility of service supply chain system as a:

"Network of suppliers, service providers, consumers, and other supporting units that performs the functions of transactions of resources required to produce services, the transformation of these resources into supporting and core services and the delivery of these services to customers."

Meanwhile, Sampson (2012) portrays a service supply chain as a bidirectional framework comprising of a client, a specialist organization, and underlying assistance where he describes an application of SSC as a framework made out of three gatherings: the help maker for foundation, the retail specialist organization, and the client.

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While the purposes of the supply chain in the manufacturing industry are to reduce the cycle time, inventory, and logistics costs, in the service industry, most of these purposes are irrelevant as the service provided is intangible or not transferrable (Gebraeel, 2017; Prasad & Selven, 2010). Due to this reason, the service industries are keen to increase supplier responsiveness and better customer service since most of the service industries deliver the service straight to the customer without the distributor, and logistics partners are searching for utilizing the upper hand to convey better client support. Moreover, incorporated an inventory network the executives satisfy the organizations' prerequisite.

In other situations, the production network in the assembling business is to reduce the process duration, stock, and coordination costs, however in the service businesses, the vast majority of these designs are unimportant as the assistance given is immaterial or not transferrable (Gebraeel, 2017; Prasad and Selven, 2010). Due to this reason, the service businesses are quick to build provider responsiveness and better client care since the majority of the help ventures convey the assistance directly to the client without the wholesaler and coordination accomplices (Gouws & Motala, 2019; Boon-itt & Pongpanarat, 2011).

Activities revolving around the SSC are about making strategies and decisions for estimating, arranging, executing, and controlling the interaction inside the organization with the network to fulfill client prerequisites effectively. It includes planning, coordinating, and controlling the item, data, and account streams both inside the association and among the accomplices (Maiti & Shilpa, 2020). For example, Hsuan et al. (2015) surveyed the utility existing supply chain models and adjusted six cycles of the Global Supply Chain Forum (GSCF) system for application to the SSC, which covers the data stream, limit, and abilities the executives, request the board, client relationship the board, provider relationship the board, administration conveyance the board and income.

In the service industry, one type of industry is different from others, and their supply chain is also different. It is inevitable that, except for the industry's largest organizations, several service providers will be required who are unlikely to belong to the same organization. Even where they are part of one business, they will likely be managed as distinct business units (Wieland, 2021). So, the need to make a seamless

system becomes imperative. Indeed, even where they are essential for one business, they will probably be overseen as particular specialty units (Petrin, 2019). Thus, the need to make a consistent framework gets basic. Such consistent tasks should endeavor to convey quality help that results in enchanted clients, maintain a relationship that sustains trustworthy service providers, provide a structure that supports exclusive requirements of client care, and focus on all out-quality administration (Kumpu, 2020).

For example, the tourism industry supply chain (Chopra & Sodhi, 2014). Tourism involves the movement of people from the tourism generating zone to the tourism endpoint zone. Seamless operations must attempt to deliver quality service that, the travel industry includes the development of entities from the travel industry endpoint zone to the travel industry endpoint zone. The executives and coordination events in movement and the travel industry may go from ground supervision to conveyance of cooking goods to data frameworks the board and consistence with wellbeing and security guidelines (OriAde and CAmerOn, 2016), as appeared in Figure 2.4.



Figure 2.4 A typical supply chain network in travel operations (OriAde & CAmerOn,

2016)

As the ultimate goal of SSC is to serve the utmost customer service, Sampson and Froehle (2006) perceived three kinds of client contributions for administrations, which are (i) customer bodies, (ii) tangible belongings, and (iii) customer-provided information. Likewise, Gursoy et al. (2019) recognized personalities, bodies, things, and data as key contributions to the service delivery process. Notwithstanding the wording utilized, classifying administrations dependent on the sort of operand source being prepared permits the SSC researchers and practitioners to understand better the product/service bundle's specific nature or uniqueness that creates customer value, which also helped the researcher of this thesis to understand the features and requirement of a service supply chain. Some of the service processes that create value for the customer are given in Table 2.2.

### Table 2.2

Service category (how the process creates value)			
Operand	Transforming	Transporting	
resource			
People	Education	Mass transportation	
	Healthcare	services (e.g., airlines,	
	Restaurants	trains, subways, buses)	
	Movies	Personal transportation	
	Theme parks	services (e.g., taxis, car	
	Entertainment services	rentals including long- term and short-term	
		leasing)	
Data	Tax returns	Email services,	
	Consulting and legal services	telecommunication	
	Advertising agencies	services, social media	
	Academic research	sites (e.g., Facebook),	
	News organizations	search engines (e.g.,	
	Video/music production	Google), music	
	Investment research and retirement	distribution (via the	
	planning	Internet, e.g.,	
	Insurance service	Rhapsody.com), retail	
		banking	

Examples of Transformation of Services in each Service Category

Table 2.2 Continued.

Service category (how the process creates value)			
Operand resource	Transforming	Transporting	
Things	Maintenance services Repair services Installation services Cleaning services	Retailing, e-tailing Third- party logistics providers Postal transportation services, freight transportation services	

There are seven hypothetical cycles of SSC that have been proposed by several researchers, namely (i) demand management, (ii) capacity and resource management, (iii) customer relationship management, (iv) supplier relationship management, (v) order process management, (vi) service performance management, and (vii) information and technology management (Jamkhaneh et al. 2018; Boon-itt & Pongpanarat, 2011). Table 2.3 defines each process, and Figure 2.5 illustrates the connection between the processes. These seven theoretical processes of SSC have been used as a reference to construct the dimension of validating the integrated academic library supply chain conceptual model developed in this study, which covers the third phase of the research process in this thesis.

# Table 2.3

# Definitions of Service Supply Chain Process

Construct	Definition
Demand management	Managing and balancing customer demand by keeping up-to-date demand information.
Capacity and resource management	Management capacity and resources of service, these resources are organized effectively and efficiently operate at optimum capacity.
Customer relationship management	Maintaining and developing long-term customer relationships by developing customer information continuously and trying to understand what customers want.
Supplier relationship management (SRM)	A process where customers and suppliers develop and maintain a close and long-term relationship as partners. SRM composes of five key components, including coordination, cooperation, commitment, information- sharing, and feedback.
Order process management	Organizing response for orders processed from customers. The scope of order process management includes getting orders until delivering service to customers.
Service performance management	Management services systems, all of which should be taken into account when managing, measuring, modifying, and rewarding service performance to improve organizational performance to achieve corporate strategic aims and promote its mission and values.
Information and technology management	Adoption of technologies to support and collaborate within the supply chain to improve service supply chain operations for achieving competitive advantage in their businesses.



Figure 2.5 Process of Service Supply Chain (Boon-Itt, Wong & Wong, 2017)

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### 2.5 The Network of Supply Chain and its Function

Physical supply chains contain many entities, ranging from the ultimate supplier to a conclusive customer. The number of the entities of these supply chains rely upon a few elements, like the intricacy of the item or administration, the number of accessible providers, and the accessibility of materials. Measurements to consider for including the supply chain network's length and the number of providers and clients at every level. It would be uncommon for an association to take an interest in just one supply chain network. The supply chain network looks less like a pipeline or chain than a removed tree where the branches and roots are the broad organizations of clients and providers (Equbal & Ohdar, 2017). Lambert, (2017) stated that there are three essential

primary parts of an association's organizational design of a supply chain model, they are:

- i. The members/entities of the supply chain,
- ii. The structural dimensions of the supply chain network and
- iii. The different types of procedures link across the supply chain.

The inquiry is the number of these branches and roots that should be overseen. Regularly, in every association, the board sees its association as the central organization and its supply chain organization will appear to be unique relying upon where the association is arranged in it. The executives need to pick the kind of association that fits specific inventory network joins (Reid and Sanders, 2019; Fan and Stevenson, 2018). Sometimes, not all connections through the supply chain ought to be firmly organized and incorporated. The most proper relationship is the one that best fits the particular situation (De Giovanni, 2020; Michalski, Montes-Botella & Narasimhan, 2018).

Figuring out what parts of the supply chain network merits the executive's consideration should be weighed against association abilities and the situation to the association. Consequently, it is imperative to have express information and comprehension of how the production network structure is orchestrated. This is possible by embarking on the network's fundamentals or theories that are related to the supply chain research area. The key to this study is determining which members are essential to librarians for academic library supply chain management, as well as how management attention and resources might be distributed among them. Hence, the

knowledge of supply chain networks is vital in this study for constructing a supply chain model for an academic library.

#### **2.5.1 The Theory of Supply Chain Network**

A supply chain network is a headway of the fundamental supply chain. Because of fast technological development, associations with an essential supply chain network can form this chain into a more perplexing construction, including a more elevated level of relationship and availability between more associations, which establishes an organized supply chain network (Slack & Brandon-Jones, 2018). Moreover, a supply chain network is profoundly nonlinear and shows complex multi-scale conduct (Chattopadhyay, Hassanzadeh, and Subramanian, 2019). It has a design spreading over a few scales, and it likewise advances and self-puts together through a perplexing interchange of its construction and capacity (Dhanorkar, Kim & Linderman, 2019; Mari et al. 2015). Store network configuration expects to find the most ideal supply chain network configuration as per an organization's serious methodology and longhaul objectives, particularly with the drawn-out essential choices identified with the number, area, and limit of creations or administrations and conveyance focuses. It likewise incorporates the flow of materials and data all through the production network and a bunch of providers to choose from (Bozarth & Handfield, 2019; Chopra and Meindl, 2013).

From the point of view of each corporation, the supply chains look different, as each company's management sees the organization as the focal business and considers participation and network structure separately. However, since each company is part of the other's supply chain, knowing its interrelated functions and viewpoints is

essential for its management (Kress & Wisner, 2012). Only when it makes perfect sense from each enterprise's viewpoint can the incorporation and management of business processes across company/organization borders be effective (Massa, Tucci & Afuah, 2017). The library supply chain network structure was also defined in various dimensions as a result (Fishman, White & Stoudenmire, 2020).

Theoretically, the fundamental design of a supply chain network is made with three levels, they are the upstream network level (supply base), the focal organization level, and the downstream network level (customer base) (Le, Le Tuan & Tuan, 2019; Stolze et al. 2018). The central organization is a relative point of view, whereby any organization can be the central organization. As such, all organizations, regardless of whether enormous or little, have an office and the capacity to settle on essential decisions. The central organization might have an alternate relationship with every one of its providers or clients regarding its exchanging exchanges, spreading over exercises, or relative force impact (Ponte, 2019; Chang, Chiang & Pai, 2012).

The supply chain network may appear to be unique from each company's viewpoint since each company's administration considers it is to be the central organization and perspectives participation and organization structure in an unexpected way. In any case, because each organization is now and then an individual from the other's supply chains, it is significant for the administration of the firm to comprehend its interrelated jobs and viewpoints. The joining and the executives of business measures across organization/association limits will be effective just if it bodes well from each association's viewpoint (Stanford, 2018; Massa, Tucci & Afuah, 2017).

For the physical structure of the supply chain network, Lambert & Enz, (2017) stated that there are three underlying components of a supply chain network while depicting, investigating, and dealing with the supply chain network. These measurements are the level construction, the vertical design, and the central association's even situation inside the store network's endpoints. Various mixes of these underlying factors are found in a few article diaries. One model is illustrative of a tight and long organization structure on the provider side, which is joined with a wide and short construction on the client-side (Marques, Yan & Matthews, 2019; Ivanov, 2018).

In some cases, expanding or diminishing the number of providers as well as clients influences the supply chain network structure. For instance, as certain associations move from different to single-source providers, the supply chain may turn out to be smaller. Rethinking coordination, assembling, promoting, or item advancement exercises is another illustration of dynamic that may modify the supply chain network systems. This circumstance may build the supply chain network's length and width and in like manner impact the central organization's level situation for the supply chain network. (Turner, Aitken & Bozarth, 2018; Lambert, 2017). In core, the embodiment of the supply chain network's common physical structure is portrayed in Figure 2.6.



Figure 2.6 Types of Inter-Organization Business Process Links (Lambert, 2017).

From Figure 2.6, supply chains with such a large number of Tier 1 of clients '/providers' strain assets (e.g., the number of cycles interface the central organization) can be incorporated and firmly oversaw past Tier 1. In correlation, organizations with wide vertical designs can effectively deal with a couple of Tier 2's clients or providers. Under certain conditions, the associations can move their little adjusting clients to wholesalers and moving to the little clients further down from the central associations. This rule is known as a utilitarian side project and can be applied to the central association's providers' organization (Hye, Nazri & Mustaffa, 2019; Gibbs & Humphries, 2015). A summary of dimensions studied under the topic of supply chain network has been presented in Table 2.4. The summary from this section has been used as the main reference in the second phase of the research process in this study, which covers the process of developing the integrated academic library supply chain conceptual model.

# Table 2.4

|--|

Dimension	References
Number of entities in SC Network	Slack & Brandon-Jones, (2018).
Number of Tiers in SC Network	Lambert, (2017); Lambert & Enz, (2017).
Structure of service/information flow in the SC Network	Dhanorkar, Kim & Linderman (2019); Mari et al. (2015).
Information flow	Bozarth & Handfield (2019); Chopra and Meindl, (2013).
Close-ended loop	Le, Le Tuan & Tuan, (2019); Stolze et al. (2018).
Open-ended loop Universiti Utara	Le, Le Tuan & Tuan, (2019); Stolze et al. (2018)
Supplier to Focal organization	Turner, Aitken & Bozarth, (2018); Lamber (2017)
Focal organization to Customer	Marques, Yan & Matthews (2019); Ivanov (2018)
Customer to Focal organization	Ponte (2019); Chang, Chiang & Pai (2012)
Focal organization to Supplier	Lambert & Enz (2017); Chopra and Meindl (2013)

#### **2.5.2 Structure of the Service Supply Chain Network**

The design of the service supply chain (SSC) network has a few likenesses with the item of product supply chain network, as the administrations are made, bought, and moved to start with one component then onto the next as a chain. The service supply chain network structure is a complex network that consolidates immediate or backhanded specialist co-ops around administration integrators (Sakhuja et al. 2016; Song and Xu, 2011). Blázquez, Díaz-Mora, and González-Díaz, (2020) evaluated the producer services and structured their supply chain with three basic elements, they are the direct services contractor at the center, the indirect services provider, and the services demander.

Sakhuja & Jain, 2012 acknowledged a service supply chain that contains a customer/client, a service provider, and an initial service provider. They also mentioned the bidirectional nature of SSCs. Based on the distribution of different services, the SSC structure can be divided into three forms: Serial-SSC, Parallel-SSC, and Hybrid-SSC (Jamkhaneh & Ghadikolaei, 2020).

Serial SSC is the arrangement of the serving join. Like a manufacturing line, the organization is permitted to begin from completing the past help. There is an order which can't be hopped over. The whole SSC just has one input (client interest) and one output (organization conveyance). The relationships among the close by providers are firmly connected. The capacity to coordinate assistance prerequisites is likewise higher (Tasnim,2018; Min, Zacharia, and Smith, 2019). The principle highlights of the parallel SSC, then again, is the parallel of the serving joins. The organization's interaction doesn't have to join intently.

There are no inclination relations between the different organizations. They can exist simultaneously and just need to sum up the last outcomes. The whole supply chain of SSC has one input yet various outputs. All organizations and reconciliation organizations maintain cozy connections, however, connections between providers are moderately portable, and organization capacities don't have to coordinate (Miraz, Saleheen, and Rahman, 2016). Finally, Hybrid-SSC is the serial and parallel mix nature. The whole cycle of organization conveyance looks more like a stream diagram. The mixture SSC can be slowly broken into serial SSC and parallel SSC. It can likewise string through the layers of settled serial and parallel structure and execution to the entire serial SSC or parallel-SSC (Miraz, Saleheen, & Rahman, 2016).

In organizations with an undeniable degree of immaterialness (and concurrence), like proficient administrations, the investment of the client in the creation and conveyance measures is required, particularly for exceptionally theoretical administrations, where worth is included in the eyes of the client as the association with the client. This prompts the advancement of more limited, bi-directional supply chains (Gandhi, Sachdeva & Gupta, 2020; Sampson, 2012), as shown in Figure 2.7.



Figure 2.7 Bi-directional service supply chains (Giannakis, 2011).

As the movement of tangible sources is limited, a more complex network of information exchange takes place (where a value is added), offering to ascend to support supply constellations or heavenly bodies in which upstream data streams are acted in a 'pull' mode, bringing about the deferred activity. As a few components are engaged with this data trade network that is autonomous of each other, the supply chain of organizations is not as 'devoted' as on account of assembling, where one supply chain network may rival another. Therefore, the intricacy of the coordination of their exercises increments. The service providers in these cases go about as 'go between' for the assistance arrangement. Alluding to the instance of property buy, for instance, the job of go-between is embraced by the monetary counsel to organize the entirety of his/her data streams to the client. Like a telecommunications or logistics supplier, different models assume the very same part in his/her supply chain network (Teixeira et al. 2020; Giannakis, 2011).

As far as the SSC organization's elements or segments, an ordinary SSC comprises of three fundamental important parts: customer, service integrator, and service provider. For instance, Demirkan and Cheng (2008) organized utilization of SSC with three individuals which are application infrastructure provider, application service provider, and customer/client (Liu et al. 2019; Prasad & Shankar, 2018; Liu et al. 2017; Sakhuja et al. 2016). Barely any discussion was done about the structure of the third-party payment services, including three basic structural components: third-party payment companies, e-commerce websites, and e-banks (Allaymoun and Hamid, 2019; Sakhuja et al. 2016). Tour operators, service suppliers, and tourists are a total travel industry supply chain, where healthcare centers, patients, and related suppliers constitute the healthcare supply chain network (Buhalis et al. 2019; Babu, Kaur & Rajendran, 2018).

Human resources have three parts in an SSC are advisors, managerial specialist organizations, and technology enablers. Based on recognized entities of the service supply chain network in various service industries, the SSC's basic architecture can have components of a service integrator, a professional service provider, and a final consumer as the supply chain members participated in the whole process of the service network. (Launio, 2019; He, Ho & Xu, 2010).

In the education supply chain, the members are the service provider (universities), suppliers (education and research suppliers), and customers (education customers/clients and research customers/clients) (Habib & Hasan, 2019). One important component of an academic institution will be its academic library, which may have its supply chain. Academic University library is a service-based organization, which is the main part of an academic system. The supply chain management of academic libraries should give a broader view of how to manage the library properly, which has been the focus of research investigated in this study.

Supply chain knowledge and practice have offered an efficient collection of resources for companies aiming to minimize costs while enhancing operational efficiency over the years. It has changed the direction of an organization's supply chain practice nowadays with an ultimate aim to link all the functions into one fully integrated supply chain for making the organization more efficient (Busse, Meinlschmidt & Foerstl, 2017). Figure 2.8 presents the contrast between the conventional supply chain model and the integrated supply chain ecosystem.



Figure 2.8 Traditional supply chain model vs Integrated supply chain ecosystem

(Strategy, 2017).

From this figure, it can be seen that the integrated supply chain covers the organization's operation as a whole in a helicopter view, which possible to offer a better-managed business network. Hence, there is a certain significance of transforming a traditional supply chain model into an integrated supply chain model perspective. Realizing the importance of having an integrated supply chain network in the service industry, this study is motivated to construct an integrated supply chain for one of the service industries, which is an academic library. Being as academic university libraries are service-oriented organizations, knowledge of the service supply chain is crucial for this research.

### 2.6 Validation of the Supply Chain Framework

The processes of validating the built supply chain model or framework under the research related to the supply chain topic are closely related to the construction of

elements in that built supply chain framework. The supply chain system component is a common fundamental segment or once in a while meant as constructs, pillars, central issues, or factors. To construct the framework or the model of the supply chain, these components (or constructs) are linked together by forming relationships among them. The crucial to this element is the sufficient content for the constructs domain requirement and the activities associated with the elements (Liu et al. 2017).

Ho, Xu, and Dey, (2010) explained that terms and constructs related to supply chain had developed quickly to the degree that they have gotten bit by bit hard to incorporate and outline the general plan of hypothetical and experimental examination nearby supply chain model. Hence, several disciplines that studied supply chain under their research area normally have a different set of elements (or constructs), in terms of their variability and uncertainty within the core of their supply chain framework (Geissdoerfer et al. 2018; Ho, Xu & Dey, 2010). In this case, the researchers normally used different ways when they want to verify and validate their built supply chain framework. Most of the built supply chain frameworks use overlapping terminology, depending on their multi-disciplinary bases (Moncada et al. 2017).

It is crucial to discover the scope of wording utilized in those supply chain structures to address the center of the fabricated systems. Soni and Kodali (2011) recommended two fundamental exploration entities that need to be analyzed in confirming and approving supply chain system (Tortorella, Miorando & Marodin, 2017) as follows:

- i. What elements (or constructs) are used for making frameworks in the supply chain?
- ii. What is the degree of standardization of these elements (or constructs) in the supply chain domain?

Ho, Xu, and Dey, (2010) also agreed with these two questions that need to be answered to determine the level of standardization of these parts (or entities) in the supply chain area. These two questions have been the main reference in the third phase of the research process in this thesis, which covers the process of validating the academic library supply chain conceptual model developed in the second phase.

It is outstanding that various examination plans are additionally utilized for check reasons. For instance, Pawar and Driva (2000) used to overview, and contextual analysis for checking the pertinence of the structure proposed to help organizations with the change towards bringing electronic business into the supply chain network. The study was utilized to get an image of the UK business patterns concerning electronic data interchange (EDI), and afterward, the contextual analysis was utilized to acquire a "client viewpoint" on EDI. Christopher and Juttner (2000) utilized various contextual investigations and spotlight bunch meets on acquiring bits of knowledge into "specialists" encounters to make and confirm a system to oversee coordinated stock chains. There is also some validation used in the supply chain before-mentioned as Lavastre et al. (2014) create and approve an instrument to gauge Innovative Supply Chain Practices (ISCP) in Supply Chain. The estimation instrument comprises three autonomous estimation scales: ISCP sending conditions and setting, association's advancement limit, and ISCP execution. The Supply Chain Operations Reference (SCOR) model of Zhou et al. (2011) has likewise been generally embraced in numerous associations. There are many ways to verify or validate data for a conceptual supply chain model, and some used techniques are listed in table 2.5.

