



UNIVERSITY OF DERBY

**EVALUATION AND IMPROVEMENT ON SERVICE QUALITY OF
CHINESE UNIVERSITY LIBRARIES UNDER NEW
INFORMATION ENVIRONMENTS**

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List of main publications

Conference Papers

1. **Yueqian Fan**, John Panneerselvam and Lu Liu, The Cost Function and Improvement Strategies of Service Quality of University Library under New Information Environments, 2017 the 10th IEEE International Conference on Cyber, Physical, and Social Computing (CPSCom-2017) June 2017, IEEE Press.
2. Guohong Shi, **Yueqian Fan**, Yuefeng Zeng, Jia Wang, Research on Two-Stage Supply Chain Revenue Sharing Contract with Loss-Aversion under Disruption, 2012 9th International Conference on Service Systems and Service Management, July 2012.

Journals

1. **Yueqian Fan**, Shi Guohong, Xia Qianlong, Hu Xinyue, An Empirical Study of Evaluation System of Chinese University Library Service Quality under the New Information Environment, Journal of Intelligence, Vol.34, 11 (2015) 193-198.
2. **Yueqian Fan**, Tao Xie, Jiansu Du, Complex Dynamics of Duopoly Game with Heterogeneous Players: A Further Analysis of the Output Model. Applied Mathematics and Computation, 218 (2012) 7829–7838.
3. Jian-guo Du, **Yue-qian Fan**, Zhao-han Sheng, Yun-zhang Hou, Dynamics Analysis and Chaos Control of a Duopoly Game with Heterogeneous Players and Output Limiter. Economic Modelling 33 (2013) 507–516.

Abbreviations

SERVQUAL: Service Quality

HEI: Higher Education Institution

CNNIC: China Internet Network Information Centre

SERVPERF: Service Performance

LibQUAL: Library Quality

ARL: Association of Research Libraries

ACRL: Association of College and Research Libraries

IOS: International Organization for Standardization

BSC: Balanced Scorecard

SSG: Service Superiority Gap

SAG: Service Adequacy Gap

IMLS: Institute of Museum and Library services

CIT: Critical Incident Technique

QFD: Quality Function Deployment

GRA: Gray Relational Analysis

AHP: Analytic Hierarchy Process

AMA: American Marketing Institute

IBM: International Business Machines Corporation

PZB: Parasuraman, Zeithaml and Berry

IQS: Internal Quality Service

PSSG: Perceived Service Superiority Gap

PSAG: Perceived Service Adequacy Gap

ARL: Association of Research Libraries

APP: Application

ECT: Expectation Confirmation Theory

GT: Gap Theory

ZOT: Zone of Tolerance

EFA: Exploratory Factor Analysis

KMO: Kaiser-Meyer-Olkin

MSA: Measures of Sampling Adequacy

CTR: Credibility Testing Result

CR: Composite Reliability

AVE: Average Variance Extracted

SEM: Structural Equation Modeling

SPSS: Statistical Product and Service Solutions

Declaration

The study outlines the dissertation carried out in the Department of Engineering and Technology at University of Derby, under supervision of Professor Lu Liu. This is to declare that the work stated in this thesis was done by the author, and no part of the thesis has been submitted in a thesis form to any other university or similar institution. No human or animal participation have been included in this research and the research presented in this thesis has been ethically approved. The candidate confirms that appropriate credit has been given within the thesis where reference has been made to the work of others.

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Abstract

The rapid development of information technology in the recent years has added a range of new features to the traditional information environment, which has a profound impact on university library services and users. The Quality of Service parameter in library services has reached a broader consensus, which directly reflects customer satisfactions and loyalty. Exploring the evaluation frameworks for service quality in university libraries cannot be undermined in this context. Besides, existing evaluation frameworks of service quality of university library services are also facing numerous challenges due to their imperfections. Thus, there is an urgency and necessity to explore and enhance the efficiencies of the evaluation frameworks of service quality. To this end, this thesis conducts a systematic analysis of evaluation frameworks with a motivation of identifying the core components that needs enhancements for achieving effective service quality in Chinese university libraries through empirical methods. Furthermore, the inferences extracted from the analysis has been exploited to provide suitable recommendations for improving the service quality of university libraries.

Firstly, through massive literature research and qualitative study, this thesis interprets the connotation and characteristics of the new era of information environment and further introduces the changes brought by the new information environment upon university library services and users. Then, the effects exerted by the new information environment upon service quality are analysed, and the formation mechanism, connotation and attributes are interpreted, which laid the foundation for the assessment scale and model construction presented in this thesis.

Secondly, based on a modified SERVQUAL construction, an assessment scale for service quality in Chinese university libraries is built along with an evaluation of the validity and applicability of the constructed scale. This thesis developed a service quality scale through deductive and inductive methods of literature analysis, interviews with users and experts. The initially developed scale is then formally purified with 26 measurement indicators using the pre-surveyed data. The purified scale is further evaluated using data obtained from a formal-survey, and the validity and applicability of the scale of modified SERVQUAL scale has been tested and verified through

confirmatory factor analysis, which provided an appropriate tool for evaluating the service quality of university libraries.