### Table 2.5

Summary	f Techniques	Used to	Validate and	Varify the	SC Model
Summary O	j rechniques	Usea io	vanaane ana	verijy ine	SC model

Techniques	Authors
Analytic Hierarchy Process (AHP)	Li et al. (2020); Wang et al. (2017)
Analytic Network Process (ANP)	Mu, Cooper & Peasley (2020); Hussain, Awasthi & Tiwari (2016)
Fuzzy AHP	Kumar & Garg, (2017); Adebanjo, Laosirihongthong & Samaranayake (2016)
Fuzzy ANP	Yadav & Singh (2020); Tirkolaee et al. (2020)
TOPSIS	Shenoy, Sharma & Prasad (2020); Forghani Sadjadi & Farhang Moghadam, (2018)
Fuzzy TOPSIS	Singh & Agrawal (2018); Mavi, Goh & Mavi (2016)
Data Envelopment Analysis (DEA)	Sabouhi, Pishvaee & Jabalameli, (2018); Pournader et al. (2016)
Multi-Objective Optimization	Rad & Nahavandi (2018); Zhang et al. (2016)
Probability Theory Integrated Stochastic-Fuzzy Approach	Kamble et al. (2021); Qazi et al. (2018) Malik & Kim (2020)
Discrete Event Simulation	Kogler & Rauch (2018); Balcou & Yadavalli (2017)

Table 2.5 continued.

Techniques	Authors
Bayesian Networks	Corman & Kecman (2018)
Queueing Theory	Mohtashami, Aghsami & Jolai, (2020);
	Memon, Li & Ahmed (2019)
Delphi Method	Gossler et al. (2019); Jafarnejad et al. (2019); Krægpøth, Stentoft & Jensen, (2017)

Analytic Hierarchy Process (AHP), Analytic Network Process (ANP), Fuzzy AHP, Fuzzy ANP, TOPSIS, and Fuzzy TOPSIS are Multi-Criteria Decision Making (MCDM) model types, and these types of techniques are suitable approaches when making decisions on a complex situation that cannot be decided immediately, which involves examining a set of multiple criteria or making a decision from possible alternatives. The AHP acts as a tool for handling qualitative and quantitative multicriteria components that comprise decision-making behavior (Kokaraki et al. 2019). However, AHP requires accurate judgments and can settle just direct models (Kaliyamurthi, 2017). The ANP has been generalized from the AHP, nevertheless, with the additional features, which consider an interaction between the elements (Sajedi-Hosseini et al. 2018). The interactions are presented in the form of a network structure consisting of any elements. The ANP gives a quantitative description of the subjective judgments and simplifies complex problems (Moons et al. 2019).

Then, Fuzzy AHP is an Analytical Hierarchy Process (AHP) strategy created with the fuzzy rationale hypothesis (Emrouznejad and Ho, 2017). The fuzzy AHP technique is utilized as the strategy for AHP. It is only that the Fuzzy AHP technique sets the AHP scale into the fuzzy triangle scale to be gotten to need. Due to significant vulnerability and uncertainty in giving an evaluation will affect the precision of the information and the outcomes acquired from AHP. Because of this, a further hypothesis was created for Fuzzy AHP (Ahmed and Kilic, 2019). Fuzzy ANP was likewise created from ANP, and Fuzzy ANP broadly utilized multi-rules to deal with cooperation among the standards and etymological factors (Wicher, Zapletal & Lenort, 2019). Fuzzy ANP provides the opportunity to capture the uncertainty associated with each factor's cumulative influence on every other factor with which it interacts (Stojčić et al. 2019).

On the other hand, the Technique for Order of Preference by Similarity to Ideal Solution or TOPSIS is utilized in surveying a significant other option or standard according to the ranking that will be presented by comparing their relative distances toward the points referred to as a positive ideal arrangement and negative ideal arrangement (Çelikbilek & Tüysüz, 2020). The TOPSIS is easier to use in solving problems that involved multiple criteria and alternatives because it is capable of maintaining the same number of procedures regardless of the size of the problem and provide results that are more robust than other techniques in the case of variation in the input data (Fu & Liao, 2019). However, TOPSIS has several disadvantages, such as the complexity of weighting and keeping the consistency of judgment, especially when there is an additional attribute (Yu & Pan, 2020). Hence, the Fuzzy TOPSIS was developed to help in the objective and systematic evaluation of alternatives on multiple criteria (Palczewski & Sałabun, 2019). For example, some research for these features used fuzzy TOPSIS methods for the supplier selection methods (Chatterjee & Stević, 2019).

Data Envelopment Analysis (DEA) and Multi-Objective Optimization are the mathematical programming method types of techniques also used in the supply chain arena. The DEA is a nonparametric technique in tasks examination and financial matters for the assessment of creation outskirts. It is utilized to experimentally gauge the gainful effectiveness of supply chain substances (Soheilirad et al. 2018). However, Results are sensitive to selecting inputs and outputs, so their relative importance needs to be analyzed before calculating the DEA method (Rashidi & Cullinane, 2019). Meanwhile, Multi-Objective Optimization is a technique of multiple criteria decision-making that is concerned with mathematical optimization problems involving more than one objective function to be optimized simultaneously (Rizk-Allah, Hassanien & Slowik, 2020). Its strategies are utilized in ongoing development-related examinations and development supply chain models (Alothaimeen and Arditi, 2019). By and way, the primary hindrance of multi-objective optimization is the meaning of the ideal objectives, which requires some extra computational exertion (Laszczyk & Myszkowski, 2019).

In the supply chain arena, probability theory and integrated stochastic-fuzzy approach techniques of stochastic mothed type are also used. probability theory is the numerical system that permits us to dissect chance occasions in a coherently solid way (Elderhalli et al. 2019). However, probability theory cannot handle events where each outcome is not equally or likely which became the main limitation for use in supply chain model analysis (Qazi et al. 2018). Integrated fuzzy-stochastic modeling (IFSM) is dependent on Monte Carlo recreation for the data sources, measurement of assessment models utilizing fuzzy participation capacities, and danger appraisal dependent on the consolidated fuzzy stochastic data (Peng, 2019). IFSM strategy is

immeasurably used to assess supply chain leanness of little and medium undertakings in the auto business (Glas, Lipka & Essig, 2019).

Discrete Event Simulation (DES), Bayesian networks, and queueing theory are simulations method type of techniques. Now simulations became quite popular in the supply chain arena. The DES models a framework's activity as a (discrete) succession of occasions as expected. Every occasion happens at a specific moment as expected and denotes a difference in the state in the framework (van der Ham, 2018). It is used to analyze and evaluate dynamic aspects and the influence of variance on supply chains, which supports decision-making (Oliveira et al. 2019). The Bayesian organization strategy is a probabilistic graphical model addressing a bunch of factors and their contingent conditions through a coordinated non-cyclic chart (Yu et al. 2017). The supply chain network disturbances are displayed utilizing the Bayesian Networksa strategy for demonstrating the reason for current and future occasions, which can show numerous factors in a supply chain and have demonstrated to be an amazing asset under states of vulnerability (Hosseini and Ivanov, 2020). Queueing theory is the numerical investigation of sitting tight for lines or lines. A queueing model is built to foresee line lengths and holding up time (Joseph, 2020). Often, the queueing network of closed-loop of the supply chain is established using queueing theory (Liu et al. 2020).

The Delphi technique is an interaction used to show up at a gathering assessment or choice by reviewing a board of specialists. Specialists react to a few rounds of surveys, and the reactions are accumulated and imparted to the gathering after each round (Smarandache et al. 2020). This method is vastly used in expert judgment for supply

chain network validation. The summary of the advantages and disadvantages of the techniques is tabulated in Table 2.6.

# Table 2.6

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Technique	Advantage	Disadvantage
Analytic Hierarchy Process (AHP)	Can handle qualitative and quantitative multi-criteria components (Kokaraki et al. 2019)	Requires accurate judgments and can settle just direct models (Kaliyamurthi, 2017)
Analytic Network Process (ANP)	Broadly utilized multi-rules to deal with cooperation among the standards and etymological factors (Wicher, Zapletal & Lenort, 2019)	The uncertainty is associated with each factor's cumulative influence on every other factor (Stojčić et al. 2019)
Fuzzy AHP	Reduce significant vulnerability and uncertainty of AHP (Ahmed and Kilic, 2019)	Affect the precision of the information and the outcomes acquired from AHP (Ahmed and Kilic, 2019)
Fuzzy ANP	Reduce uncertainty associated with each cumulative factor (Wicher, Zapletal & Lenort, 2019)	Cannot reduce uncertainty rather than cumulative factors (Stojčić et al. 2019)
TOPSIS	Capable of maintaining the same number of procedures (Fu & Liao, 2019)	The complexity of weighting and keeping the consistency of judgment (Yu & Pan, 2020)
Fuzzy TOPSIS	Helps better in alternatives on multiple criteria than TOPSIS (Palczewski & Sałabun, 2019)	Only helps on objective and systematic evaluation (Palczewski & Sałabun, 2019)
Data Envelopment Analysis (DEA)	Use to experimentally gauge gainful effectiveness (Soheilirad et al. 2018)	Results are sensitive to selecting inputs and outputs (Rashidi & Cullinane, 2019)

Table 2.6 Continued.

Technique	Advantage	Disadvantage			
Multi-objective optimization	Use in ongoing development related examinations (Alothaimeen and Arditi, 2019)	The ideal objectives require some extra computational exertion (Laszczyk & Myszkowski, 2019)			
Probability theory	Permits to dissect chance occasions in a coherently solid way (Elderhalli et al. 2019)	Cannot handle events where each outcome is not equally (Qazi et al. 2018)			
Integrated fuzzy- stochastic modeling (IFSM)	Use for the data sources measurement of assessment models (Peng, 2019)	Face problem when calculating risk management factors (Glas, Lipka & Essig, 2019)			
Discrete Event Simulation (DES)	Applied to analyses and evaluate dynamic aspects (Oliveira et al. 2019)	Indicates only a difference in the state in the framework (van der Ham, 2018)			
Bayesian networks	Useful for addressing a bunch of factors and their contingent conditions through a coordinated non-cyclic chart (Yu et al. 2017)	Useful only under states of vulnerability (Hosseini and Ivanov, 2020)			
Queueing theory	Useful to build for foresee line lengths and holding up time (Joseph, 2020)	Only established for the closed-loop of the supply chain (Liu et al. 2020).			
Delphi method	Useful for gathering assessment by reviewing a board of specialists (Smarandache et al. 2020)	Needs rounds of surveys which are accumulated and imparted to the gathering after each round (Smarandache et al. 2020)			

This study has used the Fuzzy Delphi method to validate the academic library's developed conceptual supply chain model. The integration of the fuzzy set in the Delphi Method has been researched and proved to solve a time-consuming procedure, which requires a repetitive process to reach a consensus between the experts on the

best solution (Lawnik, Krakowczyk & Banasik, 2019). The reasons for and benefits of using the Fuzzy Delphi method are described in section 2.6.1.

#### 2.6.1 Fuzzy Delphi Method

The most vastly used technique is the Delphi Method (DM) for the supply chain arena (De Loë et al. 2016). The DM has been recognized as an instrument to find, construct and arrange the experts' judgment in a decision-making process (Deveci et al. 2020). It is appropriate to be used in a condition where expert judgment is a requirement in finding information, exclusively if the information cannot be computed, unknown, inaccurate, and incomplete (Pasman & Rogers, 2020). This has made the DM a useful instrument when a condition requires expert judgment in an unexplored field. In the DM analysis, the information from the experts needs to be collected until the point of saturation can be reached and the results on the matter under a discussion are found (Alarabiat & Ramos, 2019). Hence, it is also known as an iterative procedure that indicates a methodical development to conduct a repetition round of voting (Belton et al. 2019).

Nonetheless, the disagreement among a group of experts can lead to a dead-end for the analysis. the DM is time-consuming because the consensus in experts' judgment is needed for this technique (McPherson, Reese & Wendler, 2018). Therefore, applying the fuzzy set theory be able to solve the problem and makes the decision-making smoother and better for expert judgment result analysis (Sarraf & McGuire, 2020). The Fuzzy Delphi Method (FDM) is a combination of the old and traditional Delphi Method (DM) and fuzzy set theory to get the consensus of the experts on some decision after twice undergoing a process of verifying a comprehensive questionnaire (Parteeb,

2019; Saffie & Rasmani, 2016). It allows the experts to derive the results more realistic and applicable in terms of any situation. The term is applied to various numbers that have been collected after great efforts, and weights are being assigned to the various ascribes dependent on their relative significance. The agreement is then being created on the choice given by specialists (Dawood et al. 2020). In this way, the FDM offers numerous advantages, including the capacity to acquire a well-qualified assessment, construct agreement, decide the appropriateness of actualizing instructional intercessions, gauge drifts, and communicate with research subjects without being restricted by existence (Ciptono et al. 2019).

In the supply chain arena, there are already several implementations of FDM. For example, Kumar et al. (2018) used the FDM to construct a capital acquirement dynamic model to enhance provider choice. Bouzon, Govindan, Rodriguez & Campos (2016) used this method to identify and analyze reverse logistics barriers. Tahriri, Mousavi, Haghighi & Dawal (2014) showed a Fuzzy Delphi system for decision-making of supplier ranking and manufacturing system selection. They verified and validated through an example of a numerical testbed of their developed process of supplier ranking and selection of the manufacturing system. Lin et al. (2020) applied the FDM for the decision makers' screening process (experts) to develop sustainability indicators for employee-activity-based production processes. That research showed direct indicators of the production process and employee-activity of manufacturing industries.

Lastly, Khan, Haleem, and Khan, (2020) presented hazard the board in the halal supply chain where an incorporated FDM was utilized. They considered about 72 dangerous

components, which distinguished through this method in examining the incorporated model of the supply chain. These elements are further categorized into seven different dimensions by using this technique. The segregation of the risks elements has resulted in quick decision-making about a well-developed Supply Chain Model for Halal foods. The summary of research that used the Fuzzy Delphi method in the supply chain arena is tabulated in Table 2.7.

### Table 2.7

Author (year)	Purpose of Using Fuzzy Delphi Technique				
Khan, Haleem, and Khan,	To identify risk dimensions of the halal supply chain				
(2020)	from 20 expert opinions.				
Lin et al. (2020)	the decision makers' screening process to develop				
	sustainability indicators from 30 expert opinion				
Kumar et al. (2018)	Developing enhance suppliers' choice on capital				
Un BUDI BUDI	acquirement dynamic model of the supply chain from 200 expert opinion				
Bouzon, Govindan,	Identifying reverse logistics barriers of electrical-				
Rodriguez & Campos (2016)	electronic equipment industry validated by 16				
	expert opinions.				
Tahriri, Mousavi, Haghighi	Validating decision-making of supplier selection				
& Dawal (2014)	process for manufacturing system from 64 expert				
	opinions.				

Summary of Research	Used the	Fuzzy	Delphi	in	Supply	Chain A	Arena
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Nowadays, the SC Model has become much more complicated because of the businesses' enhanced applications and functions at the global level (Hassija et al. 2020). Therefore, it is very important to get the experts from different sectors of SC within an organization and develop a single yet comprehensive model for the application (Barbosa-Póvoa, da Silva & Carvalho, 2018; Hsu, 2010). The Fuzzy

Delphi Technique can be applied to Supply Chain Model within any organization by collecting data from numerous aspects, and then it can be analyzed and evaluated based on probability to develop a consolidated consensus over validating the supply chain model (Abdel-Baset, Chang & Gamal, 2019).

#### 2.7 The Management of the Academic Library

The library is the place for people to learn to read or study and have enjoyed the programs that the library offers. For instance, Individuals seeking a new employee could learn skills to benefit them to develop resumes (Attebury, 2018; Johnson, 2012). The library's main goal is to provide resources and services from different types of media to meet library members' needs for information, education, and personal improvement, including leisure and recreation. Moreover, it has a significant part in the improvement and maintenance of a society. Accordingly, the library gives the individual access to a wide and varied collection of knowledge, ideas, and opinions (Adler, 2017; Webb, 2017).

The management of the library depends on several management utilities like planning, organizing, leading, and controlling. Planning refers to systematically taking decisions for the library objectives while organizing refers to assembling and synchronizing informational, financial, human, physical, and other resources needed to accomplish library objectives. Leading is like acting as a function, which involves exertions on the librarian's task to excite the high performance of employees. Finally, controlling involves monitoring different library processes and services (Surulinathi & Duraipandi, 2014). As for the academic library, Yang (2011) said libraries are places of cultivating students' morals, developing students' scientific and cultural excellence,
developing professional technical education, and providing encouraging environments for improving students' comprehensive excellence (Jiang, Chi & Gao, 2017).

Within the 21<sup>st</sup> century, scholastic libraries begin to start to benefit the management enhancement to upkeep an arrangement of other ways towards a progressive innovation. The exercises of change are imaginative insightful investigate and distribution, the further intensive practice also providing of computerized assets, serving increasingly assorted understudy populace, progressing talk ask from researchers' conventional assets and imaginative styles of instruction, containing ICTbased and distance learning where libraries have had slight cooperation within the past (Lata & Sonkar, 2020). Virkus and Metstar (2004) added another scenario, which is endlessly decreasing levels of resources, mainly in recruitment, leading to huge burdens on specific employ and a simple task to supervision.

Advancements in digitalization (ICT) have made it easier for libraries to provide anyone with connectivity (Senapathy, Pandikumar & Thuo, 2019). Yet with the paradigmatic shifts taking place in society, the Library and Information Services (LIS) industry has not followed along (Hjørland, 2018). Very few libraries use state-of-theart infrastructure to propagate material to their corresponding consumer groups (Kress & Wisner, 2012). The effect of emerging information technologies on the Department of Library and Information Sciences curriculum growth has been specifically defined in some cases (Ma, Stahl & Knotts, 2018). It has been claimed that IT is an important part of most university-learned topics (Malavet, 2017). So, IT functions management and operations are also key elements for academic libraries now. Usually, the academic library, the executive centers around the achievement of the targets of the academic organization (Jan & Anwar, 2019). academic library the board includes numerous capacities and cycles. The academic library's fundamental capacity is to help and support the investigation and encouragement that goes on in the academic institute. In this exertion, the academic library essentially targets to:

- i. Capture and hold the interest of the academic local area's perusing.
- ii. To produce keen clients of a wide range of archives
- iii. To develop in clients enthusiasm for libraries as scholarly foundations.

From another viewpoint, the scholarly library gives a fundamental understanding of materials and reports for research (Mierzecka, 2019). As per Fakude, (2012) the rundown of academic library the executive's capacities varies starting with one creator then onto the next. As such, four general management functions of an academic library can be distinguished, and they are arranging, putting together, driving, and controlling (Bernadette, 2020). A few analysts had considered libraries to be distribution centers for data, and when the data world changes, so should the libraries. The stockroom examination is possibly excessively aloof, and scholarly custodians universally have been compelled to work with less faculty because of choices made by the college or school they serve, consequently expecting them to turn out to be all the more favorable to dynamic for endurance (Repanovici & Landøy, 2012).

To properly manage the academic library, the key functions of the library must be identified. The fundamental utilitarian zones of the academic library and the units contained inside are (Kress and Wisner, 2012):

- i. Collections: reference, guidance, selection, bibliographers.
- ii. Technical services: cataloging, acquisitions, ordering and receiving, electronic resource management.
- iii. Access and client services: book stacks, interlibrary loan, circulation, reserve.
- iv. Information technology and web services: online public access catalog (OPAC), integrated library systems (ILS), web and digital library services.

## 2.7.1 Academic Library Supply Chain

The improvement of the academic library supply chain is like the other service organizations' supply chain research is done very rarely. To decide the supply chain structure that suits the library board, it is important to recognize those elements that are the supply chain members. A wide range of entities may make a complete organization exceptionally unpredictable since it might detonate in the number of entities added from one level to another (Rezapour Farahani & Pourakbar, 2017). For the academic library supply chain, little study has been completed to investigate the crucial elements and complexness in its supply chain network. Only a few article journals were found that studied issues identified with the library supply chain as presented in Table 2.8. Due to this reason, it has motivated the researchers of this thesis to further study this topic.

#### Table 2.8

Authors	Year	<b>Research Topic that has been Studied</b>	
Cornish	1996	Described information flow supply chain through libraries.	
Ball and	2000,	Described the primary library supply chain processes.	
Wright, Ball	2004		
Katsirikou	2003	Suggested a supply chain model for the library.	
Wathen	2009	Described interlibrary loan function by considering academic library supply chain.	
Meng-xing, Chun-xiao and Yong	2010	Described digital supply chain management in the context of china national university.	
Kress and Wisner	2012	Designed the Lied library supply chain framework.	
Wang	2017	Used SCOR model to describe the collection process of the academic library supply chain.	

Studies on Library-related Supply Chain

In the next three sections, three essential underlying parts of an academic library's organization construction of a supply chain model will be reviewed and discussed in detail, based on the structure of the general organization's supply chain network proposed by Lambert, (2017). The three angles are the individuals from the academic library supply chain, which introduced in section 2.7.2, the underlying elements of the academic library supply chain organization, and the various kinds of interaction joins across the academic library supply chain, which both aspects are presented in sections 2.7.3 and 2.7.4, respectively. These three aspects have been the basis of the research process in Phase 2 of this thesis, which covers the process of developing the integrated academic library supply chain conceptual model.

## 2.7.2 The Entities of an Academic Library Supply Chain

Kress and Wisner (2012) represented the members of the entities of a university library supply chain in their Lied library supply chain system that has a comparative construction as like Lambert and Enz, (2017) model, which are:

- i. Library customers/users such as resource sharing partners, campus users, distance users, and public users.
- Library suppliers like operation suppliers, free content collection suppliers, and purchased content collection suppliers.
- iii. The library's functional and operational systems such as user services collections, information technology, and technical services.