Thirdly, this thesis establishes a hierarchical model for measurement and evaluation of service quality of university libraries and verifies the validity and consistency of the developed model, which proves that the developed model effectively overcomes the shortcomings of the SERVQUAL evaluation method. After a qualitative research, this study proposes a hierarchical service quality model for university libraries in which service quality is a third-order construct defined by two primary dimensions (outcome quality & process quality) and five sub-dimensions (tangibility, reliability, assurance, responsiveness and empathy), this model effectively suits the psychological complexities of users whilst evaluating service quality. Empirical tests and interactive tests have also been conducted on the developed model through a range of evaluation methods such as structural equation modeling, three-stage test and partial dispersion technology, which verified the validity and stability of the proposed model for the assessment of service quality of university libraries.

Finally, the thesis explored the application of the assessment scale and model for service quality of university libraries based on the modified SERVQUAL construct on service quality improvement. A variety of methods of quantitative analysis and evaluation has been used to analyse the current situation of university libraries. Based on this evaluation, improvement measures and promotion strategies are recommended to improve the service quality of Chinese university libraries.

KEYWORDS: University library, Library service, Service quality, SERVQUAL, Empirical research

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Chapter 1: Introduction

This chapter firstly introduces the research background of this thesis, presents the research problems and highlights the purpose and significance of this research. Then, it summarizes the outreach of research in the context of service quality evaluation of libraries in China and abroad and points out the deficiencies in current researches and draws the aim and objectives of this research work. Further, the research methods and ideas adopted in this research are presented along with the main contributions and innovation of this research.

1.1 Research Context

Libraries are the core components of universities and higher education institutes, which plays an important role in the teaching and research activities among teachers and learners. With the increasing popularization and rapid development of Internet based information and communication technology, university libraries are experiencing a significant transformation in their way of availing services to users particularly through the digitization of the library assets and resources. However, the transformation at the university libraries is still lacking pace to keep up with the rapidly evolving technology. Whilst this thesis is discussing about the wave of digital library construction in line with the evolution of the network environment from Web 1.0 to Web 2.0, the era of Web 3.0 is only just around the corner. In the recent years, significant changes have been witnessed in the environment of university libraries and users, aided by the rapid development of new information technologies. This era of information technology has coined new terms such as Library 2.0 or even Library 3.0, hybrid library, smart library, ubiquitous library, mobile phone library, mobile library, handheld library, cloud library and so on in the context of library services, representing and reflecting the advent of the new information era of libraries. These new terminologies in library services also reflect the fact that library services should maintain consistency with the development of the technological evolution for being adaptive and effective in availing services to users.

New information technology also has its impacts on the behaviours of users in terms of their information requirements, while constantly improving the service efficiency and effectiveness of university libraries. New challenges are posed to the university libraries since major changes are witnessed in the way of services offered by the information service providers to users. Data in *the 34th China Internet Network Development State Statistic Report* (hereinafter referred to as “*Report*”) released by China Internet Network Information Centre (CNNIC) shows that China’s Internet users reached 632 million including 527 million mobile Internet users, and the Internet penetration reached 46.9%. In regard to the Internet user’s web devices, the usage rate of mobile phones reached 83.4%, which exceeded the rate of traditional Personal Computers witnessed at 80.9% for the first time ever, thereby mobile phones consolidate their place as the first major Internet terminal. The *Report* also indicated that the development focus of the Internet has shifted from extensive development to in-depth development; and users are making much deeper use of the Internet in every aspect; all kinds of network applications are profoundly changing user life; the usage rate is seeing a substantial increase in the mobile applications about e-commerce, information acquisition, leisure and recreation, exchange and communication and so on, and user’s life is fully embracing the Internet era. It is obvious that these changes have significantly influenced the way of services offered by university libraries. As an important channel for knowledge and information dissemination, university libraries should undergo dynamic changes to adapt the changes in the user requirements and behaviours.

In fact, user’s in-depth expression of information requirements integrates the request for service quality, and such request tends to be more sensitive. In the service marketing literature, service quality has always been one of the focuses and hotspot variables to be discussed. Quality of Service is a determining factor of user satisfaction and loyalty, which has been researched in a broader consensus in both academia and industry. Furthermore, it has been a necessity for the university libraries continuously improve the service quality in order to gain sustainable development in education and research, which laid the foundation for the research conducted on service quality of university libraries in this thesis.

As an important force for strengthening the construction of socialist spiritual civilization and an important carrier for establishing a knowledge-based harmonious society, university libraries should take the important mission and function of promoting the development of public service

undertakings. In addition, university libraries will play an important role in advancing national reading, and the service quality will be used as the determining factor of the efficiencies of the libraries, since quality service reflects the readers' reading experience and helps to improve the reading satisfaction, thus improving the national reading rate.

The exploration of evaluation frameworks cannot be ignored in the context of service quality research in university libraries, and the complexity of the new information environment also possess new challenges to the service quality evaluation of university libraries. Furthermore, a comprehensive systematic evaluation framework is still lacking, which presents a new research dimension for university libraries. Thus, there is an urgent necessity to carry out an evaluation research on the service quality of university libraries. The consolidation of research works of the Chinese library scholars in the past two decades encompasses many research literatures on service quality of university libraries. Nevertheless, most of such works focus on evaluating the service quality of university libraries under the traditional environment, while only a very few of them focus on the service quality of university libraries under new information environment. The new information environment has put forward new requirements for the service quality evaluation of university libraries. Scholars around the world have conducted many researches on the service quality of traditional libraries and libraries under the digital environment and have achieved many research evaluations. However, the evaluation models, methods, indicator systems and empirical researches on the service quality of university libraries remain in shortage, especially under the dual-environment of digital information and mobile information, insisting the need for further exploration. In view of these shortcomings, this research adopts a novel empirical research method to conduct a systematic research on evaluation and improvement of service quality of university libraries in China, and further presents a scientific evaluation system to provide theoretical basis and suitable recommendations for improving the service quality of Chinese university libraries.

Research Significance

From the viewpoints of conducting evaluation and improving research in university library service qualities, this thesis claims both theoretical significance and practical value.

A. Theoretical significance

In order to establish an evaluation scale and model for service quality of national university libraries

under the new information environment on the basis of amended SERVQUAL, and to explore the dependability of the developed model for assessing the service quality of university libraries under the new information environment, it is theoretically important to deepen the service theory and service quality management theory of university libraries. The SERVQUAL model originates from the profit seeking strategies of services industries in western culture. In contrast, university libraries are non-profit service organizations. Thus, significant discrepancies exist in the SERVQUAL model whilst deploying it in Chinese university libraries, owing to its cross-cultural and cross-industrial incompatibility. This thesis firstly uncovers the impacts of university library services and its users under the new information environment, then introduces the SERVQUAL model which is a classical evaluation model for assessing the service quality of national university libraries and analyses the applicability and effectiveness of the SERVQUAL evaluation model for national university libraries under the new information environment through empirical research. Secondly, a multilayer evaluation model for assessing the service quality of national university libraries under the new information environment is established in reference to the five characteristic factors of SERVQUAL, and the model effectiveness is verified by empirical tests and cross validation analysis. Finally, the effectiveness of the amended SERVQUAL model in improving the service quality of national university libraries under the new information environment is demonstrated.

B. Practical significance:

In order to establish a scientific evaluation index system for service quality of national university libraries under the new information environment, this thesis postulates to modify and evolve the service quality systems of the university libraries in accordance with the evolution witnessed in the new information environment. With the increasingly higher proportion of the tertiary industries in Chinese national economy, service quality management is gaining more attention. Especially, service quality research is particularly being the focus of the researchers. University library is an important component to strengthen the construction of socialist spiritual civilization, and also an important media to construct a knowledge based harmonious society. Therefore, evaluation of service quality of university library is of great practical significance, and universities should consistently improve their quality of library services. This will not only improve the service quality level of university libraries, but also signifies the values of university libraries in promoting social spiritual civilization construction. Based on theoretical research, this thesis establishes a scientific

evaluation scale and model for service quality of national university libraries under the new information environment. With the motivation of optimizing the service quality management of university libraries, this thesis lays foundation and establishes knowledge to build an innovation-oriented socio-economic culture in the country.

1.2 Research Aim

Given the rapid evolution of the Internet technology, this research is aimed at developing an evaluation model for assessing service qualities of Chinese university libraries under new information environments to assist management optimization, based on an extension of the SERVQUAL framework.

The aims of this thesis are listed below:

- Undertake a literature review on existing research works on digital libraries and service quality of digital library for investigating their technical advantages and potential problems;
- Investigate the influence of emerging IT technologies and identify the key characteristics of services offered by HEI (Higher Education Institution) digital libraries;
- Design a new service quality evaluation model based on the SERVQUAL model for HEI digital and mobile libraries driven by the investigation;
- Evaluate the developed SERVQUAL-based service quality evaluation model for HEI digital libraries;
- Develop a set of service quality improvement strategies to improve the university library service quality from multi-perspectives.