Preceding a study by Kress and Wisner (2012), Katsirikou (2003) projected a Consortia model which is a network of libraries. The information chain of supply chain model comprises of the accompanying (Katsirikou, 2003):

- i. Knowledge assets like distributers and data set suppliers, computerized media, and research suppliers.
- ii. The libraries' information substance and frameworks.
- iii. The libraries' individuals who at that point went about as wholesalers
- iv. The library clients.

In another investigation by Wathen (2009), he classified the supply network of interlibrary loan role of having four entities of academic library supply chain and as follows:

- i. Library vendors.
- ii. Suppliers.
- iii. Publishers.
- iv. Library users/ customers.

However, Cornish (1996) considered three members for the information flow supply chain:

- i. Publishers
- ii. Libraries
- iii. Users of the library.

The Lied Library supply chain system proposed by Kress and Wisner (2012) as outlined in Figure 2.9, covers a large portion of the entities/elements of an academic library, which comprised of purchased content collection suppliers, free content collection suppliers, operation suppliers, campus users, distance users, public users, recourse sharing partners, and the focus organization library. This supply chain system covers most of the entities or members that an academic library supply chain required as compared to the other library supply chain network (Cornish,1996; Katsirikou, 2003; Wathen, 2009).



Figure 2.9 Lied Library Supply Chain (Kress and Wisner, 2012)

This Lied Library system has been one of the main references to build an integrated academic library supply chain for the research in this thesis. For generalization, different types of suppliers and customers of the academic library supply chain discussed in the Lied Library framework are given in Table 2.9.

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## Table 2.9

Categories of Suppliers and users dependent on Lied Library Supply Chain Model

Suppliers	Primary suppliers/	Authors, publishers, serials subscription agents,	
	content suppliers	database vendors, government documents, gifts,	
		digital collections.	
	Operation	Online public access catalogs (OPAC),	
	suppliers	discovery platforms search interface, and also	
		janitorial, maintenance, shipping services.	
	Office supplies	Equipment, furniture.	
Customers Core customers		University students and faculty.	
	Remote and	campus community, other university users who	
	distance users	are the partner of the university, and limited	
		privileges to the general public.	

In detail, there are mainly three types of suppliers according to the Lied library supply chain model (Kress and Wisner, 2012). First, primary or content suppliers, which are authors, publishers, serials subscription agents, database vendors, government documents, gifts, and digital collections. These are all also mentioned as a supplier for academic libraries in various library science journals and books (Gregory, 2019; Gu & Blackmore, 2017; Einasto, 2016; Clark & Phillips, 2014; Kaplan, 2012). Then, there are operation suppliers, such as online public access catalogs (OPACs), discovery platforms search interfaces, and janitorial, maintenance, and shipping services. Similar types of suppliers are also mentioned by Sonawane, 2018 and Patra, 2017. The last types of suppliers are office suppliers which are equipment and furniture suppliers. In the Lied library supply chain, Kress and Wisner, (2012) distinguish between two sorts of customers. The first is the core customer, which consists of university students and faculty. These are the most common library users at an academic university library (Ouda-Onyango & Minishi-Majanja, 2020; Verma, 2018). Other categories of consumers they described include the campus community, other university users who are university partners, and the general public with limited privileges, however, these types of library users or customers are not common in all academic libraries.

## 2.7.3 The Structural Dimensions of the Academic Library Supply Chain

The structure of the library supply chain network is illustrated in diverse dimensions by several researchers. A horizontal structure of the supply chain in the Lied Library supply chain clarification is given by Kress and Wisner (2012). Kress and Wisner (2012) went through the explanation of Tier 1 horizontally from suppliers to the library and from the library to customer, which is designated in Section 2.4.1 from Figure 2.4. They explained the most elementary service, which is related to the creation and delivery of information resources and associated services within the academic library. In this case, it can be considered the value stream associated with the library's internal supply chain. They also explained the Lied Library information resources value or process is also streamed through a horizontal framework.

The Lied Library combined the technical services with the helpings of the user services into one division of the logistics and resource distribution services to decrease staff costs and potentially increase end-user value. In the library, most of the workflow to select, acquire, organize and deliver information resources extends to some departments and even divisions, moving horizontally across the academic library. Looking beyond what were previously department and division lines, the entire set of activities that create and produce information resources within the new division is identified from beginning to end and diagrammed as the value stream. The division value stream has appeared in Figure 2.10.



Figure 2.10 Information Resources Value Stream (Kress & Wisner, 2012)

Cornish (1996) stated the necessity for libraries and intellectual property owners to effort together to progress information flow to meet customer's/users' requirements. Cornish (1996) did not describe the vertical or horizontal system of the information

flow supply chain. Later, Ball and Wright (2000) and Ball (2004) also mentioned the information supply chain for describing the basic library supply chain processes like access, aggregation, creation, publication, or use. Ball and Wright (2000) also do not indicate the vertical or horizontal, but their description of the step-by-step supply chain illustrations the standard horizontal structure of the library supply chain. From another study, Wathen (2009) describes the interlibrary loan by using the supply chain network and enlightening the library's effectiveness. The group of libraries does the interlibrary loan process. This is an example of the vertical process/cycle of the academic library supply chain which is shown in Figure 2.11.



Figure 2.11 Interlibrary Loan Network (Wathen, 2009)

Du Toit and Vlok (2014) accept that the supply chain network's various measurements' design view can be a decent method to plan or develop a supply chain model. Wang (2017) utilized the supply chain operation reference model (SCOR) to depict the

academic library supply chain's collection process. He used to design, source, make, convey, and return procedures in the SCOR model to depict the library's collection service. The SCOR is illustrated in Figure 2.12.



Figure 2.12 Loop View and Linear View of the SCOR

#### 2.7.4 Links Across the Library Supply Chain Network

The success in the supply chain in any aspect needs a variation from managing individual roles to integrating actions into the key supply chain procedures. In several significant partnerships or organizations, their administrations arrived at the resolution that improving the cycle's streams can't be cultivated without executing an interactive way to deal with the business (Lambert & Enz, 2017; Gazova, Papulova & Papula, 2016). In any case, unique business measures have an alternate view on their store network structures. The similarity of a central organization with two providers, to be specific Supplier A and Supplier B, is portrayed here to represent the distinctions. The central organization just includes Supplier A, yet not Supplier B in its output advancement and business measure. Notwithstanding, the central organization's interest the board interaction is connected for both the provider's A and B. In the present circumstance, the central organization or some different associations will decide to incorporate and oversee distinctive store network joins with the business

measures fit for offering the two providers the potential for improved execution (Hugos, 2018; Jermsittiparsert, Sutduean & Sriyakul, 2019).

Coordinating and dealing with all business cycle joins all through the whole store network is likely exceptionally testing. Since the drivers for incorporation are situational and unique concerning one cycle to different cycles, the mix levels ought to likewise change from one connects to different connections of cycles over the long run where some connection is more basic than the others (Viriyasitavat & Hoonsopon, 2019). Subsequently, the undertaking of apportioning scant assets among the distinctive cycle joins across the supply chain gets critical. Wang (2017) has described the crucial integration process links of the academic library supply chain's collection process planning.

Kress and Wisner (2012) describe these kinds of process links in the Lied Library Supply Chain Framework, which is shown in Figure 2.13. The Lied Library inventory network comprises a few cycles, which connect from the numerous library clients to the different library providers in the store network organization. These processes are making data assets, fabricating the assortments, giving admittance to the assortments through the list and site, lastly conveying data assets and administrations to library clients. Figure 2.13 can be characterized into three wide substances. The primary element begins with the assortment providers, who make data content, and the activity providers, who provide the library enterprise's products and services. Then, the second element is the center of the supply chain is simply the library, where the substance is coordinated, put away, and overseen. The supply chain's last elements are the clients and the asset sharing accomplices, who will eventually utilize the substance.



Figure 2.13 Library Operational and Functional Activities (Kress & Wisner, 2012)

#### 2.7.5 Critical Issues Studied under the Management of Academic Library

Several issues have been investigated and studied under the management of academic library research and they are three possible issues that are critical and require serious attention from the researchers and practitioners as follows. Firstly, the most common and important issue for any academic library is the budget allocation for library materials. The library collection should give a wide scope of materials for clients, everything being equal, all instructive levels, and all financial foundations. To satisfy the libraries' need partners, the library attests to the basics of academic opportunity and buys materials that address different sides of a subject/point whenever the situation allows. Even though sensible individuals may differ or protest the perspective, the supervisory crew must address both. As a result of the incredible assortment of assets, there are no single bunch of measures that can generally be applied. A few things are made a decision about for the most part regarding creative worth or documentation of the occasions, while others are assigned to fulfill the library clients' sporting and instructive requirements (Hye, Nazri & Mustaffa, 2020; Savova & Price, 2018).

Secondly, the new digitalization era is also a challenge and an important issue for the academic library. For the academic library, digitization is a cycle wherein materials are changed over from the printed versions to electronic duplicates, Including text, images, video as well as audio. The main motives of digitalization are to increase the access and retrieval of the materials by selecting, creating, organizing, maintaining, and sharing the collection (Khan & Bhatti, 2017) and improving the conservation of the library materials. Shockingly, various difficulties are experienced during the time spent digitizing library materials. These difficulties incorporate human and specialized issues, which have suggestions for arranging strategy and offering on the web types of assistance (Rathee & Kaushik, 2019; Anyaoku, Echedom & Baro, 2019).

Finally, internationalization also became an important factor, especially for academic libraries. In the modern-day, students and faculties members increasingly move around the world to study, educate, and lead research; consequently, the college's geographic area implies less. This isn't only an element of the pervasiveness of the virtual universe of advanced data. The need to travel to another country for the examination can, perplexingly, increment because of the half and half nature of data assets around the world (Li et al. 2018). Academic libraries should plan for administrations that help their clients internationally. Exploiting key respective organizations with partner libraries abroad is one approach to intervene uphold their clients. Guaranteeing that academic clients can enter libraries overall is another obligation regarding curators in the present internationalized university (Cox, 2018; Cheng, Cheung & Ng, 2016).

Academic libraries nowadays provide tangible and intangible services. As a result, academic library operations have become more complex, requiring the development of more current management guidelines to adjust to the changing period (Pinfield, Cox & Rutter, 2017). As a result, it is necessary to identify entities and their functions for the academic library supply chain, which could generate a management guideline for academic library management. Additionally, an academic library must be successful in offering high-quality products, services, and information within the library's budget while meeting the needs of its users or customers (Iwu-James, Haliso & Ifijeh, 2020). Hence, a model of an integrated academic library supply chain may be developed to enable the development of a new management technique for assessing new academic library users' requirements.

# 2.8 Literature Gaps

The previous research reviewed and discussed in previous sections describes critical information on the evolution revolving around the supply chain research area, the framework of supply chain network and its function, general facility supply chain practice, verifying and validating the supply chain model, and the management of the academic library. Finally, the review of an academic library supply chain is also presented, which mainly aims to find out about the entities, functions, and components needed to build an academic library supply chain conceptual model in this thesis's research. The literature summary also highlights which functions and components are required for enhancing the academic library supply chain to make the library a cost-effective organization in dealing with modern time challenges.

Several weaknesses and deficiencies are identified from the literature, which requires further investigation and to is researched. Firstly, most research related to the academic library supply chain found in the collection of articles journals is out-to-date, and little research has been done on this topic in the past five years. The most related literature to this research is Kress and Wisner (2012), who developed a Leid library supply chain framework. Nevertheless, they did not include interlibrary loan services studied by Wathen (2009). The latest research was done by Wang (2017) who developed the SCOR model to describe the academic library supply chain's collection process. He discussed all necessary supply chain elements required for the library collection process, referencing different case studies on the academic library research. These are the three most relevant research that has been used as references for the research in this thesis.

Secondly, all the aforementioned research has only been studied until the level of the conceptual framework, which lacks information on how to operationalize the developed frameworks so that related stakeholders of the academic library can implement them. To examine these frameworks' feasibility, they should be validated and verified, either qualitatively or quantitatively. Finally, the frameworks developed in those research are also lacking with the element of advanced technology and unable to accommodate the new structure of the academic library supply chain for the era of IR 4.0. Figure 2.14 summarizes the research gaps identified in this study.



Figure 2.14 The Mapping of the Research Gaps in this Thesis

The research in this study is concerned with filling the gap by developing an integrated academic library supply chain conceptual model applicable and can accommodate the advanced technology for the new era of the academic library. This research is aided to design the new academic library supply chain structure, which covers all the viewpoints relating to the construction of academic libraries (i.e., entities and components) and their functions within the supply chain network (i.e., close-ended network or open-ended network). The newly developed model was built on the basis or fundamental of a supply chain network theory, which has been done thoroughly to integrate the structure and function of the academic library supply chain seamlessly. It

has also been validated and verified on its feasibility and practicality before it can be implemented in academic library management.

To summarise this section, a research framework is built to illustrate the three research components that map to the theory of supply chain network as depicted in Figure 2.15.



Figure 2.15 A Mapping of the Research Framework in this Study

The illustration presents how the research in this thesis has been investigated from the aspect of the structure, the functions, and the supply chain elements of an academic library in general. as well as approaches used to validate the academic library supply chain model developed in this study. To integrate and manage all activity or process links with all entities or members across the supply chain would be in most cases, should be counterproductive and if not then impossible. The key is to find out some cause for decisive which entities are critical of the accomplishment of the organizations or the supply chain. Thus, it should be assigned managerial attention and

resources. Hence, the organization needs to identify the critical entities in its supply chain network.

# 2.9 Summary of Chapter

This chapter covers the literature of all the related topics needed in this research. It contains all the literature to support information for the academic library supply chain model, supply chain model design, and supply chain model validation information. The supply chain design standard, service supply chain, and information of the library supply chain would lead to the design general supply chain model for an academic library supply chain.



# **CHAPTER THREE**

# **METHODOLOGY**

### **3.1 Introduction**

The purpose of this chapter is to set out a complete review of the methodology used for this study analysis. This section has been constructed into eight sections. Section 3.2 presents the design of this research, and Section 3.3 shows the research process that has been covered in this study. Section 3.4 discussed the information collection processes which is phase 1 of this study. The model development methods are illustrated in Section 3.5, which is phase 2. Then, the model validation approach is then explained in Section 3.6, which is phase 3 of the study. Lastly, the research process is summarized in Section 3.7, and the chapter's summary is presented in Section 3.8.

### **3.2 Research Design**

This study combined the qualitative and quantitative research approaches, whereby this study aims to develop an integrated academic library supply chain conceptual model. To achieve this aim, there is three research objective that needs to be completed; hence three phases are outlined in this study where research activities in each phase accomplished each research objective's attainment (i.e., Phase 1 to achieve Research Objective 1), as depicted in Figure 3.1. The first phase used the descriptive design approach to collect the characteristics of domain needed in the academic library supply chain model from literature and expert. Then, in the second phase, which is the most important part of this study, a conceptual model of the academic library supply chain has been built using the System Thinking approach. In the second phase, exploratory research designs were used to uncover flaws and challenges from past

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studies, and this study bridged the gap in the research by developing the conceptual academic supply chain model. Finally, the diagnostic research design is adopted in Phase 3 to validate the developed conceptual model.



Figure 3.1 Phase involved in these Research Activities.

# 3.3 The Overview of Research Process

The aim of the outcome from each phase and methods and analysis used to execute the research process in those phases are presented in this section. Detail description of each phase will be explained from Section 3.4 until Section 3.7 and summarized in Figure 3.2.



Figure 3.2 The Flow of Research Process

# **3.4 Phase 1 - Information Collection**

Phase 1 aims to achieve Research Objective 1, whereby it involves identifying the entities and their functions related to academic library management. In this phase, two main activities have been conducted, which are reviewing literature and conducting the interview with experts, and explanation of each of the activities in the next sections.

# **3.4.1** Activity 1 – Review the Literature

The first activity started by selecting findings from relevant articles and other related literature about the structure, the functions, the supply chain elements of an academic library in general, as well as approaches used to validate and verify the service supply chain network model, as shown in Figure 3.3. This had been completed and reported in Chapter 2.



Figure 3.3 Information Collection from Literature Materials

The theoretical literature review technique has been used in this study to find out about entities, functions, and networks of academic library supply chains by reviewing supply chain theories and frameworks, service supply chain, library supply chain, and findings from research gaps of academic library supply chains. This technique is useful for determining what ideas already exist, including their relationships, and the extent to which existing theories have been studied, as well as for developing new hypotheses to test (Paul & Criado, 2020). It can assist the researcher to discover a body of knowledge that has accumulated with a topic, concept, theory, or phenomenon (Turner, Baker & Kellner, 2018).

#### **3.4.2** Activity 2 – Interview the Librarians

In the second activity, a semi-structured interview with librarians has been conducted to gather practical information from the librarians' point of view about the structure, the functions, and the supply chain elements of an academic library. This interview also serves the purpose of seeking more information that perhaps has not been covered in the literature. The interview activity in this study is qualitative and the phenomenon analysis approach is adopted when designing the interview's questions. The generalization from this collected information using the phenomenon analysis approach is easy to be made, regardless of whether the study is theoretical, analytical, or logical (King, Horrocks & Brooks, 2018; Saunders et al. 2018). An interview protocol (or a set of semi-open-ended questions) was prepared, which contains the questions covering general knowledge about academic library management and its operation and critical issues and problems faced by the academic library personnel. Detail on the questions is displayed in Figure 3.4.

- 1. What are the operational frameworks of the academic library?
- 2. How is the budget for the library allocated and distributed? Specifically, how do you manage this process for the library?
  - a. What are the criteria used for budget allocation?
  - b. Do you employ any prioritization approach to rank the criteria?
  - c. Do you apply any mathematical model for the final budget allocation process?
- 3. What is the most critical aspect of managing the library with regards to:
  - a. operating budget,
  - b. efficiency, and
  - c. customer satisfaction/service?
- 4. What are the library's strategies in tackling these following issues?
  - a. Scholarly research and publication.
  - b. More intensive use and delivery of digital resources.
  - c. Serving increasingly heterogeneous student population.
  - d. Continuing high demand from students for traditional resources.
  - e. New modes of study, including ICT-based and distance learning.
  - f. Ever-reducing levels of resources, particularly in staffing, leading to enormous pressures on individual staff and a severe challenge to management.
- 5. What are the activities, as part of corporate social responsibility, conducted by the library for the local community outside of university campus?
- 6. What are the activities conducted to generate income for the Library or university?
- 7. What is the policy of the university library?

### Figure 3.4 Interview Protocol Used in Phase 1

The university library management personnel have been chosen as the respondents in this study because they have knowledge and experience about the academic library. The interviews with the respondents have been conducted under group and one-onone interview session settings. A total of three staff from two different academic libraries have been interviewed and they are those who hold the qualification in library science and have working experience of more than 12 years in the academic library. They are also those who hold a top-level management position in their academic libraries.

A group interview session was conducted with the chief librarian and deputy chief librarian of the University Utara Malaysia (UUM) and a one-on-one interview session was conducted with the deputy chief librarian of Prime University (Bangladesh). The Chief Librarian of the UUM has more than 21 years of work experience and the deputy chief librarian of UUM and Prime University have more than 12 years of working experience in the academic library. The respondents are experts and very qualified about the present practice and the need for an integrated academic library supply chain model. The UUM's Chief Librarian and Deputy Chief Librarian discussed not only the UUM library but also academic library operations in all Malaysian libraries. For a wider viewpoint from a different national context, an interview with the deputy chief librarian of Prime University (Bangladesh) was conducted to gain a thorough understanding of academic library supply chain practices.

The interview sessions were recorded by using a voice recorder and were guided with the interview protocol constructed, as shown in Figure 3.4. The library staff also discussed the supply-related problem of the academic library. In this study, the content analysis process has been used to find important factors regarding the academic library supply chain because there is no common practice about the supply chain for the academic library. Content analysis is a process to find common patterns across the data set and it involves making sense of the interview respondents' distinct stories (Krippendorff, 2018).

Firstly, to conduct the content analysis, the process of familiarization with the text through reading or listening to the recording from the interview several times is done before the process to code the text is started. Then, the preliminary coding's priority theme is identified based on information in the text relevant to the interview protocol questions. Thirdly, the codes are clustered into a group with the same data or information to see their relationship.

Fourthly, an initial template has been developed by including the coding and it has been presented in a linear format. Next, the template is modified by screening the initial template to erase any redundant ideas and sort the cluster systematically. After the template has been modified until every section becomes relevant to answer the research question, the final template has been developed and organized accordingly. The data template is then interpreted to ensure that the analysis for all data coded is clear and understandable. Finally, the write-up process has been done by using a mixture of theme-by-theme and case-by-case approaches. Steps in this content analysis have been done manually since the interview session only involved three interviewed experts. Findings from the content analysis presented have been presented in Chapters 4.

#### 3.5 Phase 2 - Model Development

Phase 2 aims to achieve Research Objective 2, where a conceptual model of an academic library supply chain is built. In this phase, the conceptual model was built with information gained in Phase 1. Activities in this phase are concerned with filling the gap from the previous studies and the outcome from this phase is one of the main contributions of this study, which has been explained in detail in Section 2.7. The conceptual model in this research has been built qualitatively by using a system thinking approach. The system thinking method is used to make inside linkage for the academic library supply chain model's conceptual framework. This model depicts which library departments are linked with which suppliers and which services or information flow in the supply chain network, which later will be validated in Phases 3.

The system thinking approach is a holistic method of analysis, which emphasizes the technique where the system's parts correlate and how systems process actively, within the context of greater systems (Tani, Popoluca & Sasso, 2018; Eren Şenaras & Sezen, 2017). As the world becomes progressively interrelated, globalization raises our community systems in complex new innovative behaviors. Technological improvement issue's system after system where each growing in interrelationship on other systems that have previously (e.g., software, internet, GPS, APIs, and power grid). Global trade ties countries organized in powerful commercial feedback loops. Moreover, policy changes in one in one country inescapably reason rippleeffects in another. However, they were disconnected, systems are firmly moving near interconnection as they hurtle into upcoming globalization (Baporikar, 2020). Thus, these systems provender to each other to produce tremendously complex, random effects were with this use of an ability set called system thinking.