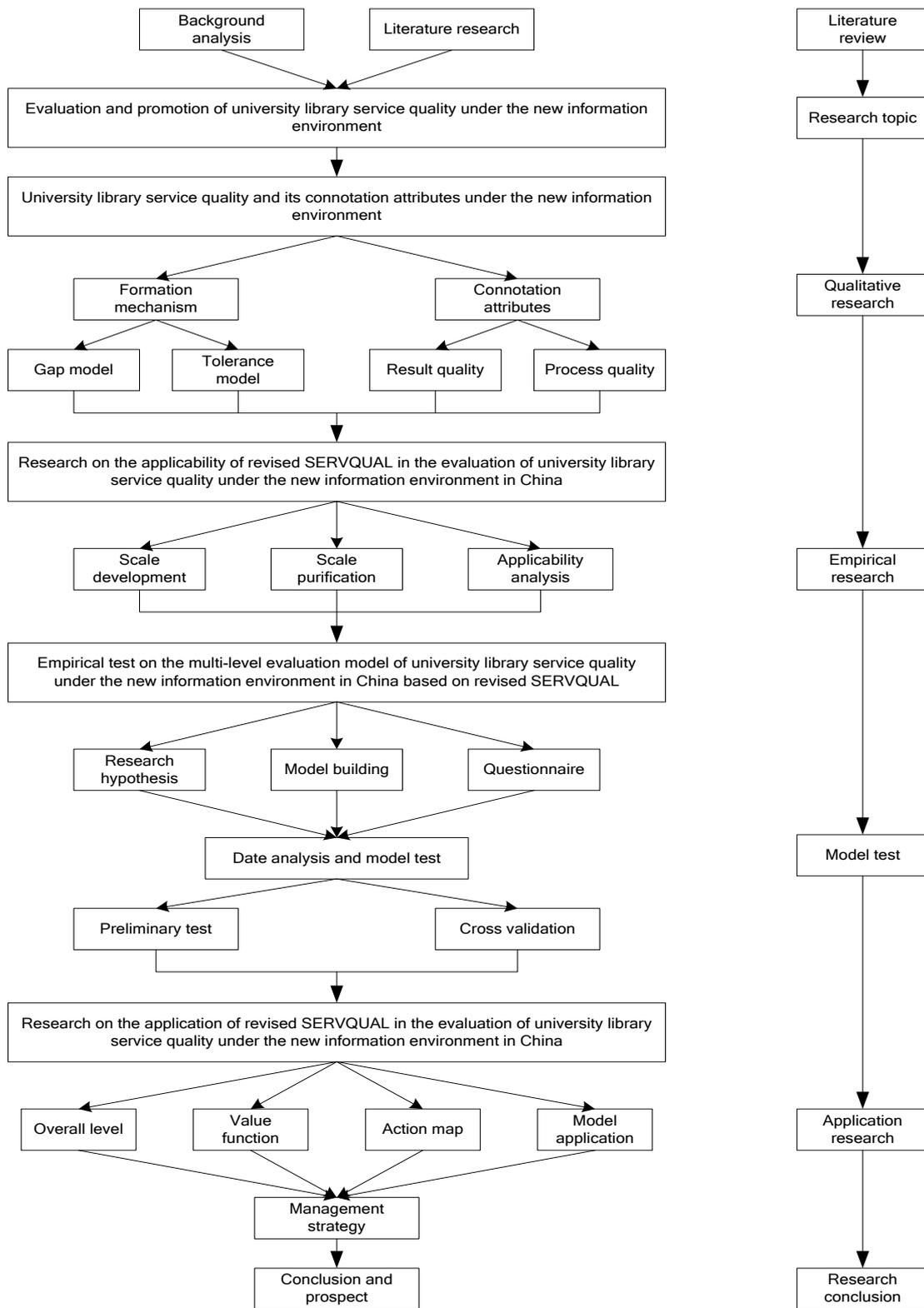


Figure 1-1 PhD Research Roadmap

1.3 Research Methods

The research methodology of this thesis integrates a combination of qualitative research and

empirical research. Firstly, extensive literature research is conducted based on current state-of-the-art related to service quality, library service quality and new information environments, to extract theories and viewpoints, which provide the theoretical basis for developing the questionnaire design and empirical analysis. Secondly, qualitative research is conducted on the connotation and characteristics of the new information environment, the influence of the new information environment on the service of university libraries and its users, the user-perceived service quality of university libraries and its connotation attributes. The methodology of constructing the evaluation scale of university library service quality includes qualitative research methods such as focus group interviews and expert in-depth interviews, so as to improve the scientific values and rationality of the scale construction process. Thirdly, this thesis collects data from questionnaires based on SERVQUAL scale to modify in the initially developed scale, and to carry out a cross-validation of the multi-level evaluation model. Finally, this thesis combines the theories and methods of multiple disciplines including management, library and information science, statistics, sociology, econometrics, etc. through an interdisciplinary research method, to study and explore the questions and concerns on university library service quality evaluation.

The PhD research road map of the subject is as shown in Figure 1-1.

1.4 Potential Contributions

Important contributions of this thesis are listed below.

First, this thesis presents an analysis of the changes brought by the new information environment to university library services, user requirements and behaviours, and describes the service quality of university libraries and its connotation attributes, thus laying a foundation for constructing the evaluation scale and model. In the past, research on library service quality mainly focuses on the physical service attributes of traditional libraries, and rarely involves service elements under the information environment. To aid the evaluation of university library service quality under the new information environment, this thesis defines and elaborates on the connotation and characteristics of the new information environment and analyses the influence of the new information environment on university library service quality.