Moreover, one can anticipate improving realize the deep roots of these complex activities to expect them better and, eventually, regulate their results. The exponential progress of systems in our world has formed a rising requirement for system thinkers to challenge these complex difficulties. This requirement gives distance beyond the science and engineering arenas, for surrounding the reality of all parts of life. Nowadays, system thinkers are required to formulate a complex globalized system of systems upcoming. Because of this view, it could be strongly reasoned that all persons in decision-making parts should have proper knowledge about system thinking (Arnold & Wade, 2015).

Thus, a system thinking standpoint involves interest, simplicity, sympathy, courage, and choice. This method contains the inclination to see a condition entirely, identify that we are consistent, recognize that there are often several interferences to a problematic and title-holder connection that may not be common. System thinking increases the variety of selections obtainable for solving a problem by expanding thoughtful and helping us critical complications in innovative and diverse ways. Simultaneously, the values of system thinking make us conscious that there are no flawless results where the selections we make will affect other portions of the system. Through forecasting the effect of each trade-off where we can minimalize its severity or uniform use it to our particular benefit. Therefore, system thinking agrees to us to make conversant adoptions (Riley et al. 2017; Sevaldson, 2017).

There are many system thinking methods (i.e., interconnectedness, system mapping, and synthesis) (Emes & Cole, 2019). Still, only a synthesis method is used as a reference to develop the conceptual model in this study. The synthesis system thinking method discusses the combination of two or more things to produce something new. When it comes to systems thinking where the goal is synthesis, as opposed to analysis, which is the division of complexity into manageable apparatuses. Analysis fits into the mechanical and reductionist worldview, where the world is shattered down into parts. The synthesis system thinking method is about understanding the whole and the parts simultaneously, along with the relationships and the connections that make up the changing aspects of the whole (Mononen, 2017).

In this research, the synthesis method has been chosen to build the academic library supply chain conceptual model development as it suits the requirement of supply chain network theories and practices and has been widely used by many researchers in their studies (Lawrence et al. 2019). Some researchers that used the synthesis method in their studies are Lindskog, (2012) and Jaradat et al. (2017). Using this synthesis method, there are two main activities involved to develop the conceptual model as follows:

# **3.5.1** Activity 1 - Analyze the Data Collected in Phase 1

Before the conceptual model can be developed in this research, important information gathered in Phase 1 needs to be processed and classified according to the dimension under the theory of Supply Chain Network (or SC network), which has been explained in Section 2.3.1. The conceptual model in this study has been

built by anticipating the SC network's complexity and flow structure in the SC network. All of Academic University Supply Chain parts, including the number of entities in SC network, number of tiers in SC network, the structure of service/information flow in the SC network, information flow, close-ended loop, open-ended loop, supplier to the library, library to the customer, customer to library and library to supplier needed to be identified to construct the conceptual model. Furthermore, based on the information gathered, which suppliers link to which department of the library and which departments provide which services to the library's users also need to be discovered. Thus, different and common types of suppliers and customers have been identified in this step, which will be combined and become one link in the next step.

# **3.5.2** Activity 2 - Link the Entities in the Academic Library SC Network

The process to link the entities and information that have been gathered to develop the conceptual model of the academic library supply chain of this research involves three steps. The first step is to find the linkage between the library's suppliers and the academic library departments. The second step is to find the linkage between the library's customers and related departments of the academic library. Finally, the two built linkages are then tied up or mapped and integrated as one illustrative diagram. Three types of models have been developed in this research, namely the Holistic View of Supply Chain Model for the academic library, Material Purchasing Decision Making Model, and Conceptual Supply Chain Model for Academic Libraries. Detail about these models will be discussed in Chapter 4, which later will be validated in Phase 3.

#### 3.6 Phase 3 - Model Validation

After the construction of Models in Phase 2, they have been validated in Phase 3, in achieving Research Objective 3. This research follows Soni and Kodali's (2013) way to verify the built models, covering the validation process from the aspects of verifying (a) the elements or constructs that are included in the supply chain model and (b) the degree of standardization of these elements in the supply chain model. To validate the models, the experts' judgment method was used. Three main activities are involved in this phase as follows.

#### 3.6.1 Activity 1 - Construct a Structured Questionnaire

A questionnaire has been developed as the main instrument to collect the data for analysis in this Phase 3. The questionnaire questions are about the expert's agreement on the conceptual models developed in Phase 2, including the elements, links, and processes determined in the built models. The developed questionnaire used the numerical rating scale where a seven-digit numeric scale is employed, extending from strongly disagree until strongly agree. This implies that the range from "1" to "7" is "strongly disagree" to "strongly agree" respectively. The 7 points of the Likert scale are applied since the reliability could be optimized with seven response categories (Chyung et al. 2017). The layout of the questionnaire has been created in four main sections, which are given below in Table3.1. The format of the question in each section is both a combination of closed-ended and semi-ended questions, enclosed in Appendix A.

## Table 3.1

chain.

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	Section	Descriptions about the questions	
1.	General Information	Gathering information from the respondents.	
2.	Verification of the	Respondents have been asked about their	
	elements or constructs	agreement on the developed conceptual model	
	that are included in the	of the academic library supply chain, whether	
	holistic view of the	entities, elements, and linkages in the Model	
	supply chain model.	are in right place.	
3.	Verification on a material	Respondents have been asked about their	
	purchasing decision-	agreement whether all the elements and	
	making model	linkages material purchasing decision-making	
		model for the purchasing department of the	
		academic library is in right place.	
4.	Verification on the degree	Respondents have been asked about their	
	of standardization of these	agreement whether processes in developed	
	elements in the developed	conceptual model of academic library supply	
	conceptual model of the	chain about fulfilling the basic seven service	
	academic library supply	supply chain processes.	

## The Layout of the Questionnaire has been Created.

# **3.6.2** Activity 2 – Collect the Data (Population, Sample, and Sampling Method)

To collect the data, the population of interest and its sample, which is determined based on the sampling method need to be identified. Individuals or entities who share at least one characteristic are considered to be members of a population (Roudini, 2015). It is composed of a set of symptoms that are a part of a bigger group or community's choice select, such that this specified collection is an introduction, for example, the quality and features of the area and the larger the group or community's choice picked (Robinson & Leonard, 2018). It may be required to gather data from a particular group of individuals rather than from those who are readily available on a given day. The rationale for this is that only the respondents selected are eligible to supply adequate information, hence, just the selected samples that meet the criteria will be selected for data collection purposes. A procedure is referred to as purposive sampling. Purposive sampling, also known as judgmental, selective, or subjective sampling, is a nonprobability sampling method in which researchers choose members of the population to participate in their surveys based on their judgment (Sharma, 2017). Additionally, purposive sampling is a type of purpose sampling that entails some form of a subjective selection of those who are most suited to supply the information sought (Abiso, 2021). In this study, the desired sample for obtaining expert opinions has consisted of experts whose experience and skills are related to the subject matter of this study. The statistical sample is not practical in this study, and cannot be used because of the expert judgment matter.

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The respondents of this study are those who are experts in the management of the academic library and they must have at least a bachelor's degree in library science and working experience of at least five years in the academic library (Rader, 2002). A total of 52 library management personnel from several universities answered the questionnaire constructed, which has been explained in Section 3.6.1. All of them responded to answer the questionnaire and their profiles are tabulated in Table 3.2.

# Table 3.2

			Working
No.	University	Position	Experience in Academic
			Library
1.	Prime University, Bangladesh	Deputy Chief Librarian	11-12 years
2.	Universiti Utara Malaysia, Malaysia	Library System Officer	5-10 years
3.	Universiti Utara Malaysia, Malaysia	Librarian (Reference and Customer service department)	5-10 years
4.	Universiti Utara Malavsia, Malavsia	Reference Librarian (Reference Department)	5-10 years
5.	Universiti Utara Malaysia, Malaysia	Librarian (Reference and Customer service department)	11-20 years
6.	Central University of Venezuela	Assistant Librarian	5-10 years
7.	Daffodil International University, Bangladesh	Librarian	0-4 years
8.	University Malaysia Perlis, Malaysia	Librarian	11-20 years
9.	University Malaysia Perlis, Malaysia	Librarian	11-20years
10.	University Malaysia	Librarian	5-10 years
11.	University Malaysia	Librarian	5-10 years
12.	University Malaysia	Senior Librarian	11-20 years
13.	University Malaysia	Librarian	11-20 years
14.	University Malaysia	Librarian	11-20 years
15.	University Malaysia	Librarian	11-20 years
16.	University Malaysia	Deputy Chief Librarian	11-20 years
17.	Universiti Sains	Senior Librarian	11-20 years
18.	Malaysia, Malaysia Universiti Sains	Senior Librarian	11-20 years
19.	Malaysia, Malaysia Universiti Sains Malaysia, Malaysia	Assistant Chief Librarian	11-20 years

Table 3.2 continued
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			Working
No.	University	Position	Experience in Academic Library
20.	Universiti Sains	Chief Librarian	21+ years
21.	Malaysia, Malaysia Dhaka University, Bangladesh	Librarian	5-10 years
22.	Khulna University of Engineering &	Deputy Librarian	11-20 years
23.	Technology, Bangladesh Khulna University of Engineering & Technology, Bangladesh	Assistant Librarian	5-10 years
24.	Shahjalal University of Science and Technology, Bangladesh	Librarian	5-10 years
25.	North South University, Bangladesh	Librarian	5-10 years
26.	Eastern University, Bangladesh	Assistant Librarian	5-10 years
27.	Shahjalal University of Science and Technology,	Librarian	5-10 years
28.	Bangladesh Brandenburg University of Technology- Cottbus,	Assistant Librarian	5-10 years
29.	Brandenburg, Germany Brandenburg University of Technology- Cottbus, Brandenburg, Germany	Assistant Librarian	0-4 years
30.	Brandenburg University of Technology- Cottbus,	Librarian	5-10 years
31.	Brandenburg, Germany University of Management Sciences,	Senior Librarian	11-20years
32.	Lahore, Pakistan University of Management Sciences,	Librarian	5-10 years
33.	Lanore, Pakistan Habib University, Karachi, Pakistan.	Librarian	5-10 years
34.	Habib University, Karachi, Pakistan.	Librarian	5-10 years
35.	Habib University, Karachi, Pakistan.	Assistant Librarian	0-4 years
Table 3.2 continued.

No.	University	Position	Working Experience in Academic Library
36.	American International University-Bangladesh, Bangladesh	Deputy Librarian	21+ years
37.	State University of Bangladesh	Assistant Librarian	5-10 years
38.	State University of Bangladesh	Library Officer	0-4 years
39.	State University of Bangladesh	Librarian	11-20 years
40.	World University of Bangladesh	Librarian	5-10 years
41.	World University of Bangladesh	Librarian	5-10 years
42.	Sher-e-Bangla Agricultural University, Bangladesh	Librarian	21+ years
43.	Sher-e-Bangla Agricultural University, Bangladesh	Assistant Librarian	5-10 years
44.	Linköping University, Sweden	iti Librarian alaysi	a 11-20years
45.	Linköping University, Sweden	Librarian	11-20years
46.	Linköping University, Sweden	Assistant Librarian	5-10 years
47.	Sant'Anna School of the Advanced Studies, Pisa, Italy	Librarian	11-20years
48.	Sant'Anna School of the Advanced Studies, Pisa, Italy	Librarian	11-20years
49.	Bangladesh University of Engineering and	Librarian	11-20years
50.	University of Regina, Saskatchewan, Canada.	Librarian	5-10 years
51.	University of Rajshahi, Bangladesh	Assistant Librarian	0-4 years
52.	University of Auckland, New Zealand	Librarian	5-10 years

However, out of 52 library management professionals, five had less than five years of experience. Therefore, Library Personal 7, 29, 35, 38, and 51 are excluded from the analysis of this study. The number of experts according to their countries is shown in Figure 3.5.



Figure 3.5 Number of Respondents According to The Countries

Although the majority of the responses came from Malaysia and Bangladesh, other countries such as Sweden, Germany, Italy, Pakistan, Canada, New Zealand, and Venezuela also contributed, representing different opinions from the other continents of the world.

## 3.6.3 Activity 3 – Analyze the Data Using the Fuzzy Delphi Method

In the final activity, data collected from the questionnaire has been analyzed by using a Fuzzy Delphi Method (FDM). The FDM generally can be used to validate a supply chain model within any organization, by collecting data that includes experts' opinions, and then analyzing and evaluating it based on probability values to achieve a consolidated opinion (Abdel-Baset, Chang & Gamal, 2019). Details on the implementation of FDM in previous studies have been explained in detail in Chapter 2 (Section 2.6.1). This section explains the technical aspect of FDM used in this research where the explanation of the Delphi Method (DM) and fuzzy set are the following.

The procedure of the DM can be divided into several steps, which are as follows:

- i. Select a panel of experts for the judgment.
- ii. Prepare an inclusive questionnaire and distribute it to the panel of experts to get the first iteration.
- iii. Analyze the results by conducting statistical analysis if there a consensus result among the expert cannot be reached then prepare the other questionnaire.
- iv. Provide the feedback to the panel of experts in each iteration form of a summary of individual input and a result of statistical analysis relating to the entire group.
- v. Repeat each iteration until the panel of experts decides the agreement in their judgment.

Nonetheless, for the FDM, the fuzzy set is applied because of its ability to skip Step (v) of the DM procedure and conduct the incomplete or ambiguous information of linguistics terms used in the ranking process (Roy et al. 2019). This method also solves the problem that involves selecting the optimal alternatives according to the possible set of criteria, which have been weighted with the fuzzy set (Pham, Ma & Yeo, 2017).

The fuzzy set can be considered the top method in solving opinions that occur during group decision-making (Wan, Li, & Dong, 2018). The fuzzy set can be classified into a few types, which are triangular, trapezoidal, and gaussian. Although both triangular and trapezoidal fuzzy numbers are equally adopted in theoretical and practical parts, the structures and acceptance of computation made fuzzy triangular numbers (TFNs) are more suitable to be used (Wu & Liu, 2013). Usually, fuzzy triangular numbers (TFNs) has been used to assist the decision-makers that are incompetent in determining a condition, where it implements a binary logic that is mathematically explained as zero and one {0,1} or among the conditions of membership or non-membership values (Chukhrova & Johannssen, 2019). Hence, the TFNs adopted into this research.

A fuzzy number is a special fuzzy set in which  $\tilde{A}\{(x, \mu A(x), x \in R)\}$  that x value is in  $\mathcal{R} \to [0,1]$ . The fuzzy number ( $\tilde{A}$ ) is defined on  $\mathcal{R}$  so that it is a TFN, and the membership function can be defined as follows:

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$$\mu_A(x) = \begin{cases} (x - m_1)/(m_2 - m_1), & m_1 \le x \le m_2, \\ (m_3 - x)/(m_3 - m_2), & m_2 \le x \le m_3, \\ 0, & otherwise \end{cases}$$

The symbol of  $m_1$  is the minimum value,  $m_2$  is the possible value, and  $m_3$  is the maximum value of the fuzzy numbers. The minimum value of  $m_1$  and maximum value of  $m_3$  is used to select the boundary points. Geometrically, the TFNs can be represented in Figure 3.6.



Figure 3.6 The Membership Function of the Triangular Fuzzy Numbers

From Figure 3.6, the symbol of x and the values that range from zero to one or in the interval of  $\{0,1\}$  is the function of membership,  $\mu_A(x)$ . As declared in the equation above,  $m_1$  is denoted by the minimum value, 0, whereby  $m_2$  and  $m_3$  are respectively selected as the most probable value that lies between  $0 \le \mu(x) \le 1$  and the maximum value 1. The range values of the membership function can also be applied when x is positioned between  $m_1$  and  $m_2$ ,  $m_1 \le x \le m_2$  and between  $m_2$  and  $m_3$ ,  $m_2 \le x \le m_3$ . This coincides with the theory that the membership function of fuzzy triangular numbers (TFNs) is a class of objects with a range of membership grades (Lowen, 2012).

The fuzzy numbers can help to translate experts' judgments in the form of linguistic scales into numerical scales, whereby every experts' judgment based on the linguistic scale in the survey will be represented by the fuzzy numbers (Liao et al. 2018). Linguistic scale usually consists of either a 5-scale linguistic term or a 7-scale or a 9-scale as it may differ between the scale used in the survey. In this study, a 7-scale has been adopted for this research, ranging from "Strongly Agree" to "Strongly Disagree". The description of the FDM analysis is the following. Firstly, the linguistic term of the scale was codified into the TFN and the codified values of the TFN for each term of the linguistic variable are presented in Table 3.3.

#### Table 3.3

Linguistic terms and Fuzzy Numbers

Scale	<b>Fuzzy Numbers</b>
1	(0,0,1)
2	(0,1,3)
3	(1,3,5)
4	(3,5,7)
5	(5,7,9)
6	(7,9,10)
7	(9,10,10)
	Scale 1 2 3 4 5 6 7

Then, the fuzzy set theory is deployed to calculate the weightage, which the score has been calculated through a sequence process of fuzzification, determining fuzzy weight using the geometric mean method and defuzzification. Steps taken for the calculation to run the FDM in this research follows Nouri, Nikabadi, and Olfat (2019), as follows:

Step 1: The Triangular Fuzzy Numbers (TFNs) were determined for index

 $O_i = (L_i, M_i, U_i)$  for each *i*-factor whereby,

 $L_i$  represents the minimum value provided by the experts:  $LC_i = min(L_i, M_i, U_i)$ .

 $M_i$  is the Geometric mean of the experts' opinions and is determined as

follows: 
$$M_i = (R_{i1} \times R_{i2} \times \cdots R_{ik})^{\frac{1}{k}}$$
.

 $U_i$  represents the maximum value provided by the experts:  $U_i = max(L_{ik})$ .

In this case,  $L \le M \le U$ , L and U are the smallest and highest values, respectively, and M represents the most probability of value.

$$\mu A(x) = \begin{cases} \frac{x - L}{M - L}, & x \in [L, M] \\ \frac{U - x}{U - M}, & x \in [M, U] \\ 0, & \text{otherwise} \end{cases}$$

**Step 2**: When the TFNs are set for all factors, the center of area method is used for the defuzzification and determine the *Gi* value:

$$G_i = \frac{(U_i - L_i) + (M_i - L_i)}{3} + L_i$$

**Step 3**: The factors are screened by determining  $\alpha$ . The basis for screening is as follows: factors whose  $G_i$  are greater than or equal to the threshold,  $\alpha = 3.5$  remains, and other factors are eliminated:

$$\begin{cases} \text{If } G_i \geq \alpha, \text{ then select No: } i \text{ factor} \\ \text{If } G_i \geq \alpha, \text{ then delete No: } i \text{ factor} \end{cases}$$

Many researchers who adopted the FDM invalidating the indicator of supply chain performance used  $\alpha = 3.5$  as the threshold value where they had deployed the 7scale measurement in their questionnaire survey (Khan, Haleem & Khan, 2020; Bouzon et al. 2016; Tahriri et al. 2014). Nonetheless, some used  $\alpha = 7.0$  or 5.0 (Lin et al. 2020; Kumar et al. 2018). The summary of recent research that deployed the FDM in the supply chain arena and their  $\alpha$  values is tabulated in Table 3.4.

### Table 3.4

Author (year)	Linguistic Scale	Alpha value
Khan, Haleem, and Khan,	7-scale	3.5
(2020)		
Lin et al. (2020)	9-scale	5.0
Kumar et al. (2018)	5-scale	7.0
Bouzon, Govindan, Rodriguez	7-scale	3.5
& Campos (2016)		
Tahriri, Mousavi, Haghighi &	7-scale	3.5
Dawal (2014)		

Previous Supply Chain Research Arena Linguistic Scale and Alpha Value

Based on the previous studies, this research adopted a threshold value,  $\alpha = 3.5$  since the 7-scale has been deployed to collect the data for analysis. Hence, the values of  $L_i$ ,  $M_i$  and  $U_i$  for the lowest scale is (0,0,1) and the highest scale is (9,10,10). Microsoft Excel was used to run the analysis and expected most of the library management personnel to agree with our developed conceptual supply chain model for the academic library. The steps of fuzzy Delphi analysis also presented a flowchart in Figure 3.7 for a clear view. The result and findings from this phase will be discussed in detail in Chapter 4.



Figure 3.7 The Flowchart of Fuzzy Delphi Analysis

# **3.7 Summary of Research Process**

The overview of the research process that has been planned in this research is tabulated in Table 3.5. This research starts with information collection, which aims to identify entities and their functions in the academic library supply chain. For this purpose, a theoretical literature review from articles and content analysis from the semi-structured interview of experts are used. This collected information is used to model an academic library supply chain's conceptual model by using the system thinking method. Finally, the proposed conceptual model of an academic library supply chain is validated by the Fuzzy Delphi Method (FDM). The FDM is done by structured questionnaire results from expert judgment with Excel simulation.

## Table 3.5

Summary of Research Activities Flow

Pł	nase	Aim	Method/Analysis	Tools
1	Information	Identification of entities	Theoretical	Articles
	Collection	and their functions in the	Literature	Journal,
		academic library supply	Review; Content	Semi-
		chain.	Analysis	Structured
				Interview
2	Model	Construction of a	System Thinking	Information
	Development	conceptual model of an	approach	from Phase 1
		academic library supply		
		chain.		
3	Model	Validation of the	Fuzzy Delphi	Structured
	Validation	developed model	Method	Questionnarie,
				Excel
		🔊 Universiti U	tara Malaysi	a

# 3.8 Summary of Chapter

This chapter contains the methodology of the study. It reported all the information about how this research should be done. This study is mainly focusing on the research objective of designing a general supply chain model for the academic library. It also includes findings and analyzing the key entity within the academic library supply chain to improve its functions and services. This whole study would make a guideline on improving the supply chain practice of academic libraries from a decision-making perspective. This research would also open new research opportunities for the next researchers.