Second, this thesis postulates an extension to the traditional SERVQUAL evaluation model generated under the western culture, in order to make it suitable for the evaluation of Chinese

university library service quality. Further, it provides a powerful tool for Chinese university libraries to evaluate the service quality and points out the direction for improving the library service quality. The applicability of the SERVQAUL model in Chinese university library services are evaluated in various aspects, in order to adopt suitable modifications. Through empirical research and statistical analysis, the credibility, validity and applicability of the modified SERVQAUL scale in measuring the service quality of Chinese university libraries has been demonstrated.

Third, as evaluation model for university library service quality has been constructed by a multi-level method, which overcome the drawbacks of the traditional SERVQUAL method, and provides a more suitable tool for evaluating the service quality of university libraries and accords with the complex psychological mechanism of user's perception of university library service quality. Service quality has been widely accepted by scholars as a complex multi-dimensional structure, but no consensus has been reached yet on the structural level of service quality. Most researchers deal with the service quality as a two-level structure, but service quality is actually a multi-dimensional two-level structure. To this end, thesis constructs an evaluation model for university library service quality from a multi-dimensional multi-level perspective. That is to say, the process of university library user perceiving service quality involves multiple levels, since users evaluate the service quality from three different levels including sub-dimension layer, main dimension layer and integral layer. The integral layer is the highest level. The overall service quality of university libraries is usually decided by the main dimension layer. The sub-dimension layer decides the process quality, which is the third level and concerns about tangibility, reliability, assurance, responsiveness and empathy. Such a multi-dimensional multi-level arrangement is more suitable for explaining the complex psychological process of users perceiving the service quality.

1.5 Thesis Organization

The remainder of this thesis is structured as follows:

Chapter 2 presents the literature review and reviews the history of service quality research and presents a formal definition of service. Specifically, this Chapter demonstrates theories related to service quality and library service quality. With an absorption and reference to the existed service quality theory, library service quality theory and other relevant theories, this Chapter carries out a systematic research on university library service quality evaluation through a characteristic analysis

of the new information environment and presents importance inferences for enriching the traditional evaluation framework of university library service quality.

Chapter 3 presents an analysis of the impacts of the new information environment on services in university library and its users, along with the connotation attributes of perceived service quality of university library. Finally, this chapter focuses on the discussion of the formation mechanism and connotation attributes of user perceived service quality of university library.

Chapter 4 presents the influencing factors of university library service quality. Then, it describes the proposed SERVQUAL model amendments for the new information environment. At last, this chapter demonstrates the applicability of the proposed SERVQUAL model under new information environments. This chapter lays a solid foundation for verification of the multi-level evaluation model of university library service quality under the new information environment.

Chapter 5 firstly presents the relevant theoretical assumptions and the concept models of multi-level evaluation; then introduces the test methods and procedures of multi-level evaluation model for university library service quality under the new information environment. Finally, this chapter validates the multi-level evaluation model through preliminary tests and cross validation. The results of the preliminary test and cross validation verified the correctness of the theoretical assumptions proposed in this research. The evaluation model demonstrates good applicability and validity, which provided directions of improvement for university library service quality under the new information environment.

Chapter 6 presents an analysis of the overall university library service quality under the new information environment. Then, it demonstrates an analysis of the cost function, action diagrams and application analysis of the proposed evaluation model under the new information environment. At last, this chapter provides the improvement strategies for library service quality in higher education institution under the new information environment.

Chapter 7 summarizes and concludes this thesis along with outlining the future research directions.

Chapter 2: Literature Review

This chapter presents the theoretical concepts of university library service quality evaluation. Firstly, defining the characteristics of services, this chapter further provides an overview of the state-of-the-art in the context of service quality including the constitution, model and evaluation of service quality. Finally, it discusses the theories of library service quality, especially focuses on the history of library service quality evaluation in detail.

2.1 Service

2.1.1 Definition of service

Service is an extremely complex phenomenon and activity, which usually ranges from individual services to product services; from traditional services to emerging services; from labor-intensive services to capital-intensive services; from knowledge-intensive services to technology-intensive services; and even to a broader range. The concept of service has been controversial since its emergence and many organizations and scholars both in China and overseas have defined service from different perspectives. Some of the definitions of services are presented as follows.

American Marketing Institute (AMA) has classically defined services as, "Services are activities, interests and satisfaction that are sold alone or together with products to customers".

The service research agency of IBM, a leading business company, believed that service is a process of interaction between suppliers and customers to create or acquire value.

Lehtinen [95] defines service as "a series of activities that are done with an interaction between customers and service providers or devices, which can satisfy customers".

It is observable that the definition of service has constantly evolved over time. For example, the initial definition of service is mostly focused on service activities and only confines to service sectors in a traditional sense. Besides, early definitions of service are heavily insisting on products, but the intrinsic service characteristics such as intangibility are not particularly emphasized. This is an open-minded definition focused on a wider range of service activities and takes a different perspective from the traditional service definitions, which are mostly limited with their scope of

views on services. Latest definitions of services have expanded the context of services to a new high, for instance services are used as an effective parameter to achieve competitive advantages in industries. An effective definition of services should include the following elements.