## **CHAPTER FOUR**

## MODEL DEVELOPMENT AND VALIDATION

#### 4.1 Introduction

This chapter discusses the development of the conceptual supply chain model for the academic library. It also describes the finding of validation of the models, which accomplished the research objectives 2 and 3, respectively. Hence, this chapter has been constructed into seven sections. Section 4.2 summarises crucial findings from literature and content analysis from Chapter 2 and Chapter 3. Section 4.3 explains the overview of the model development process then descriptions and findings of the models have been discussed in Section 4.4. In Section 4.5, the overview of the model validation process has been illustrated then, results and findings from the Fuzzy Delphi method have been presented in Section 4.6. Lastly, the conclusion of this chapter is described in Section 4.7.

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#### 4.2 Findings from Literature and Content Analysis

The findings of a theoretical literature review and a content analysis were utilized to construct a conceptual model of the academic library supply chain. This section discusses the most significant findings from them. Using these findings, the conceptual supply chain model in this study has been developed by anticipating the SC network's complexity and flow structure in the SC network. The literature findings in this study are presented in Table 4.1.

# Table 4.1

Catagom of Data Needed for the Concentual Model Development	
Calegory of Dala Needea for the Conceptual Model Development	

Category	References
Number of entities in SC Network	Kress and Wisner (2012), Wathen (2009), Cornish (1996).
Number of Tiers in SC Network Information flow	Wang (2017), Kress and Wisner (2012). Ball (2004), Katsirikou, (2003), Ball and Wright, (2000).
Close-ended loop	Wang, (2017)
Open-ended loop	Wang, (2017)
Supplier to Library	Kress and Wisner (2012), Wathen (2009)
Library to Customer	Kress and Wisner (2012), Wathen (2009)
Customer to Library	Kress and Wisner (2012), Wathen (2009)
Library to Supplier	<b>rsiti Utara Malaysia</b> Kress and Wisner (2012), Wathen (2009)

Table 4.2 shows the profile of respondents interviewed for content analysis. For this study, these respondents were considered highly competitive.

### Table 4.2

List of Interviewed Respondents' Profile

No.	Position	University	Gender	Working Experience
				in Academic Library
1.	Chief Librarian	University Utara	Male	More than 21 years
		Malaysia (UUM),		
		Malaysia		
2.	Deputy Chief	University Utara	Male	More than 12 years
	Librarian	Malaysia (UUM),		
		Malaysia		
3.	Deputy Chief	Prime University	Male	More than 12 years
	Librarian	(PU), Bangladesh		
	M Duna 8 S	Universiti Uta	ara Ma	laysia

Relevant information for this study from the interview sessions is categorized in a few points, which have been summarized in Table 4.3. The expert librarians discussed the importance of services and which part they mainly faced challenges. The summary has been picked up on the desiccation of the research-related operational aspect of the academic library.

One of the main challenges faced by the academic library is to maintain its main operations, which is preparing relevant materials for its customer. The UUM Chief librarian mentioned that the focus of the academic library supposedly can provide relevant books, journals, and e-material to the library users. While coping with the emergence of the academic library role for university ranking, branding, and internationalization, the main focus of academic library operation cannot be undermined by these new roles of the academic library (Operational). This is highlighted when the UUM Chief librarian illustrates the operational process of the academic library. Therefore, it is noted as an operational theme for simplification.

"The main focus of the academic library is to provide books, journals, and ematerials to the library users."

(Chief librarian/ UUM)

Meanwhile, the PU Deputy Chief Librarian mentioned that most of the academic library is highly dependent on its academic institution (Strategical). This is emphasized when the Deputy Chief Librarian of PU explains about strategical management of the academic library. Thus, it is stated as a strategical theme for simplification.

"The academic library is highly depending on the academic institution that sponsored the academic library."

(Deputy Chief Librarian/PU)

The Deputy Chief Librarian of UUM emphasized that academic libraries often have difficulties in selecting reading materials to purchase since there is a decision gap between academic library management and university administration over which materials are most necessary to purchase (Developmental). This is underlined when the Deputy Chief Librarian of UUM describes the development planning of the academic library. Hence, it is mentioned as a developmental theme for simplification. "Most of the time academic library find the problem of selecting reading materials purchase because which materials are most important to buy there is decision gap between academic library management and university management."

(Deputy Chief Librarian/UUM)

The Chief Librarian of UUM recognized the significance that new technology adds to an academic library, and so the organization of training sessions has become an integral aspect of an academic library (Developmental). This is emphasized when the Chief Librarian of UUM discusses the academic library's development planning. As a result, it is referred to as a Developmental theme for simplification.

"New technology is adding to an academic library, so training session arranging also became an important part of an academic library."

(Chief librarian/ UUM)

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Additionally, the Deputy Chief Librarian of PU also emphasized that providing training facilities is becoming more popular for university libraries (Operational). This is highlighted when the Deputy Chief Librarian of PU explains about operational processes of the academic library. Therefore, it is stated as an operational theme for generalization.

"Providing training facilities is also becoming common for the academic library." (Deputy Chief Librarian/PU) According to UUM's Deputy Chief Librarian, the most crucial aspect of library management is making material selection decisions for academic library users (Strategical). This is underlined when the Deputy Chief Librarian of UMU explains about strategical management of the academic library. Hence, it is stated as a strategical theme for simplification.

"The most critical part of managing is the purchasing decision of materials for the academic library users."

(Deputy Chief Librarian/UUM)

According to UUM's chief librarian, library strategies are also determined by the materials required for library users, and academic libraries must also satisfy the sponsor academic institution (Operational). This is underscored when the Chief librarian of UUM illustrates the operational process of the academic library. So, it is noted as an operational theme for generalization.

"Library strategies depend on the materials needed for the library users and academic library also satisfy the sponsor academic institution."

(Chief librarian/ UUM)

The overall finding from the content analysis of this study is presented in Table 4.3.

## Table 4.3

Main Theme	Code
Operational	Preparing relevant materials for its users.
	Satisfy the sponsor academic institution.
	Providing training facilities is also becoming common
Strategical	Highly depended on the academic institution.
	The most critical part of managing is the purchasing decision of materials.
Developmental	New technology is adding, therefore training session arrangement is necessary.
Universiti	Materials purchase decision gap between academic library management and university management.

The Final Template for Content Analysis Findings

The findings of this section have been used to create a conceptual supply chain model of the academic university library, which will be discussed in detail in the next section.

## **4.3 Model Development**

The development of the conceptual supply chain model for an academic library is the most important part of this thesis's study process. The main processes in this phase are determining all the entities of the academic library supply chain, examining their roles and relationships among the entities in the academic library supply chain network. In this thesis, the process of developing the model has been explained in Chapter 3, where

the conceptual model of the academic library supply chain was built with information gained from the findings of the Phase 1 research process, covering the data collected from the literature review and interview session. A literature review, the conceptual model in this research, has been built qualitatively by using the system thinking approach's synthesis method, which is explained in section 3.5. The synthesis method of the system thinking approach can be used to combine two or more things to create something new. While dimensions or domains needed for the conceptual model construction are based on information in Table 4.1, anticipated the process of determining:

- i. The number of entities in the supply chain network
- ii. The number of tiers in the supply chain network
- iii. The structure of service or information flow in the supply chain network (i.e., flows from suppliers to library, library to customer or suppliers, closed-ended or open-ended loop)

As reviewed in Chapter 2, the basic structure of a supply chain network comprises three levels: the upstream network level (supply base), the focal firm/organizational level, and the downstream network level (customer base). Based on the analysis conducted in Phase 2, findings show that the structure of the academic library supply chain network developed in this thesis is not complex. The entities' role is simple, but the flow of material/information that occurred within the entities is quite complicated and needs to be well understood, which requires standardization in the operational procedure within the entities' role in the academic library management. Main references have been used in constructing this conceptual Model have been tabulated in Table 4.1, including Wang (2017), Kress and Wisner (2012), Wathen (2009), Ball (2004), Katsirikou, (2003), Ball and Wright, (2000), as well as Cornish (1996). Three types of conceptual supply chain models have been built from the analysis: The Holistic View of Supply Chain Model for an Academic Library, Material Purchasing Decision Making Model, and Conceptual Supply Chain Model for Academic Libraries. The description of these three models will be explained in detail in the next sections.

## 4.3.1 The Holistic View of Supply Chain Model for Academic Library

The Holistic View of the Supply Chain Model represents all the Supply Chain Model entities for the Academic library. This Model strategically constructed all types of Tier of academic library's suppliers and customers in a graphical layout. As a starting point, the Lied Library supply chain model of Kress and Wisner (2012) has been applied as a model template, which is illustrated in Chapter 2 in Figure 2.9. The template developed includes most of the library supply chain relations, covering all important categories of supply chain shown in Table 4.1, with its horizontal and vertical structure of a supply chain network. The explanation, according to each category is the following:

## a) Number of Entities and Their Roles

The entities and their roles that should be considered in the supply chain network of the academic library in this model will be discussed according to the basic structure of a supply chain network, which is the upstream network level (supply base), the focal firm/organizational level and the downstream network level (customer base). For a better understanding, the entities identified in the holistic view of the supply chain model for the academic library according to the supply chain network structure are tabulated in Table 4.4.

#### Table 4.4

Structure	Entity
Supply-based	Publishers
	Serial subscription agents
	Database vendors
	IT supports division or company
	Organizers of trainers
	Delivery service company(s)
	Other maintenance suppliers
Customers-based	Library users or customers
	Sponsor (Academic Institution)
Supplier and	Resource Sharing Partners
Customer-based	

Entities of the Holistic View of Academic Libraries Supply Chain Model

Under the supply base structure, the entities that supply the academic library with both material and services are the Publisher, Serial subscription agents Database Vendors, IT Support Division or Company, Organizers of Trainers, Delivery service company(s), and Other Maintenance Suppliers. During the interview session with the academic library personnel, one new specific function has been discovered of an academic library in this study, which acts as a provider for relevant training programs to the library's stakeholders, namely Organizers of Trainers. This entity was not included by other researchers of the academic library supply chain, but its function has

been highlighted in other research related to the management of the academic library, such as Abban (2018), Bamidele, Omeluzor, Imam, and Amadi (2013), as well as Masrek et al. (2012). Hence, the Organizer of the Trainer is included in this model. This finding is one of the striking findings of this study.

The customers who receive the services from the academic library under the customer base supply chain network structure are the library users or customers and the Sponsor (Academic Institution), where the Sponsor (Academic Institution) has been identified as a new entity in the academic library supply chain network. Even though the Sponsor could act as a supplier in this conceptual model since it finances the expenses of the academic. However, for the service supply chain, the ultimate benefit goes to the ultimate customer or consumer (Habib, 2017). For the academic library, the ultimate benefit goes to sponsor academic institutions because mostly library users provide academic feedback or benefit to the sponsor academic institution. Additionally, the amount of capital invested is indirectly involved in the operation of the academic library but should be equivalent to the Sponsor's satisfaction with the performance of academic library (i.e., University's ranking, internationalization, the and digitalization), which directly describe the academic library operation. Hence, the Sponsor is defined to act as a customer in this model. The Sponsor's role as the academic library's customer is supported by Jordan (2017), Henderson, Mazodier, and Sundar, 2019.

This model also has an entity that acts as a supplier and a customer in both ways, namely the Resource Sharing Partner. The description of the role of this entity will be explained in detail in Section 4.4.3. Illustration of the entities of this Model is depicted in Figure 4.1, and the description of the entities' roles are the following:

- i. Publisher: A book/journal publisher is a group or person who is responsible for bringing the book/journal to the public for reading purposes. The book/journal publisher is involved in the major steps of developing, marketing, producing, printing, and distributing the books/journals (Clark & Phillips, 2014).
- ii. Serial subscription agents: The generic term for the publications supplied through subscription agents is serials. These may also be known as journals, periodicals, magazines, and series. A serial may be published regularly, e.g. weekly, monthly, quarterly, annually, etc., or at irregular intervals (Gregory, 2019; Gu & Blackmore, 2017). They may be published in a variety of formats online, print, CD-ROM, etc. Although most serials continue indefinitely, some have a limited lifespan. Besides, agents supply monographic series either shipped directly by the publishers or handled through the agent. These publications are often invoiced at the time of supply of each volume, unlike subscriptions to journals, which are charged annually in advance and usually posted directly by the publisher.
- iii. Database Vendors: Database Vendors mainly provide e-materials (e-book and e-journals) to the libraries by providing their database (i.e. science direct etc.), but they also could provide a hard copy of the e-materials to the libraries (Einasto, 2016; Kaplan, 2012).

- iv. **Delivery Service Company(s):** Delivery is the process of transporting materials, goods, or documents from a source location to a predefined destination. There are different delivery types. Cargo (physical goods) are primarily delivered via roads and railroads on land, shipping lanes on the sea, and airline networks in the air (Ivanov, Tsipoulanidis & Schönberger, 2017).
- v. The IT Supports the Division of Company: IT support suppliers include those offering information architecture services such as library online public access catalogs (OPAC) and discovery platforms, which provide one simple search interface for a wide range of library resources (Patra, 2017; Sonawane, 2018).
- vi. Organizers of Trainers: Training program organizing is one of the services of the Academic library. Therefore, organizing proper trainers is the key element for this service (Abban, 2018; Bamidele et al. 2013; Masrek, Johare, Saad, Rahim & Masli, 2012).
- vii. **Other Maintains Suppliers:** The academic library also requires equipment, furniture, office supplies, and janitorial, maintenance (Hye, Nazri, & Mustaffa, 2019), which we have categorized as other maintenance suppliers.
- viii. Library Users/Customers: The core users/customers of academic libraries are the campus users, which include students and faculty (Ouda-Onyango & Minishi-Majanja, 2020; Verma, 2018). The libraries also typically serve remote and distance users as part of the campus community. For example, in addition to the main UUM

campus, there are several UUM campuses in Malaysia. The UUM Library also serves to provide access and limited privileges to the general public.

- ix. **Sponsor** (Academic Institution): An academic institution usually sponsors an academic library. An academic library's main goal should be related to serving the Academic institution users that sponsored it and spending money to maintain the academic library (Jordan, 2017; Eighmy-Brown, McCready & Riha, 2017). In this study of academic library supply chain management, sponsored academic institutions were named shortly as sponsors.
- x. Resource Sharing Partners: Resource sharing partners are those libraries where the academic library shares its resources. Recourse-sharing partners are working as both suppliers and customers, which is known to most users as the interlibrary loan (Hilyer, 2018; Kress and Wisner, 2012; Wathen, 2009). As an example, all public university libraries of Malaysia are resource-sharing partners to one another, so they can provide interlibrary loan services to all their users.



Figure 4.1 The Holistic View of Supply Chain Model for Academic Library

#### b) Number of Tiers

Figure 4.1 identified three Tiers that could be included in this supply chain model of the academic library. On the left side of Figure 4.1, there are the Tier 1 Supplier and Tier 2 Supplier, which depicted the main horizontal structure of the Model for the supply-based network structure with seven entities (i.e., two entities as the Tier 2 Supplier and five entities as the Tier 1 Supplier), While, on the right side of this figure, there is the Tier 1 Customer, which represents the customer-based network structure with two entities. The Resource Sharing Partners entity represents both a Tier 1 customer and Tier 1 supplier vertically.

#### c) Structure of Service/Information Flow

The flows of materials, information, and services in the holistic view of the academic library's supply chain model were also identified. The description of the flows in Figure 4.1 is presented as follows.

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From the left side of Figure 4.1, the flow from the Tier 2 supplier to the Tier 1 supplier delineates a Closed-ended loop system, whereby the entities of Publishers and Database Vendors (in Tier 2 supplier) deal with the Serials Subscription agents (in Tier 1 supplier) for supplies of book, journals, and e-materials for the academic library. The entities in the Tier 2 supplier also engage with the Delivery Service Company (in Tier 1 supplier) for the delivery of the materials. Nevertheless, the entities in Tier 2 suppliers sometimes engage directly with the academic library.

Meanwhile, the Tier 1 Supplier flow to the Academic Library also operationalizes as a Closed-ended loop system. In detail, the aforementioned entities of suppliers provide books, journals, and e-materials for the Academic Library. Secondly, the entity of IT Supports division or Company and Other maintains suppliers provide services to the academic library to serve the library users according to the users' demand. Finally, the Organizers of Trainers entity, which is a new entity added to the academic library supply chain network, organizes the training program that is relevant to the library's employees and users.

Similar to the aforementioned flows (i.e. from Tier 2 Supplier to Tier 1 supplier and from the Tier 1 supplier to the academic library), the flow from the academic library to Tier 1 customer on the right side of Figure 4.1 also operationalizes with the Closed-ended loop system. The academic library distinctly delivers materials, services, and information to the library users. The users require to return the materials in a particular period or feedback on the academic library's services. The academic library user's feedback, and the Sponsor is responsible for financing the academic library's materials. The flow between the Resource Sharing Partners and the academic library also forms a Close-ended loop supply chain system, representing the interlibrary loan service among libraries. Overall, it can be concluded that the flows of materials from one entity to the other entities in this model formed a closed-ended loop supply chain system (as opposed to an open-ended supply chain system). To make this holistic view of the supply chain model for the academic library more meaningful, the integrated conceptual supply chain model for the academic library metwork has been developed.

#### 4.3.2 Material Purchasing Decision Making Model

The material purchasing decision-making model is a diagram layout of the academic library's materials purchase activity, which the Procurement division manages. This model demonstrates the example of how the model of the academic library supply chain can be used for an academic/university's day-to-day activities and decision-making process. The materials purchasing activity has been chosen as this activity was deemed to be the most challenging by the management of the UUM library and Prime University library, which was discovered during the interview session conducted in Phase 1 of this research work. This activity encompasses a process of making decisions involving money. Thus, the decision that has been made cannot be taken for granted. To develop this model, the purchasing frameworks proposed by Wang (2017) and Kress and Wisner (2012) are used as the main references, which mainly described the collection system of the academic library.

The Procurement Division of the academic library is part of the operation center of the library's material resources for an academic library, which is responsible to buy materials (i.e. books, journals, and e-materials) for the academic library. These materials are mainly supplied by Publishers and Database vendors, and they are the Tier 2 suppliers for the academic library. The Publishers can sell their hard copy and soft copy of their resources directly to the academic library, but sometimes Serial Subscription Agents might buy from them, and consequently, the Academic Library also buys resources that are sold by Publishers and Databases Vendor from these Serial Subscription Agents. Nevertheless, the Database Vendor's main activity is to take the journals from publishers and sell them to the library. They also publish the electronic journals, which they sell the material to the Academic Library as well as the Serial

Subscription Agent. The Serial Subscription Agent is the Tier 1 Supplier under the academic library supply chain network. Meanwhile, the Delivery Services Companies provide all transportation and logistics services if needed.

Nevertheless, the decision on which materials need to be purchased is decided upon the outcome from the information collection conducted by the academic library management under the Procurement Division. From the interviews with librarians, it was revealed that the academic library has designated one person in each school or faculty to collect information on behalf of the institution. The representative usually discusses which books and journals should be bought for academic references purpose with the Dean, Deputy Dean, Head of the departments, coordinators, and Professors from that school. Then, the representative submits the suggestions to the Administration Division and the information submitted will be processed and the decision will be made on the materials that should be bought, whereby the amount of money spent on these materials must be within the budget allocated for the library's materials and the materials are available from the suppliers. The complete illustration of the material purchasing decision-making model is presented in Figure 4.2.



Figure 4.2 Material Purchasing Decision Making Model

#### 4.3.3 Conceptual Supply Chain Model for Academic Library

The Integrated Conceptual Supply Chain Model for Academic Library is constructed in this section. This Model discusses entities identified for the operationalization of the Academic Library and their roles as well as the flows of materials, services, and information between the operational units (or Division) identified and the entities in Tiers 1 and 2 suppliers as well as the Library Users, which formed the structure of integrated conceptual supply chain model for academic library network.

The entities of operational structure inside the academic library in this Model can be classified into two types of supply chain operations network according to their roles to the library users, and they are materials operations of the supply chain network and service operations of the supply chain network. Explanation of these two types of supply chain operations network as follows:

Figure 4.3 illustrates the graphical layout of the Material Operation of the supply chain network, which consists of seven entities that have been identified to represent the operational supply chain network in managing the materials under the academic library supply chain. The explanation of each of the entities' roles is tabulated in Table 4.5.

# Table 4.5

The entity a	nd its role	in the Material	<b>Operation</b>	Supply	Chain Network
-					

Entity	Role	Source
Procurement	Purchase materials from the	Shang et al. 2017;
division	Publisher, Database Vendor, and	Wang (2017); Kress
	Serials Subscription Agents to be	and Wisner (2012).
	sent to the Process Techniques	
	Division for Cataloging.	
Gift and Swap	Collect gifts (i.e. books, magazines)	Kathy, 2020; Casey,
division	from the Publisher, Database	2011.
	Vendor, Serials subscription agents	
	or other parties to be sent to the	
	Process Techniques Division for	
	Cataloging. Handle materials'	
	swapping in the event of materials'	
	defect from the Suppliers.	
Process Techniques	Catalog the materials received from	Jordan, 2017; Budd,
Division	the Procurement Division and Gift	2005; Edelman,
	and Swap Division to be handed into	1979.
	the Special Collections & Media	
	Division, a Reference section,	
	Circulation Division, and Section	
	Archive.	
Special Collections	Provide photographs, filmstrips,	Hirshon, Jackson &
& Media Division	maps, slides, motion picture films,	Hubbard, 2016;
	LP records, audio spools, audio and	Jordan, 2017.
	videotapes, laserdiscs, video discs,	
	etc. to the Library Users.	

### Table 4.5 Continued.

Entity	Role	Source
Reference section	Provide Almanacs, Atlas & Maps,	Dahan et al. 2016;
	Biographical Resources,	Jordan, 2017.
	Dictionaries, Directories, and	
	Encyclopedias to the Library Users.	
Circulation	In-charge loan services of books and	Caswell, 2019;
Division	journals to the Library Users.	Jordan, 2017.
Section Archive	Provide accumulation of historical	Allen, 2019; Jordan,
	records to the Library Users.	2017.

From Figure 4.3, the Procurement division is responsible to buy the materials (i.e., books and journals), and the Gift & Swap division in-charges of collecting materials received as a gift and dealing with suppliers in the event of materials defect. All the materials are then sent to the Process Techniques division, where this division mainly catalogs these materials. Once the materials are cataloged, they are distributed to four different divisions based on types of the cataloged materials: Special Collections & Media, Reference, Circulation, and Archive. The Library Users can borrow the materials or refer to them, but they have to return them to the library. This ecosystem of the library users' borrowing or using the materials can be classified as a Close-ended loop system.



Figure 4.3 Material Operation of Supply Chain Network for the Academic Library

The type of service operation supply chain network in an academic library is illustrated in Figure 4.4. The supply chain network of service operation has been identified to have six entities that are suitable to manage the services of the academic library supply chain network. The explanation of each of the entities and their role is shown in Table 4.6.

# Table 4.6

The entity and its Role in the Service Operation Supply Chain Network

Entity	Role	Source
Administration	Manage all the operations and	Jordan, 2017; Lewis,
Division	maintenance of the academic	2016.
	library	
Research &	Provide in-person consultations	Hilyer, 2018; Cox et al.
Corporate	about the academic library's	2017.
communication	information and services to	
	users, and this division also	
	supports researchers (i.e.	
	plagiarism check).	
Training &	Organize training programs for	Lewis, 2016; Gathered
Quality	academic library users as well as	information about it from
	library employees.	Phase 1 research in the
		activity of interview of
	Universiti Utara I	experts.
The library	Manage the information systems	Jordan, 2017; Lewis,
computer system	of the academic library.	2016.
Division		
Operations and	Update electronic resources and	Graham, 2020; Jordan,
Computer	manage the IT operations for the	2017; Lewis, 2016.
Applications	academic library.	
e-Library Division	Mange e-library user interfaces	Głowacka, 2019; Sharma,
	for library users.	2016.
The library computer system Division Operations and Computer Applications e-Library Division	Universiti Utara Manage the information systems of the academic library. Update electronic resources and manage the IT operations for the academic library. Mange e-library user interfaces for library users.	activity of interview of experts. Jordan, 2017; Lewis, 2016. Graham, 2020; Jordan, 2017; Lewis, 2016. Głowacka, 2019; Sharma, 2016.

From Figure 4.4, the digital library services are provided by the divisions of Library Computer System, Operations and Computer Applications, and e-Library. The Training & Quality division organizes a series of training designated for Library Users and employees for knowledge enhancement and workforce diversity improvement (i.e., training about using plagiarism detection software from the library and reducing plagiarism from the text). The Research and Corporate Communication division mainly helps the Library Users with personal consultations on library services, like providing all the guidelines on using the library resources and supporting them to use and find the library resources. The other examples of services are helping researchers with plagiarism detection, e-thesis dissertation, etc.



Figure 4.4 Service Operation of Supply Chain Network for the Academic Library

Lastly, the division that administers the academic library's whole operation is the Administration division, which can be considered the important division that is responsible for managing all the operations and maintenance of the academic library. Overall, this service operation can be considered to operate with the Close-ended loop supply chain system because other than the Library Users receiving the services, they also provide feedback on the quality of services given to them.

To represent a complete illustration of the supply chain model for the academic library, the graphical layout of the material and service operations is combined. This new illustration is depicted in Figure 4.5. From this figure, the conclusion can be made by saying that the illustration structure of the academic library supply chain network is not complex, but the service/information flow of the supply chain network of the academic library is complex. The complexity of the service/information flow of the

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An example is the management of materials in the form of digital. Before the digital material can be used or borrowed by the users, the back-end of processes is quite complex. The process starts with cataloging the digital materials on the computer applications, which are done and maintained by the Library Computer System division. The Library Users can get access to the digital materials through the e-Library Management System, which can be accessed via the library's intranet system. Then, requests from the Library Users will be processed by the e-Library division.

The other example with complex service/information flow is the interlibrary loan function, where the Resource Sharing Partners manages the function and is mainly connected through the e-Library division. Suppose any user needs any material that is not available in the particular academic library but is available at other libraries. In that case, the Library Users can send the request on the material to those resource-sharing partners via the Operations and Computer Applications division. Then, the resourcesharing partners will process the request, and once the requested material is available, it will be sent to the process techniques division, which later will be delivered to the library users via the circulation division. In this case, the Resource Sharing Partners act as suppliers, but they can also act as customers.

As an ultimate consumer, like other service supply chains, all benefit from the academic library should provide benefit to the Sponsor (Academic Institution), which is one of the most important findings from this study. As a consequence, an academic library is an extremely vital component of any academic institution.

From the aforementioned examples, they described the complexity of the academic library material/service/information flows as the structure of the library's operation involves multiple entities with cross-sectional functionality, thus may require the library to have a systematic operating procedure, which possible to be implemented under the integrated supply chain network structure. Therefore, the academic library's conceptual supply chain model is a striking finding with a novelty of reporting the whole operationalization of the academic library, which has never been done in any previous research related to the service supply chain model for the academic library.

Theoretically, an integrated service supply chain should cover seven service supply chain processes. They are demand management, capacity and resource management,
customer relationship management, supplier relationship management (SRM), order process management, service performance management, information, and technology management (Jamkhaneh et al. 2018; Sakhuja et al. 2016; Boon-itt & Pongpanarat, 2011). The proposed conceptual model is named as Integrated Academic Library Supply Chain (IALSC) which covers all these processes and is defined in Figure 4.5.





Figure 4.5 Integrated Academic Library Supply Chain (IALSC) Model

#### 4.3.4 Summary of Model Development

Theoretically, an integrated supply chain refers to an organization's resource planning approach for the supply chain (Jamkhaneh & Ghadikolaei, 2020; Kurbel, 2016). While the holistic view of the supply chain model for academic libraries describes the conceptual model according to the supply chain network theory and the Material purchasing decision-making model graphically explains how the decision-making process has been conducted for the academic library's most critical operation. Lastly, the most important part of this research development of the conceptual supply chain model for academic libraries illustrates the ideal integrated supply chain model for the academic library.

In holistic view of supply chain model for an academic library, the main findings are the entities and their roles that are ideal for the supply chain network of the academic library, which identified according to the basic structure of a supply chain network (i.e., the supply base, the focal firm/organizational level and the customer base). Entities of the supply chain network in academic library supply chain built by Kress and Wisner (2012) covered all types of academic library entities were also covered in this model, but additional entities have been discovered for the conceptual academic library supply chain model, as a result from the findings of the interview sessions that have been conducted with the library employers. The newly identified entity, the 'Sponsor', who is responsible for sponsoring the expenses of the academic library, which is the main challenge of managing by the majority of the academic library in developing countries for them to continue the academic library operation. The material purchasing decision-making model represents the process of materials purchase activity and information flow activity of the Procurement Division of the academic library. This Model shows how the academic library supply chain model can be used for a decision-making process and a very important strategical tool. There are several models constructed for solving the library's material purchasing problems, but this model succeeds to illustrate the decision-making process graphically according to the supply chain network framework, which has never been done in any research related to the academic library supply chain research.

The developed conceptual supply chain model for the academic library or Integrated Academic Library Supply Chain (IALSC) inspected the elements and their roles recognized for the operationalization of the academic library, covering the administration of the materials and services as well as related information. This model is one of the best novelties discovered from this research, whereby the operationalization of the academic library supply chain network has been described as a whole, compared with the studies done by the previous researchers who covered just part of the academic library operation.

To make these proposed models more meaningful for real-life academic library operation and be accepted as standard models for all academic libraries, the models have been validated using the expert's judgment analysis. The validation process is presented in the next section as follows.

#### 4.4 Models Validation Using Fuzzy Delphi Method

This section presents the findings of validation analysis on the models built in Section 4.4, covering the outcome of Phase 3 research activities. The purpose of validating the models is to confirm that the conceptual models of an integrated academic supply chain proposed in this thesis are reliable and able to be practiced by the academic library management. To validate these models (i.e., Holistic View of Supply Chain Model for an academic library, Material Purchasing Decision Making Model and Conceptual Supply Chain Model for Academic Library), Soni and Kodali's (2013) approach was applied in this research, covering the aspects of verifying the elements or constructs that are included in the supply chain model, the degree of standardization of these elements in the supply chain model and the materials and information flow for procurement division in the supply chain model. For analysis, this research used the experts' judgment analysis by analyzing their opinion of agreement with the proposed models.

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The three main activities involved in this analysis are constructing the structured questionnaire, collecting the questionnaire data, and analyzing the data using the fuzzy Delphi method (FDM). In the questionnaire, the experts have been asked about their agreement with the statement constructed that describes the graphical layouts of Models, and the statements are listed in Table 4.7 as follows.

# Table 4.7

Statements	Constructed	in the	Question	ıaire
------------	-------------	--------	----------	-------

Model	No.	Statement
Holistic View of	1	All the elements are covered (included) in the
Supply Chain Model		proposed conceptual model of the academic library
for academic library		supply chain.
	2	All the linking lines correctly cover the functions of
		the proposed conceptual model of the academic
		library supply chain.
Material Purchasing	1	All the elements are covered (included) in the
Decision Making		proposed conceptual model of materials and
Model		information flow for the procurement division of the
		academic library.
	2	All the linking lines cover the functions of the
	Ur	proposed conceptual model of materials and information flow for the procurement division of the
		academic library.

Table 4.7 continued.

Model	No.	Statement
Conceptual Supply	1	The demand management process system is properly
Chain Model for		covered in this proposed conceptual Model of the
Academic Library or		academic library supply chain.
Integrated Academic		
Library Supply Chain	2	The capacity and resource management process
(IALSC)		system are properly covered in this proposed
		conceptual Model of the academic library supply
		chain.
	3	The customer relationship management process
		system is properly covered in this proposed

chain.



The supplier relationship management process system is properly covered in this proposed conceptual Model of the academic library supply chain.

conceptual Model of the academic library supply

- 5 The order process management process system is properly covered in this proposed conceptual Model of the academic library supply chain.
- 6 The service performance management process system is properly covered in this proposed conceptual Model of the academic library supply chain.
- 7 The information and technology management process system is properly covered in this proposed conceptual Model of the academic library supply chain.

The detail of these three activities has been explained in Chapter 3, Section 3.6. The next section will discuss the results and findings from these activities.

## 4.4.1 Data Coding

Firstly, the response in the questionnaire from each of the experts has been codified into the triangular fuzzy number (TFN). Table 4.8, Table 4.9, and Table 4.10 present the summary of the TFN values for the Models of Holistic View of Supply Chain for Academic Library, Material Purchasing Decision Making, and Conceptual Supply Chain Model for Academic Library, respectively. Detail outcomes for each of the respondents can be referred to from Appendix B, Appendix C, and Appendix D.

Two statements have been used for the validation of the Holistic View of Supply Chain Model for Academic Library, with Question 1 denoting Statement 1 or St1 and Question 2 denoting Statement 2 or St2. In Table 4.8, the total sum of the results and the average results have been displayed. Table 4.8 also includes converted fuzzy numbers total sum and average values, which represent the values of minimum value (i.e., l), Geometric mean (i.e., m), and maximum value (i.e., u).

## Table 4.8

Measurement		Statement (St)	Total	Average
Actual Score		St1	275	5.288
		St2	271	5.212
Fuzzy Value	l	St1	315	6.057
	m		396	7.615
	и		446	8.577
	l	St2	307	5.904
	m		389	7.481
	и		442	8.500

Academic Library Supply Chain Model Triangular Fuzzy Number Summary

Likewise, two statements also have been utilized to validate the Material Purchasing Decision Making Model. The total sum of the results and the average results are shown in Table 4.9. Additionally, Table 4.9 gives the total sum and average values for converted fuzzy numbers.

### Table 4.9

Measure	ment	Statement	Total	Average	
Actual Score		St1	276	5.308	
		St2	277	5.327	
Fuzzy Value	l	St1	317	6.096	
	т		396	7.596	
	u		443	8.519	
	l	St2	319	6.135	
	m		396	7.615	
	u		443	8.519	
	Univers	iti litovo Mol	lawala.		

Material Purchasing Decision Making Model Triangular Fuzzy Number Summary

In total seven statements were used to validate the Conceptual Supply Chain Model for Academic Library, and the total sum and average of the results are shown in Table 4.10. Additionally, Table 4.10 includes the total sum and average values of the seven statements as converted into fuzzy numbers.

## Table 4.10

Conceptual	Supply C	Chain Mod	del Trian	igular .	Fuzzy	Number	Summary	for Acc	idemic
Library or I	Integrate	d Academ	ic Librai	ry Supj	oly Ch	ain (IAL	SC)		

Measurem	Statement	Total	Average	
Actual Score		St1	270	5.192
		St2	267	5.135
		St3	265	5.096
		St4	264	5.077
		St5	265	5.096
		St6	270	5.192
		St7	267	5.135
Fuzzy Value	l	St1	305	5.865
	т		386	7.423
	и		439	8.442
	l	St2	299	5.75
	m		381	7.327
	и		436	8.385
	liversi	St3	293	5.635
	m		378	7.269
	и		437	8.404
	l	St4	293	5.635
	m		378	7.269
	и		436	8.385
	l	St5	293	5.635
	m		378	7.269
	и		436	8.385
	l	St6	303	5.827
	m		385	7.404
	И		439	8.442
	l	St7	299	5.75
	т		383	7.365
	и		439	8.442

#### 4.4.2 Defuzzification and Aggregation

Then, the defuzzification has been deployed to determine the agreement among the experts on the statement constructed about the models, which can be represented by the  $G_i$  value. The formula for calculating the  $G_i$  value has been explained in Chapter 3, Section 3.6. To interpret the meaning of the  $G_i$  score, the value is compared with the value of the threshold where  $\alpha = 3.5$  as a screening basis. If the  $G_i$  value is greater than  $\alpha$ , then it can be accepted as the experts indicate their consent on the statement being discussed. Otherwise, the statement will be eliminated if the  $G_i$  value is less than  $\alpha$ . Detail outcome of  $G_i$  values and screening results for each of the statements and each of the respondents are shown in Appendix E for result Holistic View of Supply Chain Model for Academic Library, Appendix F for Material Purchasing Decision Making Model, and Appendix G for Conceptual Supply Chain Model for Academic Library.

Based on the  $G_i$  values in Appendix E and Appendix G, all of the librarians were consensually agreed on the elements or constructs that have been included in the Holistic View of Supply Chain Model for Academic Library and the Conceptual Supply Chain Model for Academic Library where the degree of standardization of elements of the  $G_i$  values obtained in both models are greater than  $\alpha = 3.5$ . On the other hand, the result tabulated in Appendix F has shown that not every librarian was agreed on the elements covered in the proposed conceptual model, which refers to the linking lines covered for the functions of the Material Purchasing Decision Making Model. The results show that the scores given by Librarian 2 for Statements 1 and 2 are 3.00, which is less than  $\alpha = 3.5$ . In this case, both statements are supposed to be deleted but have been decided not to delete them since it was rejected by only one librarian. To overcome the issue of reaching the consensus from all experts, all the experts' responses were aggregated to see the result in a form of group consensus, as tabulated in Table 4.10. From this table, the experts agreed with all of the entities included in the Conceptual Model of Holistic View of Supply Chain Model for Academic Library, with Aggregated  $G_i = 7.42$  and all the lines linked constructed in this model correctly cover the functions of the entities (Aggregated  $G_i = 7.29$ ).

The finding also shows that the experts believe all the entities are included in the Material Purchasing Decision Making Model, with Aggregated  $G_i = 7.40$ , and all the linking lines cover the functions of the entities for the materials and information flow for the procurement division of the academic library, with Aggregated  $G_i = 7.42$ .

The degree of standardization of the seven elements for the service supply chain best practice, which should be displayed in Conceptual Supply Chain Model for Academic Library or Integrated Academic Library Supply Chain (IALSC) has also properly covered the elements of demand management (Aggregated  $G_i = 7.08$ ), the capacity and resource management (Aggregated  $G_i = 6.99$ ), the customer relationship management (Aggregated  $G_i = 6.99$ ), the supplier relationship management (Aggregated  $G_i = 6.91$ ), the order process management (Aggregated  $G_i = 6.93$ ), the service performance management (Aggregated  $G_i = 7.04$ ) and the technology management process system (Aggregated  $G_i = 7.00$ ).

# Table 4.11

# The Results from Aggregation Process

Model	Statement	Aggregated	Screening
		G <sub>i</sub>	
Holistic View of	All the elements are covered	7.42	Accepted
Supply Chain	(included) in the proposed		
Model for	conceptual model of the academic		
Academic	library supply chain.		
Library.	All the linking lines correctly	7.29	Accepted
	cover the functions of the		
	proposed conceptual model of the		
	academic library supply chain.		
Material	All the elements are covered	7.40	Accepted
Purchasing	(included) in the proposed		
Decision Making	conceptual Model of materials and		
Model.	information flow for the		
	Procurement Division of the		
	academic library.	alaysia	
	All the linking lines cover the	7.42	Accepted
	functions of the proposed		
	conceptual Model of materials and		
	information flow for the academic		
	library's procurement division.		

Table 4.11 continued.

Model	Statement	Aggregated G <sub>i</sub>	Screening
Conceptual Supply Chain Model for Academic Library or	The demand management process system is properly covered in this proposed conceptual Model of the academic library supply chain.	7.08	Accepted
Integrated Academic Library Supply Chain (IALSC)	The capacity and resource management process system are properly covered in this proposed conceptual Model of the academic library supply chain.	6.99	Accepted
	The customer relationship management process system is properly covered in this proposed conceptual Model of the academic library supply chain.	6.99	Accepted
	The supplier relationship management process system is properly covered in this proposed conceptual Model of the academic library supply chain.	6.91 Malaysia	Accepted
	The order process management process system is properly covered in this proposed conceptual Model of the academic library supply chain.	6.93	Accepted
	The service performance management process system is properly covered in this proposed conceptual Model of the academic library supply chain.	7.04	Accepted
	The information and technology management process system are properly covered in this proposed conceptual Model of the academic library supply chain?	7.00	Accepted

Overall, the outcome from the fuzzy Delphi analysis succeeded to achieve the saturation on the librarians' agreement with the conceptual models developed in this thesis, thus they have a high potential to be proposed as the strategic decision-making tools for an academic library, i.e. the flow of funds through the operations of the library, the library stakeholders' satisfaction measurement, the decision process currently made by the library management team on the purchasing of new library resources such as books, journals or e-documents and the library resource suppliers. Moreover, the management for academic libraries would have more understanding about entities and functions for the academic library's supply chain network.

The finding is in line with the observations of several studies, which advised new management guidelines as an example. Urban, (2021) suggested balancing demand and budget restrictions while evaluating access models in academic libraries. The Material Purchasing Decision Making Model and the IALSC will be beneficial in this study for balancing demand and budget. Lucky and Harkema, (2018) proposed resource allocation decisions for academic libraries in the digital era, which are essentially identical to identifying the academic library's entities and functions, and the Holistic View of Supply Chain Model for Academic Library could be much more beneficial. Additionally, Park and Yoo (2019) identify the importance of supply and resource planning based on the library users' needs in their study and they also described the importance of sponsor academic institution's role. Sponsor academic intuition is also an important find in this study.

Moreover, Stvilia and Gibradze (2017) defined the supplier management of an academic library in a way that resembles the supplier part entity of the IALSC model.

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Nitecki and Alter, (2021) demonstrated the sensitive significance of training in academic libraries to adopt technology, justifying the addition of a new entity provider of trainers to this IALSC model. Ornat and Moorefield (2019) showed how to connect workflow processes in an academic library to almost all of the IALSC model's process links. Therefore, this study could be a valuable resource to academic library management.

## 4.5 Summary of the Chapter

In this chapter, the model development process has been presented of the conceptual supply chain model of the academic library, its operational framework, and particular supply chain model of the procurement division of the academic library. This study successfully presented the new approaches under the research area of service supply chain network and as extensions of the supply chain model for the academic library from the previous research works discovered in Chapter 2. This study also succeeds to validate the built conceptual model, covering the models' entities and operational linkages by using the fuzzy Delphi method to make this developed model more acceptable for every academic library of the world, which has never been done in any research related to the academic supply chain network.

## **CHAPTER FIVE**

## CONCLUSION

## **5.1 Introduction**

This chapter contains discussions of the most significant findings of the study objectives. This is the final chapter, which has been divided into seven sections. Section 5.2 discusses the overview of the study. Section 5.3 illustrates the issues, complexities, and outcomes of this study. Then, section 5.4 discusses the overall research implications and contributions. The next section is devoted to discussing the study's limitations, which is followed by a discussion of many recommendations for future research. Finally, a conclusion about the study is made at the end of this chapter.

## 5.2 Overview of The Study

The supply chain model is vastly used in the modern world to make organizations' operations more effective and cost-efficient. Though, research works done on the library supply chain are still deficient. Supply chain research could be an important tool to make the library a cost-effective organization. This study aims to identify entities and their functions for the academic library supply chain, construct a conceptual model of the integrated supply chain of the academic library, and analyze the interrelationship among the newly developed model entities. Finally, a holistic view of the supply chain model for an academic library was constructed, which shows entities and components of an academic library supply chain network.

Besides, a new diagram layout of the material purchasing decision-making model has also been developed in this study, to illustrate the academic library's materials purchasing activity. This model depicted the role of the Procurement division that demonstrates the example of how the model of the academic library supply chain can be used for an academic/university's day-to-day activities and decision-making process. In this case, Wang (2017) and librarians from UUM and Prime University are those who emphasized this academic library activity because it reflects their main service by providing various activities to the library users.