Firstly, a service itself is a series of activities or processes which are inherently intangible and do not refer to anything tangible.

Second, the essence of service is an interaction, not transaction. Although transactions may exist between service enterprises and customers, the nature of this service is still an interaction. Without interaction, service may become a pure transaction, thus will not affect the perceived quality of customer service. The interaction between service enterprises and customers should necessarily create a real service value.

Finally, a service should form the core element of an enterprise's competitiveness and should reflect the development of the enterprise. Both the traditional service organizations and other types of organizations like manufacturing sectors should depend on their service level in order to maintain a consistent growth.

2.1.2 Characteristics of service

In the field of service marketing, the generation of service concept is usually related to tangible products. Although there may exist many similarities between services and tangible products, some inherent basic features of services make them different from tangible products. Chinese scholars Wang Chunxiao and Cai Haoran compared the characteristics of services and tangible products in the book *Service Marketing and Service Quality Management*, as shown in Table 2-1:

From Table 2-1, it can be observable that several basic characteristics of services such as intangibility, simultaneous occurrence of production and consumption, etc., make them fundamentally different from tangible products. It is worthy of note, that different service sectors may be interested in certain individual characteristic of services different from other sectors. Thus, services should necessarily include the basic characteristics such as intangibility, non-storage (perishability), simultaneity of production and consumption (inseparability), and difference (heterogeneity).

Table 2-1 Comparison of Characteristics between Services and Tangible Products

Service	Tangible products
Intangible	Tangible
Different forms	Similar forms
Simultaneous occurrence of production, distribution and consumption	Non-simultaneous occurrence of production, distribution and consumption
A behaviour or process	An object
Generation of core value in the contact between buyer and seller	Generation of core value in factory
Customer participation in production process	No customer participation in production process
Non-storable	Storable
No transfer of ownership	With transfer of ownership

Source: Wang Chunxiao, CaiHaoran. *Service Marketing and Service Quality Management* [M] . Guangzhou: Sun Yat-sen University Press, 1996: 2-9.

a) Intangibility is the fundamental characteristic of services that differ from ordinary tangible products. Service activity may interact with many physical devices, machines, tools, files, etc., but the service itself is still physically intangible. A service cannot often be easily perceived, since a service is usually composed of a series of activities. Customers do not hold the ownership of a service while consuming them, for example, when a customer lives in a hotel, he or she rents the hotel room/bed rather buying and owning them. Customers may face some issues brought by the intangible nature of the service. For example, before purchasing or consuming a service, customers are unable to determine the type and quality of service beforehand, and rarely do a trial before purchasing. However, it is possible that customers do choose services based on the experience or word of mouth of other customers. This scenario may certainly introduce some difficulties and subjectivities for customers whilst perceiving and evaluating the service quality.

b) Non-storage is also called as perishability, that is, service can easily disappear. Suppose that 400 out of 500 rooms are occupied in a given evening, the credibility and the service value of the remaining 100 rooms might degrade during that evening. Since services cannot be stored and transported alike tangible products, service providers must maintain sufficient service capacity at all times in order to respond to the changes in the market demand at any time. If the service capacity is insufficient, customer complaints or discontent may arise, resulting in customer defection. At the same time, service organizations need to establish flexible and efficient remedies to repair customer

complaints and service errors.

c) Simultaneity of production and consumption: In general, the production and consumption of tangible products characterize a time sequence, that is, products are produced, stored, transported, sold and then consumed by customers. But the production process of service is accompanied by consumption at the same time, and customers are also involved in the production of service onsite, for example, in a barbershop, the service and consumption occur at the same time. Because of the inseparability nature of services, it is often necessary to bring together the various components of service activities, and to deliver and consume services through the joint participation of service personnel and customers. Because of this nature, service providers must provide services in an appropriate way through proper service contact with customers; otherwise, service providers may easily face customer dissatisfaction. Furthermore, service providers may face more than one customer at a time during the process of service production and consumption. Thus, the behaviours and attitudes of some customers may also affect the production of other customer's consumption services.

d) Difference can also be described as heterogeneity, whereby, the services provided by different service providers may not be the same, and even the same services may differ as well. Thus, the behaviours of service providers and customers cannot be the same in the process of producing and delivering every individual service. In addition, the factors such as customer demands, service staff's ability, time of consumption, participation of other customers, etc., may also be heterogeneous; this may exert different levels of influences up on the production and consumption of each service. This heterogeneity of services makes it impossible to manage services like products, so the quality assurance requirements of services need to be realized by the management method different from that of products. From customer's point of view, a customer's knowledge, experience, participation and other factors will certainly have a reflection up on their level of satisfaction, so services organization and staff should provide differentiated and personalized services for different customers, to reduce the gap among customer's perceived service levels in order to improve the perceived equity.

2.2 Theories Related to Service Quality

2.2.1 Connotation and characteristics of service quality

Service is complex, while service quality is even more complicated than the service itself and is determined by the characteristics of services. Service quality reflects the level of service, so that it is important to define the connotation of service quality accurately. Service quality is a complex construct encompassing several attributes, which has aroused the research interests of a large number of scholars and business persons in the early 1970s. In the past 30 years, the service quality has been one of the hot spots in the field of service marketing. Scholars have continued to study the service quality over the years to extract and wide range of research inferences, nevertheless debate around a precise definition of service quality is still prevailing and no consensus has been reached so far (as shown in Table 2-2).

Table 2-2 Summary of Representative Viewpoints on the Connotation of Service Quality

Scholar (year)	Connotation of service quality
Levitt (1972)	Service result conforms to the defined dimensions
Churchill and Surprenant (1982)	The degree of satisfaction with services is determined by the difference between actual service and previous expectation.
Garvin (1983)	A subjective quality perceived by customers rather than objective quality.
Lewis and Booms (1983)	Degree of matching between delivered services and customers' expectations
Grönroos (1984)	Result of comparative evaluation made by customers between service expectations and perceived service performance
Parasuraman et al. (1985)	Comparison between customers' expectations and perceptions of the services received
Zeithaml et al. (1985)	Evaluation made by customers on the overall excellence or superiority of services
Lewis (1989)	Continuous satisfaction or overriding satisfaction with customer expectations
Bitner (1990)	Evaluation and subjective judgement of the service contacts between customers and service providers
Ghobadian et al. (1993)	Used to measure the degree of service delivery satisfying customer expectations
Nitecki et al. (2000)	Meet or go beyond customer expectations, or the gap between customers' perceptions and expectations

Source: analysis of the research

Because of the inseparability nature of services, service quality is determined at the time of service presentation by the customer it serves rather than by the provider. Most researchers agree to define

or measure the service quality from a customer's perspective, while a vast majority of the definitions of service quality follows a "customer-oriented" paradigm according to Ghobadian et al, [56]. For example, Lewis [97] defined service quality as a continuous satisfaction or overriding satisfaction of customer expectations. Churchill [29] defined service quality as the degree of customer satisfaction with the service, which is determined by the difference between actual service and previous expectation. Lewis and Booms [96] believed that service quality is the act of matching the delivered service with the customer desire. Garvin [57] pointed out that service quality is the subjective quality, rather than objective quality, perceived by customers.

Based on the previous researches, Grönroos [58] later put forward the concept of customer perceived service quality for the first time. He thought that service quality depends on two variables, namely, expected service and perceived service performances. Further, Grönroos stated that the customer perceived service quality could be obtained from a comparative evaluation of the differences between customer's service expectations and perceived service performance. When the service expectation is higher than the perceived service performance, the customer perceived service quality is considered low, and when the service expectation is lower than the perceived service performance, the customer perceived service quality is considered high. However, this definition suffers limitations and fuzziness, since customers may differ with their service expectations and perceived performances, and the function of perceived service quality of each customer may differ as well. This subjective perception results may not provide sufficient inferences for service providers to improve their service quality. However, undeniably, this paradigm of comparison strategy distinguishes the concepts and nature of service quality and tangible product quality, and it is the most powerful definition of service quality, providing important theoretical foundation for the follow-up researches on service quality.

Few other scholars also defined service quality from different perspectives, but mostly based on the same "customer orientation" paradigm. For example, Bitner [10] considered that perceived service quality comes from the service contacts between customers and service providers in which customers evaluate the quality and form subjective judgments. Parasuraman [136] presented perceived quality as a comparison between customers' expectations and perceptions of services they receive. Zeithaml [226] proposed that service quality could be obtained from an evaluation made by customers on the overall excellence or superiority of services. Ghobadian et al [56]. stated that

service quality could be used to measure the degree of service delivery satisfying customer expectations.

Although scholars had different views on service quality, most scholars believed that service quality has several characteristics including the following. (1) It is a form of customer attitude, which is greatly influenced by customers' subjective judgment and is difficult to be judged by service providers; (2) It depends on the comparison between actual perceived service performance and expected service level; (3) It is related to the centralized evaluation, and reflects customers' evaluation of service elements; (4) Compared with service results, it focuses more on service process, and depends on the contact and interaction between customers and service providers. Further to these characteristics, it is worthy of note that service quality reflects a customer's overall judgment and cognitive attitude, and the cognitive process should be formed over time, not merely based on the result of a specific transaction at a certain moment. Thus, service quality should be evaluated from the result of customer perceived service quality accumulated over time, thus reflecting more than just the concept of customer satisfaction.

To sum up, scholars had diversified view on service quality, and it is inevitably harder to extract a universally accepted standard of consensus for service quality. The definition of standardization will change with the situation, and the definition of service quality will change across different industries, departments and cultures.