Furthermore, the integrated supply chain model for the academic library has also been developed, which represents entities identified for the operationalization of the academic library supply chain network and their roles, as well as the flows of materials, services, and information between the operational units (or Division) identified and the entities in Tiers 1 and 2 suppliers as well as the library users.

Finally, to make it more meaningful for real-life academic library operation and be accepted as standard models for all academic libraries, the models have been validated using the expert's judgment analysis. In this study, the fuzzy Delphi method (FDM) has been used to analyze the expert's judgment.

### **5.3 Discussion**

This section summarizes issues relating to academic library supply chain management, then explains the complexities of supply chain model implementations in academic libraries, all of which relate to the study's three research objectives. Finally, the outcomes of the developed Integrated Academic Library Supply Chain Model have been discussed and how the model constructed can be a reference for the strategic planning of the academic library.

#### 5.3.1 Problem related Academic Library Supply Chain Management

Many challenges have been explored and analyzed under the management of academic library research, and three potential issues are significant and require serious attention from academics and practitioners, which are listed below: First and foremost, the budget allocation for library items is the most frequently encountered and critical issue for any academic library. If all other factors are equal, the library collection should provide a diverse range of materials for users at all instructional levels and across all financial backgrounds. Because libraries need partners who require basic academic opportunities, the library corroborates these opportunities and purchases materials that address different sides of a subject or point whenever the circumstances allow it. Regardless of the fact that reasonable individuals may disagree or object to the viewpoint, it is the management team's responsibility to address both. As a result of the enormous variety of assets available, there is no single set of measurements that can be used consistently across the board. Only a few things are decided upon, primarily in terms of their artistic value or documentation of the events, while others are assigned to meet the sporting and educational requirements of the library's users (Hye, Nazri & Mustaffa, 2020; Savova & Price, 2018).

Second, the new digitalization period causes a challenge and an important concern for the academic library, which is discussed further below. In the context of an academic library, digitization is a process in which items are converted from printed versions to electronic copies, which may include text, photos, video, and audio files. Digitalization is being used to improve the maintenance of library materials while also increasing access and retrieval of materials. This is being done by selecting and developing materials for the collection, categorizing and maintaining them, and sharing them with others (Khan & Bhatti, 2017). A variety of obstacles are encountered while digitizing library items, which is an unusual occurrence. These obstacles include both human and specialist issues, and there are recommendations for organizing a strategy and providing various sorts of aid on the internet (Rathee & Kaushik, 2019; Anyaoku, Echedom & Baro, 2019).

Finally, internationalization has become a significant feature, notably for academic libraries, in the development of its services. Students and faculty members are increasingly traveling around the world to study, instruct, and do research in the modern-day; as a result, the geographic location of the institution is less significant. This is not just an example of the pervasiveness of the virtual environment of advanced data; it's also an aspect of it. Because of the half-and-half nature of data assets around the world, the requirement to travel to another country for investigation may increase which is confusing (Li et al. 2018). Academic libraries should make provisions for operations that assist their customers on a global scale. Exploiting significant relevant organizations with partner libraries in other countries is one method of intervening and upholding their customers' needs. Maintaining the ability of academic users to enter libraries on a general basis is another responsibility of curators in today's internationalized university environment (Cox, 2018; Cheng, Cheung & Ng, 2016).

## 5.3.2 Academic Library Supply Chain Model Implementation Challenges

On basis of the facts gathered from previous studies, certain shortcomings and deficiencies have been identified that need to be explored further and studied in significant detail. In the first place, the majority of the research on the academic library supply chain available in the collection of articles journal is out of date, and only a

small amount of new research has been done on the subject in the last five years. Kress and Wisner (2012), who built a Leid library supply chain framework, is the most closely linked piece of literature to this study. Nonetheless, they did not include the interlibrary borrowing service that Wathen had researched previously (2009).

Wang (2017) conducted the most recent research, in which he established the SCOR model to represent the collecting process in the academic library supply chain. He outlined all of the supply chain aspects that are required for the library collecting process, including examples from several case studies on academic library research to support his points. These are the three most relevant research studies that have been cited as references for the research in this study, according to the author.

All the previous studies before this study have only been studied up to and including the level of the conceptual framework, resulting in a scarcity of information on how to operationalize the developed frameworks so that related stakeholders of the academic library can put them into practice. Validation and verification of these frameworks, either qualitatively or numerically, could be performed to determine their practicality. The frameworks produced in those studies are deficient in advanced technology and are unable to adapt to the new structure of the academic library supply chain that is required in the era of IR 4.0.

Academic libraries currently provide both tangible and intangible services to their users. As a result, academic library operations have gotten more complex, necessitating the establishment of more up-to-date management principles to keep up with the changing environment (Pinfield, Cox & Rutter, 2017). The identification of

entities and their functions for the academic library supply chain, which might be used to produce a management guideline for academic library management, is necessary because of this.

Another requirement of a successful academic library is its ability to provide highquality products, services, and information while staying within the library's financial constraints and meeting the needs of its users or customers (Iwu-James, Haliso & Ifijeh, 2020). As a result, it may be possible to construct a model of an integrated academic library supply chain, which will allow for the development of a new management technique for analyzing the requirements of new academic library users.

Therefore, three research objectives have been developed in this study to solve these complexities. The first objective is to identify entities and their functions in academic library management that can represent the general practice for an academic library supply chain. The second objective is to construct a conceptual model of an integrated academic library supply chain. The third objective is to analyze the interrelationship among the entities in the integrated model developed in the second objective.

## 5.3.3 Outcome of the Integrated Academic Library Supply Chain Model

The concept "integrated supply chain" refers to an organization's approach to resource planning for the supply chain in theory, rather than in practice (Jamkhaneh & Ghadikolaei, 2020; Kurbel, 2016). Meanwhile, the holistic view of the supply chain model for academic library describes the conceptual model according to the supply chain network theory (i.e., first model), and the Material purchasing decision-making model (i.e., second model) illustrates graphically how the decision-making process has been conducted for the academic library's most critical operation, material purchasing. Finally, the most essential element of this research-creation of conceptual supply chain model for academic library depicts the ideal integrated supply chain model for the academic library (i.e., third model), which is the culmination of all of the previous research.

The main findings of the first model, a holistic view of the supply chain model for the academic library are the entities and their roles that are ideal for the supply chain network of the academic library, which are identified according to the basic structure of a supply chain network (i.e., the supply base, the focal firm/organizational level, and the customer base), which are described in detail in the following sections. However, as a result of the findings of the interview sessions that were conducted with library employers, additional entities have been discovered for the conceptual academic library supply chain model. The supply chain network in the academic library supply chain built by Kress and Wisner (2012) covered all types of academic library entities that were also covered in this model, but additional entities have been discovered for the conceptual academic library supply chain model is the Sponsor, who is responsible for sponsoring the costs of running the academic library, which is the most difficult challenge that the majority of academic libraries.

It reflects the process of materials buy activity and information flow activity carried out by the Procurement Division of an academic library, the second model, and it is represented by a decision-making model for material purchasing. An example of how the academic library supply chain model can be used in a decision-making process and as a critical strategic tool is demonstrated in this model. There have been several models developed to address the material purchasing issues faced by libraries, but this model is the first to successfully illustrate the decision-making process graphically following the supply chain network, something that has never been done before in any research related to the supply chain of an academic library.

Academic libraries have a complex supply chain that includes many elements and roles that must be considered for them to be operationalized. Hence, another model constructed in this study, the third model, known as an Integrated Academic Library Supply Chain (IALSC), examined the various elements and roles that must be considered for an academic library to be operationalized, including the administration of materials and services as well as related information. This model, which describes the operationalization of the academic library supply chain network as a whole, is one of the most significant novelties uncovered as a result of this research, as opposed to prior studies that included only a portion of the academic library supply chain network. This developed model of the academic library supply chain fulfilled the seven service supply chain processes as it has been verified in the expert's opinions analysis.

These three models have been validated by using the expert's judgment analysis for accepted as standard models for all academic libraries. In this case, they have been verified by librarians from different countries, such as Malaysia, Bangladesh, Pakistan, Venezuela, Canada, Germany, Italy, Sweden, and New Zealand. The expert opinion analysis was done by constructing the structured questionnaire, collecting the questionnaire data, and analyzing the data by using the fuzzy Delphi method (FDM). The FDM's outcome succeeds in achieving the librarians' agreement with the conceptual models developed in this study, so these developed models could be used as a general supply chain model for the academic library. However, because it has been validated by university library staff, the proposed Integrated Academic Library Supply Chain (IALSC) model is only applicable to university libraries. Although this IALSC model could be applied to other academic libraries, nonetheless it is not proposed in this study.

### **5.4 Study Implications and Contributions**

The purpose of this study is to contribute to further research and execution in the field of academic library supply chain management, based on the research objectives that have been established. This study provides new information and insights to the following stakeholders, which is discussed in the following sections, covering contributions to academia explained in Section 5.4.1, academic library contributions from this study explained in Section 5.4.2, and contributions towards academic institutions described in Section 5.4.3.

### 5.4.1 Academia

This is viable that this study would provide useful data and information to scholars, which will assist them in the development of relevant academic library supply chain management research. The results of the extensive research may allow a scholar to gain a better understanding of the requirements of academic library supply chain strategies in the long run, rather than misunderstand them as a result of the research.

Researchers in academic libraries, particularly those who research academic libraries, but have little encounter with supply chain strategies in the context of library management, may find this study to be useful. This study has the potential to attract the interest of scholars who are interested in learning about the antecedents of academic library supply chain practices from the perspective of a service organization, as well as to provide a comprehensive understanding of the operations of academic libraries.

#### **5.4.2 Academic Libraries**

This study may help to create better awareness and knowledge of the needs of supply chain procedures in academic libraries for the organizational oriented. This study could uphold the necessary data for the academic library supply chain model, for example, the entities/elements of an academic library supply chain network, the primary elements of an academic library chain organization, and the various sorts of interaction joins across an academic library supply chain network. This study could likewise portray a few explicit investigations including explicit elements inside the academic library supply chain.

This study could likewise feature the capacities and segments that need to improve the academic library supply, chain board. From this present reality point of view, supply chain research could be a basic instrument to make the library a more prosperous/thriving organization. Appropriately, this exploration should bring about a guide, which empowers to develop a total general supply chain model for an academic library and to dissect the exhibition of key elements inside the academic library supply chain towards improving its capacities and administrations.

A proficient and extensive model for the academic library supply chain network would define a guide to guarantee quality assistance for the library clients and the partners. A coordinated procedure that starts a circumspect interaction for all applicable partners inside a library maybe can help towards expanding the conception of beating likely downsides of the academic library. The library management should define the library's strategic direction and articulate its vision and be responsible for ensuring that the library is engaged with its users in a way that satisfies users' needs as well as accomplishing the mission of the library. Therefore, this study proposes to design an integrated supply chain model for the academic library, focusing on how to integrate the entities or departments involved in library operation to in line with the current trend of academic library's suppliers and users' requirements.

## **5.4.3 Academic Institutions**

Academic libraries serve as the most important source of information for academic institutions around the world. Academic libraries are primarily sponsored or maintained by every academic institution. Academic institutions would greatly benefit from the findings of this study. The supply chain models developed in this study provide strong indications that the ultimate beneficiary of an academic library is the sponsoring academic institution, according to the findings. This is one of the most significant accomplishments of this study.

As a service provider, academic libraries ultimately benefit the sponsoring academic intuition by providing them with valuable services to the library users. As a result, academic institutions may want to consider raising their efforts to assist with academic

library management. As a result, the academic university administration would like to consider making their libraries more advanced and efficient.

## 5.5 Limitation

The findings from this study have shown a potential for improvement in the academic library supply chain. Nonetheless, there is some limitation, which can be taken into account for further study. Some of the limitations are explained in the following paragraphs.

First and foremost, there is a lack of up-to-date literature on the academic library supply chain. The supply chain of academic libraries has received little attention due to a lack of study into the topic. As a consequence, there have been numerous challenges in constructing the models for this study. This significant obstacle prevented the development of an all-encompassing supply chain model for the academic library from progressing further.

Second, it is difficult to acquire expert opinions regarding the academic library's supply chain because the majority of librarians are unfamiliar with supply chain terminology, which made gathering data one of the most difficult tasks to accomplish. This is only viable to use this as a strategic tool to preserve academic libraries if the library management staff understands the significance of the supply chain. Even though certain librarians are particularly interested in supply chain models, the vast majority of them are unsure how to implement them into their current management system.

Lastly, developing the questionnaire was a significant challenge because it needed to be understandable for librarians while also attempting to bridge the gap between supply chain standard terminology. Because it is intended to be understood by librarians, the questionnaire may be a little below standard in terms of quality, but this is on purpose. For example, if librarians could be asked questions concerning closedended loop, open-ended loop, uplink, and downlink construction, the questionnaire could be more standard in terms of supply chain model validation considerations. However, librarians would require time to become familiar with supply chain terminology.

### 5.6 Recommendation

The review of the literature, as well as the limitations of this thesis, have identified potential areas for future investigation. An academic library's strategic decision-making tools or new management guidelines have a great deal of potential to be proposed basis of the findings. Some recommendation is discussed for further research in the next following sections.

### 5.6.1 Improvement on Library Operations

Process management for the academic library could be a new area of study, particularly in several areas.

The flow of funds through the academic library's operations is also a significant function. It is impossible to overstate the importance of providing libraries with a stable stream of enough funding on an ongoing basis. Funds for the library's operations must be set aside as soon as possible. To properly allocate funds for various purposes, it is necessary to thoroughly evaluate and review the expenses incurred during the preceding fiscal year. Also important are standards in a variety of areas, such as fund allocations and the flow of funds, which should be taken into consideration. The supply chain model of the academic library, which has been developed, could be used to create a new flow of funds model for the operations of the academic library in the future.

Cross-functional service design for academic libraries is a new challenge for libraries. Different points of view, different sources of experience, and different skills of all team members should come together at one point and collaborate towards a new objective. As a result, new services could be offered as a result of the rapid change that is going to occur in all organizations today. In this case, the proposed Integrated Academic Library Supply Chain (IALSC) perspective could serve as a new tool for the development of a new cross-functional service for library users for efficiency improvement in the overall process management.

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### 5.6.2 Strategic Management of Academic Library

Strategic planning of academic library, covering the supply chain models and frameworks are critical components of every organization's strategic planning process, and they should not be overlooked. Despite recent advances in technology, academic libraries continue to lag in this area. With the development of a supply chain for the academic library, new options for the development of a new strategic plan for academic libraries would be created.

Decision-making of supplier ranking could be a very interesting study. Different suppliers provide the same type of resources to academic libraries, but they do so in

several different ways. A supplier ranking model based on their profiles and previous experience with the library could be developed. The IALSC model may also be of assistance in this regard.

New cross-functional planning of academic libraries could be a remarkable study. Cross-functional planning is an essential method for developing a new service or product. The IALSC model will provide a new layer of strategic tools to the academic library management team's toolbox for developing cross-functional planning for academic libraries.

The committed leadership of the academic library could also be a fascinating study. Any organization's leadership is a difficult task. Academic library management will need to develop new ideas for how to leverage the supply chain model more efficiently to improve the academic library. The IALSC model has the potential to open up new horizons in terms of leadership tools for academic libraries.

## 5.6.3 Performance Feedback Measurement

Using the IALSC model, it may be possible to conduct a significant study on the satisfaction of library stakeholder groups. To better analyze service difficulties, it may be possible to create a satisfaction assessment database that includes all stakeholders.

Another key research topic may be the flow of information and feedback from academic library stakeholders. In today's world, the flow of information is vital to the success of any business venture. As a result of this analysis, a new study may be done in the future on the design of information flow chains. A feedback system design for library stakeholders, on the other hand, is missing, which could be an interesting future study in its position in the future. The summary of recommended studies has been tabulated in Table 5.1, which would provide a simplified view for this section.

### Table 5.1

<b>Recommended Area of Future</b>	<b>Recommended Particular Topics of</b>
Studies	<b>Future Study</b>
Improvement on library operations	Process management for the academic
	library.
	The flow of funds through the academic
	library's operations.
	Cross-functional service design for
	academic libraries.
Strategic management of academic	Strategic planning of academic library.
library	Decision-making of supplier ranking.
Univers	New Cross-functional planning of
	academic libraries.
	Committed leadership of academic library.
Performance feedback measurement	The library stakeholders' satisfaction
	measurement.
	Information flow and feedback from
	academic library stakeholders.

Summary of the Recommendations

Lastly, by including additional entities and services into the supply chain models that have been developed, these models could be made even better in the future. Future studies could work on developing the Tier 3 component of this model, which would then be able to contribute to the supply chain model of the academic library from the supplier side.

## 5.7 Conclusion

The main objective of this study is to explore the application of the supply chain concept to academic libraries, particularly university libraries. This empirical study is primarily concerned with the development of a new management technique for academic university libraries, with particular attention paid to the operations and components of the academic library supply chain model.

In this study, the model development process has been illustrated for the academic library's conceptual supply chain model. This study prevails to introduce the new methodologies under the research area of the service supply chain network and as extensions of the academic library's supply chain model from the previous study. Additionally prevail to validate the constructed conceptual models, covering the models' elements and operational linkages by utilizing the Fuzzy Delphi technique to make our created model more adequate for every academic library of the world, which has never been done in any research related to the academic supply chain network. A new name for this new validated model has been proposed, which could be called as Integrated Academic Library Supply Chain (IALSC)Model.

Many academic libraries are struggling to provide the numerous and continuously evolving products or services, and information items that their users demand in the situation of reduced operating budgets, cheaper and faster computing capabilities, and more users demanding a wider variety of library services. These are the main problems that librarians face at most academic libraries. The ability of a library to deliver services and information to users efficiently and cost-effectively is vital to its success. Additionally, the supply chain's objective is to organize the organizations' processes and activities with those of its suppliers and customers, such that the organizers delivered products and services that meet or exceed customer requirements.

To provide a high-quality service to library users and stakeholders, an efficient and comprehensive supply chain model for the academic library would be established. Academic libraries can benefit from a well-organized supply chain model that creates a systematic process for all relevant stakeholders within a library, which can support in increasing understanding of the library's potential drawbacks and reducing them.



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## Appendix A

Questionnaire of Model Validations for Expert Judgement Analysis

### PART I: GENERAL INFORMATION

### 1. POSITION

2. Number of years working with the	$\Box$ 0-4 years	$\Box$ 5-10 years	□ 11-20 years	$\Box$ 21+ years
Academic/University Library				
<b>3.</b> Name of Academic/University Library				
RUDI BLEI	Univers	iti Utara	Malaysia	

#### PART II: The verification of the elements or constructs that are included in the supply chain model.

Please observe **DIAGRAM A** for the holistic view of the supply chain model and respond to the following statements by ticking ( $\sqrt{}$ ) in the right box.



**DIAGRAM A: The Holistic View of Supply Chain Model** 

Statement 1	Strongly	Moderately	Slightly	Neutral	Slightly	Moderately	Strongly
	Disagree	Disagree	Disagree		Agree	Agree	Agree
All the elements are covered (included) in the	□ 1	□ 2		□ 4			□ 7
proposed conceptual model.							
Please write the missing elements below if there are a	any.						
AL UTARA							
Statement 2	Strongly	Moderately	Disagree	Neutral	Agree	Moderately	Strongly
NV.	Disagree	Disagree	Slightly		Slightly	Agree	Agree
All the linking lines correctly cover the functions of				□ 4			□ 7
the proposed conceptual model.				_	_		
Please identify and list the missing linking lines below	w, if there a	re any.	Jtara	Mala	aysia		

**PART III:** The verification of the degree of standardization of these elements in the supply chain model.

Please observe DIAGRAM B for the conceptual supply chain model for the academic library and respond to the following statements by ticking  $(\sqrt{})$  in the right box.

DIAGRAM B: The Conceptual Supply Chain Model for Academic Library



Statement 1	Strongly	Moderately	Disagree	Neutral	Agree	Moderately	Strongly
	Disagree	Disagree	Slightly		Slightly	Agree	Agree
The demand management process system is properly		□ 2		□ 4		□ 6	□ 7
covered in this proposed conceptual model of the							
academic library supply chain.							
If your response is 6 or less, please give your suggestic	on for us to i	mprove the sys	stem.				
Statement 2	Strongly	Moderately	Disagree	Neutral	Agree	Moderately	Strongly
F	Disagree	Disagree	Slightly		Slightly	Agree	Agree
The capacity and resource management process system are properly covered in this proposed conceptual model of the academic library supply chain.	Unliv	ersi <sup>2</sup> ii	□ 3	M 4	ny 515	□ 6	□ 7
If your response is 6 or less, please give your suggestic	on for us to i	mprove the sys	stem.	1	1	1	1

Statement 3	Strongly	Moderately	Disagree	Neutral	Agree	Moderately	Strongly
	Disagree	Disagree	Slightly		Slightly	Agree	Agree
The customer relationship management process	□ 1	□ 2		□ 4	□ 5	□ 6	□ 7
system is properly covered in this proposed							
conceptual model of the academic library supply							
chain.							
	L	Д					
Statement 4	Strongly	Moderately	Disagree	Neutral	Agree	Moderately	Strongly
	Disagree	Disagree	Slightly	Mala	Slightly	Agree	Agree
The supplier relationship management process system is properly covered in this proposed conceptual model of the academic library supply chain.	□ 1	□ 2	□ 3	□ 4	5	□ 6	□ 7
If your response is 6 or less, please give your suggestic	on for us to i	mprove the sys	stem.	1		I	I

Statement 5	Strongly	Moderately	Disagree	Neutral	Agree	Moderately	Strongly
	Disagree	Disagree	Slightly		Slightly	Agree	Agree
The order process management process system is	□ 1	□ 2		□ 4	□ 5	□ 6	□ 7
properly covered in this proposed conceptual model							
of the academic library supply chain.							
If your response is 6 or less, please give your suggestion	n for us to i	mprove the sys	stem.	1			
Statement 6	Strongly	Moderately	Disagree	Neutral	Agree	Moderately	Strongly
F	Disagree	Disagree	Slightly		Slightly	Agree	Agree
The service performance management process system		2		4	□ 5	□ 6	□ 7
is properly covered in this proposed conceptual					5		
model of the academic library supply chain.							
If your response is 6 or less, please give your suggestion	n for us to i	mprove the sys	stem.	I			

Statement 7	Strongly	Moderately	Disagree	Neutral	Agree	Moderately	Strongly
	Disagree	Disagree	Slightly		Slightly	Agree	Agree
The information and technology management process	□ 1	□ 2	□ 3	□ 4		□ 6	□ 7
system are properly covered in this proposed							
conceptual model of the academic library supply							
chain?							
If your response is 6 or less, please give your suggestion	on for us to i	mprove the sys	tem.				
	Univ	ersiti I			avsia		
	C III V	CIDICI		Plan	aysia		

#### Part IV: The Proposed Conceptual Model

Please observe DIAGRAM C for the conceptual model of the material purchasing decision-making of the academic library and respond to the following statements by ticking ( $\sqrt{}$ ) in the right box.





Statement 1	Strongly	Moderately	Disagree	Neutral	Agree	Moderately	Strongly
	Disagree	Disagree	Slightly		Slightly	Agree	Agree
All the elements are covered (included) in the	□ 1	□ 2		□ 4	□ 5	□ 6	□ 7
proposed conceptual model of the Material							
Purchasing Decision Making Model of the academic							
library.							
Please write the missing elements below if there are an	ny.					•	
2							
Question 2	Strongly	Moderately	Disagree	Neutral	Agree	Moderately	Strongly
	Disagree	Disagree	Slightly	Mal	Slightly	Agree	Agree
All the linking lines cover the functions of the	□ 1	□ 2		□ 4		□ 6	□ 7
proposed conceptual model of the Material							
Purchasing Decision Making Model of the academic							
library.							
Please identify and list the missing linking lines below	v, if there are	e any.	1	1	L	1	1

### Appendix B

Table of the Triangular Fuzzy Number (TFN) for the Statements for Holistic View of

Expert			Statem	Statement								
-		1			2							
	l	т	и	l	т	и						
Librarian 1	7	9	10	7	9	10						
Librarian 2	5	7	9	3	5	7						
Librarian 3	9	10	10	9	10	10						
Librarian 4	7	9	10	7	9	10						
Librarian 5	7	9	10	9	10	10						
Librarian 6	9	10	10	7	9	10						
Librarian 7*												
Librarian 8	7	9	10	7	9	10						
Librarian 9	9	10	9	10 10								
Librarian 10	9	10	10									
Librarian 11	5	7	9									
Librarian 12	9	10	10	9	10	10						
Librarian 13	9	10	10	9	10	10						
Librarian 14	3	5	7	3	5	7						
Librarian 15	7	9	10	3	5	7						
Librarian 16	5	7	9	5	7	9						
Librarian 17	9	10	10	9	10	10						
Librarian 18	3	5	7	3	5	7						
Librarian 19	9	10	10	9	10	10						
Librarian 20	7 0	9	10	7	9	10						
Librarian 21	7	9	10									
Librarian 22	9/0/	10	10	9	10	10						
Librarian 23	9	10/er	10	a M9alav	10	10						
Librarian 24	9	10	10	9	10	10 10 10						
Librarian 25	5	7	9	5	7	9						
Librarian 26	7	9	10	7	9	10						
Librarian 27	an 27 5 7 9 5 7											
Librarian 28	5	7	9	5	7	9						
Librarian 29*	<u> </u>											
Librarian 30	7	9	10	7	9	10						
Librarian 31	9	10	10	9	10	10						
Librarian 32	7	9	10	7	9	10						
Librarian 33	7	9	10	7	9	10						
Librarian 34	5	7	9	5	7	9						
Librarian 35*		-			,	,						
Librarian 36	7	9	10	7	9	10						
Librarian 37	5	7	9	5	7	9						
Librarian 38*		,	-	~	,	,						
Librarian 39	7	9	10	7	9	10						
Librarian 40	5	7	9	5	7	9						
Librarian 41	3	5	7	3	5	7						
Librarian 42	7	9	10	5	7	9						
Librarian 43	7	9	10	7	9 10							
Librarian 44	, 7	9	10	7	9 10							
Librarian 45	7	9	10	7	9	10						
Librarian 46	5	7	9	5	7	Q						
Librarian 47	7	9	10	7	9	10						

Supply Chain Model for Academic Library

Expert			Statem	ent				
_		1		2				
	l	т	и	l	т	и		
Librarian 48	5	7	9	5	7	9		
Librarian 49	3	5	7	5	7	9		
Librarian 50	5	7	9	5	7	9		
Librarian 51*								
Librarian 52	9	10	10	7	9	10		



# Appendix C

Table of the Triangular Fuzzy Number (TFN) for the Statements for Material

Expert	Statement												
•		1			2								
	l	т	и	l	т	и							
Librarian 1	9	10	10	9	10	10							
Librarian 2	1	3	5	1	3	5							
Librarian 3	9	10	10	9	10	10							
Librarian 4	9	10	10	9	10	10							
Librarian 5	5	7	9	9	10	10							
Librarian 6	9	10	10	9	10	10							
Librarian 7*													
Librarian 8	9	10	10	9	10	10							
Librarian 9	9	10	10	9	10 10								
Librarian 10	9	10	10										
Librarian 11	5	7	9										
Librarian 12	9	10	10	9	10	10							
Librarian 13	9	10	10	9	10	10							
Librarian 14	5	7	9	5	7	9							
Librarian 15	3	5	7	3	5	7							
Librarian 16	7	9	10	7	9	10							
Librarian 17	9	9 10 10 9											
Librarian 18	3	5	7	3	5	7							
Librarian 19	7	9	10										
Librarian 20	7	7 9 10 7											
Librarian 21	9	10	10										
Librarian 22	9/1	10	10										
Librarian 23	9	10/er	a M9alav	10	10								
Librarian 24	9	10	10	9	10	10							
Librarian 25	5	7	9	5	7	9							
Librarian 26	7	9	10	7	9	10							
Librarian 27	5	7	9	5	7								
Librarian 28	7	9	10	5	7 9								
Librarian 29*			10										
Librarian 30	5	7	9	5	7	9							
Librarian 31	9	10	10	9	10	10							
Librarian 32	7	9	10	7	9	10							
Librarian 33	7	9	10	7	9	10							
Librarian 34	5	7	9	5	7	9							
Librarian 35*	5	,		5	,								
Librarian 36	7	9	10	7	9	10							
Librarian 37	, 5	7	9	5	7	9							
Librarian 38*	5	,		5	,								
Librarian 30	7	Q	10	7	9	10							
Librarian 40	5	7	9	5	7	9							
Librarian 41	3	5	7	3	5	7 7							
Librarian 42	7	9	10	7	9	10							
Librarian 42	7	9	10	7	9	10							
Librarian 44	7	9	10	7	9	10							
Librarian 45	7	9	10	7	9	10							
Librarian 46	5	7	9	5	7	9							
Librarian 47	7	9	10	7	9 10								

Purchasing Decision Making Model

Expert			Statem	ent						
_		1		2						
	l	т	и	l	т	u				
Librarian 48	5	7	9	5	7	9				
Librarian 49	5	7	9	5	7	9				
Librarian 50	5	7	9	5	7	9				
Librarian 51*										
Librarian 52	9	10	10	9	10	10				



Expert										St	ateme	nts									
_		1			2			3			4			5		$\begin{array}{c c c c c c c c c c c c c c c c c c c $				7	
	l	т	и	l	т	и	l	т	и	l	т	и	l	т	и	l	т	и	l	т	и
Librarian 1	7	9	10	7	9	10	5	7	9	9	10	10	7	9	10	9	10	10	9	10	10
Librarian 2	9	10	10	9	10	10	9	10	10	5	7	9	5	7	9	5	7	9	9	10	10
Librarian 3	5	7	9	5	7	9	7	9	10	7	9	10	7_	9	10	7	9	_10	7	9	10
Librarian 4	9	10	10	9	10	10	9	10	10	9	10	10	9	10	10	9	10	10	7	9	10
Librarian 5	9	10	10	9	10	10	5	7	9	5	7	9	9	10	10	9	10	10	5	7	9
Librarian 6	9	10	10	9	10	10	9	10	10	7	9	10	9	10	10	9	10	10	9	10	10
Librarian 7*			R				-														
Librarian 8	9	10	10	5	7	9	5	7	9	7	9	10	9	10	10	9	10	10	5	7	9
Librarian 9	9	10	10	9	10	10	9	10	10	9	10	10	9	10	10	9	10	10	9	10	10
Librarian 10	9	10	10	9	10	10	9	10	10	9	10	10	9	10	10	9	10	10	9	10	10
Librarian 11	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9
Librarian 12	9	10	10	9	10	10	9	10	10	9	10	10	7	9	10	9	10	10	9	10	10
Librarian 13	9	10	10	9	10	10	9	10	10	9	10	10	9	10	10	9	10	10	9	10	10
Librarian 14	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9
Librarian 15	3	5	7	3	5	7	3	5	7	3	5	7	3	5	7	3	5	7	3	5	7
Librarian 16	9	10	10	9	10	10	9	10	10	9	10	10	9	10	10	9	10	10	9	10	10
Librarian 17	9	10	10	9	10	10	9	10	10	9	10	10	9	10	10	9	10	10	9	10	10
Librarian 18	3	5	7	3	5	7	3	5	7	3	5	7	3	5	7	3	5	7	3	5	7
Librarian 19	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10
Librarian 20	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10
Librarian 21	9	10	10	9	10	10	5	7	9	9	10	10	5	7	9	5	7	9	9	10	10
Librarian 22	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10
Librarian 23	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10
Librarian 24	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10
Librarian 25	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9

## Appendix D

Table of the Triangular Fuzzy Number (TFN) for the Statements for Conceptual Supply Chain Model for Academic Library

Expert	Statements																				
-		1			2			3			4			5			6			7	
	l	т	и	l	т	и	l	m	и	l	т	и	l	т	и	l	т	и	l	т	и
Librarian 26	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10
Librarian 27	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9
Librarian 28	5	7	9	3	5	7	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10
Librarian 29*																					
Librarian 30	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9	7	9	10
Librarian 31	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10
Librarian 32	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10
Librarian 33	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10
Librarian 34	3	5	7	3	5	7	3	5	7	3	5	7	3	5	7	3	5	7	3	5	7
Librarian 35*			3			1															
Librarian 36	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10
Librarian 37	3	5	7	3	5	7	3	5	7	3	5	7	3	5	7	3	5	7	3	5	7
Librarian 38*			n			//\$	-														
Librarian 39	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10
Librarian 40	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9	_ 5	7	9	5	7	9
Librarian 41	3	5	7	3	5	7	3	5	7	3	5	7	3	5	7	3	5	7	3	5	7
Librarian 42	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10
Librarian 43	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10	7	9	10
Librarian 44	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9
Librarian 45	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9
Librarian 46	3	5	7	3	5	7	3	5	7	3	5	7	3	5	7	3	5	7	3	5	7
Librarian 47	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9
Librarian 48	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9
Librarian 49	7	9	10	7	9	10	7	9	10	3	5	7	3	5	7	7	9	10	5	7	9
Librarian 50	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9	5	7	9
Librarian 51*																					
Librarian 52	9	10	10	9	10	10	7	9	10	7	9	10	7	9	10	9	10	10	7	9	10

# Appendix E

Table of the  $G_i$  Value for Statements of the Holistic View of Supply Chain Model for

Expert	Statement									
•	1	Screening	2	Screening						
Librarian 1	8.67	Accepted	8.67	Accepted						
Librarian 2	7.00	Accepted	5.00	Accepted						
Librarian 3	9.67	Accepted	9.67	Accepted						
Librarian 4	8.67	Accepted	8.67	Accepted						
Librarian 5	8.67	Accepted	9.67	Accepted						
Librarian 6	9.67	Accepted	8.67	Accepted						
Librarian 7*		•		•						
Librarian 8	8.67	Accepted	8.67	Accepted						
Librarian 9	9.67	Accepted	9.67	Accepted						
Librarian 10	9.67	Accepted	9.67	Accepted						
Librarian 11	7.00	Accepted	7.00	Accepted						
Librarian 12	9.67	Accepted	9.67	Accepted						
Librarian 13	9.67	Accepted	9.67	Accepted						
Librarian 14	5.00	Accepted	5.00	Accepted						
Librarian 15	8.67	Accepted	5.00	Accepted						
Librarian 16	7.00	Accepted	7.00	Accepted						
Librarian 17	9.67	Accepted	9.67	Accepted						
Librarian 18	5.00	Accepted	5.00	Accepted						
Librarian 19	9.67	Accepted	9.67	Accepted						
Librarian 20	8.67	Accepted	8.67	Accepted						
Librarian 21	8.67	Accepted	8.67	Accepted						
Librarian 22	9.67	Accepted	9.67	Accepted						
Librarian 23	9.67	Accepted	9.67	Accepted						
Librarian 24	9.67	Accepted	9.67	Accepted						
Librarian 25	7.00	Accepted	7.00	Accepted						
Librarian 26	8.67	Accepted	8.67	Accepted						
Librarian 27	7.00	Accepted	7.00	Accepted						
Librarian 28	7.00	Accepted	7.00	Accepted						
Librarian 29*		•		•						
Librarian 30	8.67	Accepted	8.67	Accepted						
Librarian 31	9.67	Accepted	9.67	Accepted						
Librarian 32	8.67	Accepted	8.67	Accepted						
Librarian 33	8.67	Accepted	8.67	Accepted						
Librarian 34	7.00	Accepted	7.00	Accepted						
Librarian 35*		· · ·		•						
Librarian 36	8.67	Accepted	8.67	Accepted						
Librarian 37	7.00	Accepted	7.00	Accepted						
Librarian 38*				· ·						
Librarian 39	8.67	Accepted	8.67	Accepted						
Librarian 40	7.00	Accepted	7.00	Accepted						
Librarian 41	5.00	Accepted	5.00	Accepted						
Librarian 42	8.67	Accepted	7.00	Accepted						
Librarian 43	8.67	Accepted	8.67	Accepted						
Librarian 44	8.67	Accepted	8.67	Accepted						
Librarian 45	8.67	Accepted	8.67	Accepted						
Librarian 46	7.00	Accepted	7.00	Accepted						
Librarian 47	8.67	Accepted	8.67	Accepted						
Librarian 48	7.00	Accepted	7.00	Accepted						

Academic Library

Expert	Statement									
	1	Screening	2	Screening						
Librarian 49	5.00	Accepted	7.00	Accepted						
Librarian 50	7.00	Accepted	7.00	Accepted						
Librarian 51*										
Librarian 52	9.67	Accepted	8.67	Accepted						



# Appendix F

Table of the  $G_i$  Value Statements for the Material Purchasing Decision Making Model

Expert				
-	1	Screening	2	Screening
Librarian 01	9.67	Accepted	9.67	Accepted
Librarian 02	3.00	Deleted	3.00	Deleted
Librarian 03	9.67	Accepted	9.67	Accepted
Librarian 04	9.67	Accepted	9.67	Accepted
Librarian 05	7.00	Accepted	9.67	Accepted
Librarian 06	9.67	Accepted	9.67	Accepted
Librarian 07*				
Librarian 08	9.67	Accepted	9.67	Accepted
Librarian 09	9.67	Accepted	9.67	Accepted
Librarian 10	9.67	Accepted	9.67	Accepted
Librarian 11	7.00	Accepted	7.00	Accepted
Librarian 12	9.67	Accepted	9.67	Accepted
Librarian 13	9.67	Accepted	9.67	Accepted
Librarian 14	7.00	Accepted	7.00	Accepted
Librarian 15	5.00	Accepted	5.00	Accepted
Librarian 16	8.67	Accepted	8.67	Accepted
Librarian 17	9.67	Accepted	9.67	Accepted
Librarian 18	5.00	Accepted	5.00	Accepted
Librarian 19	8.67	Accepted	8.67	Accepted
Librarian 20	8.67	Accepted	8.67	Accepted
Librarian 21	9.67	Accepted	9.67	Accepted
Librarian 22	9.67	Accepted	9.67	Accepted
Librarian 23	9.67	Accepted	9.67	Accepted
Librarian 24	9.67	Accepted	9.67	Accepted
Librarian 25	7.00	Accepted	7.00	Accepted
Librarian 26	8.67	Accepted	8.67	Accepted
Librarian 27	7.00	Accepted	7.00	Accepted
Librarian 28	8.67	Accepted	7.00	Accepted
Librarian 29*				
Librarian 30	7.00	Accepted	7.00	Accepted
Librarian 31	9.67	Accepted	9.67	Accepted
Librarian 32	8.67	Accepted	8.67	Accepted
Librarian 33	8.67	Accepted	8.67	Accepted
Librarian 34	7.00	Accepted	7.00	Accepted
Librarian 35*				
Librarian 36	8.67	Accepted	8.67	Accepted
Librarian 37	7.00	Accepted	7.00	Accepted
Librarian 38*				
Librarian 39	8.67	Accepted	8.67	Accepted
Librarian 40	7.00	Accepted	7.00	Accepted
Librarian 41	5.00	Accepted	5.00	Accepted
Librarian 42	8.67	Accepted	8.67	Accepted
Librarian 43	8.67	Accepted	8.67	Accepted
Librarian 44	8.67	Accepted	8.67	Accepted
Librarian 45	8.67	Accepted	8.67	Accepted
Librarian 46	7.00	Accepted	7.00	Accepted
Librarian 47	8.67	Accepted	8.67	Accepted
Librarian 48	7.00	Accepted	7.00	Accepted
Librarian 49	7.00	Accepted	7.00	Accepted

Expert	Statement										
	1	Screening	2	Screening							
Librarian 50	7.00	Accepted	7.00	Accepted							
Librarian 51*											
Librarian 52	9.67	Accepted	9.67	Accepted							



									-			-		
							S	Statement						
Expert	1	Screening	2	Screening	3	Screening	4	Screening	5	Screening	6	Screening	7	Screening
Librarian 1	8.67	Accepted	8.67	Accepted	7.00	Accepted	9.67	Accepted	8.67	Accepted	9.67	Accepted	9.67	Accepted
Librarian 2	9.67	Accepted	9.67	Accepted	9.67	Accepted	7.00	Accepted	7.00	Accepted	7.00	Accepted	9.67	Accepted
Librarian 3	7.00	Accepted	7.00	Accepted	8.67	Accepted								
Librarian 4	9.67	Accepted	8.67	Accepted										
Librarian 5	9.67	Accepted	9.67	Accepted	7.00	Accepted	7.00	Accepted	9.67	Accepted	9.67	Accepted	7.00	Accepted
Librarian 6	9.67	Accepted	9.67	Accepted	9.67	Accepted	8.67	Accepted	9.67	Accepted	9.67	Accepted	9.67	Accepted
Librarian 7*		15	9//		2									
Librarian 8	9.67	Accepted	7.00	Accepted	7.00	Accepted	8.67	Accepted	9.67	Accepted	9.67	Accepted	7.00	Accepted
Librarian 9	9.67	Accepted												
Librarian 10	9.67	Accepted												
Librarian 11	7.00	Accepted												
Librarian 12	9.67	Accepted	9.67	Accepted	9.67	Accepted	9.67	Accepted	8.67	Accepted	9.67	Accepted	9.67	Accepted
Librarian 13	9.67	Accepted												
Librarian 14	7.00	Accepted												
Librarian 15	5.00	Accepted												
Librarian 16	9.67	Accepted												
Librarian 17	9.67	Accepted												
Librarian 18	5.00	Accepted												
Librarian 19	8.67	Accepted												
Librarian 20	8.67	Accepted												
Librarian 21	9.67	Accepted	9.67	Accepted	7.00	Accepted	9.67	Accepted	7.00	Accepted	7.00	Accepted	9.67	Accepted
Librarian 22	8.67	Accepted												

# Appendix G

#### Table of the G<sub>i</sub>Value for the Statements for The Conceptual Supply Chain Model for Academic Library

							S	Statement						
Expert	1	Screening	2	Screening	3	Screening	4	Screening	5	Screening	6	Screening	7	Screening
Librarian 23	8.67	Accepted												
Librarian 24	8.67	Accepted												
Librarian 25	7.00	Accepted												
Librarian 26	8.67	Accepted												
Librarian 27	7.00	Accepted												
Librarian 28	7.00	Accepted	5.00	Accepted	8.67	Accepted								
Librarian 29*			1	UTARA										
Librarian 30	7.00	Accepted	8.67	Accepted										
Librarian 31	8.67	Accepted												
Librarian 32	8.67	Accepted												
Librarian 33	8.67	Accepted												
Librarian 34	5.00	Accepted												
Librarian 35*					1.									
Librarian 36	8.67	Accepted												
Librarian 37	5.00	Accepted												
Librarian 38*				BUDI P										
Librarian 39	8.67	Accepted												
Librarian 40	7.00	Accepted												
Librarian 41	5.00	Accepted												
Librarian 42	8.67	Accepted												
Librarian 43	8.67	Accepted												
Librarian 44	7.00	Accepted												
Librarian 45	7.00	Accepted												
Librarian 46	5.00	Accepted												
Librarian 47	7.00	Accepted												

r														
Expert		Statement												
	1	Screening	2	Screening	3	Screening	4	Screening	5	Screening	6	Screening	7	Screening
Librarian 48	7.00	Accepted												
Librarian 49	8.67	Accepted	8.67	Accepted	8.67	Accepted	5.00	Accepted	5.00	Accepted	8.67	Accepted	7.00	Accepted
Librarian 50	7.00	Accepted												
Librarian 51*														
Librarian 52	9.67	Accepted	9.67	Accepted	8.67	Accepted	8.67	Accepted	8.67	Accepted	9.67	Accepted	8.67	Accepted





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