2.2.2 Constitution of service quality

Service quality is a complex multi-dimensional construct, which is a consensus in the academia, but there are different opinions on the specific composition dimensions. From the two-dimensional quality model of Nordic school to the five-dimensional quality model of North American school and then to the multi-level constitution theory, the composition of service quality is defined is a process of gradual deepening, reflection and perfection. From traditional service quality to e-commerce service quality, and then to mobile commerce service quality, some representative views of service quality from different periods are summarized in Table 2-3.

Table 2-3 Summary of Representative Viewpoints on the Constitution of Service Quality

Scholar (year)	Dimension	Service types
Grönroos (1982)	Technical quality, functional quality	Traditional

Lehtinen and Lehtinen (1982)	Physical quality, enterprise quality, interaction quality	service
Parasuraman (1988)	Tangibility, reliability, responsiveness, assurance, empathy	
Rust and Oliver (1994)	Service product, service delivery, service environment	
Dabholkar et al. (1996)	Physical layer, reliability, human interaction, Problem solving, policy	
Brady and Cronin (2001)	Interaction quality (attitude, behaviour, expertise), physical environment quality (surrounding conditions, design, social factors), result quality (waiting time, punctuality, valence)	
Barnes and Vidgen (2002)	Availability, design, information, trust, empathy	E-commerce
Wolfenbarger and Gilly (2003)	Website design, reliability performance, privacy security, customer service	
Parasuraman et al. (2005)	Effectiveness, performance, system availability, privacy	
Lu et al. (2009)	Interaction quality (attitude, expertise, problem solving, information) Environment quality (equipment, design, position), result quality (punctuality, tangibility, quoted value)	Mobile commerce
Tan and Chou (2008)	Perceived usefulness, perceived ease of use, content, diversity, feedback, exploration and personalization	
Akter[5] (2013)	System quality (reliability 4, effectiveness 4, privacy 3), interaction quality (cooperation 4, confidence 3, solicitude 4), information quality (utilitarianism 4, hedonism 3)	

In 1982, Grönroos, a representative of the Nordic school, presented the concept of customer perceived service quality for the first time based on previous researches. He pointed out that perceived service quality is composed of technical quality and function quality, in which, the technical quality is also called as result quality, which is the service result obtained by customers, and the functional quality is also called as process quality, which is a service process about how customers obtain the service result. This two-dimensional structure of service quality has an important significance in the research history of service quality, because it has influenced or provided reference for many subsequent researches on service quality, and also has a strong practical value till now.

In 1985, famous scholars of service quality from North American school, Parasuraman, Zeithaml and Berry (hereinafter referred to as PZB) proposed the gap model of service perceived quality under the research context of Grönroos, concluding that service quality is composed of 10

dimensions including reliability, responsiveness, competence, availability, appearance, communication, credibility, security, customer understanding and tangibility. Soon later, they reduced the 10 dimensions to 5 dimensions, through an empirical analysis, including tangibility, reliability, responsiveness, assurance and empathy. Although this division had suffered from criticism in early days, it has been regarded as the most scientific and completed interpretation of the constitutional dimension of service quality, and later widely recognised as the classic five-dimensional service quality structure in both China and overseas, which has a profound impact until now.

Following this, scholars Rust and Oliver [154] improved and supplemented the Grönroos's two-dimensional service quality model by incorporating the environmental factors and proposed a service quality model including three quality factors such as service product, service delivery and service environment, which provides a more complete consensus for the two-dimensional quality model. As a result, both academia and industries have started to focus on the physical environments of services, rather than focusing too much on the contact and result of services. In this consensus, service product is similar to result quality, service delivery is similar to process quality, and service environment is similar to tangibility in the PZB's five-dimensional model.

The research conducted by Chinese scholars on service quality is mainly based on the assimilation of theories. Though lagging behind time, research on service quality in China is now picking up. The most influential viewpoints of Chinese scholars include the following. Wang Chunxiao [189] with an empirical study conducted on hotel industry, postulated that the service quality is composed of tangible quality and intangible quality; Fan Xiucheng [51] proposed the concept of interaction quality, which states that service quality contains output quality and interaction quality, of which, interaction quality is the key element of service quality.

It is obvious that the above viewpoints constitute multi-dimensional view on the attributes of services. With a deeper understanding of the customer's psychological mechanism, some scholars start to notice that the constitution of service quality may include a multi-level paradigm. Dabholkar et al. [44], the earliest scholars whom noticed and studied this multi-level paradigm, proposed a multi-dimensional multi-level structure of service quality, in which the main dimensions of service quality include physical layer, reliability, human interaction, problem solving, and policy, with each

of the main dimensions including respective sub-dimensions.

Brady and Cronin [9], based on the summary of previous researches, proposed a more general multi-dimensional multi-level model of perceived service quality; the main dimensions of which include interaction quality, physical environment quality and result quality. The interaction quality is determined by the attitude, behaviour and expertise sub-dimensions, the physical environmental quality is determined by the surrounding conditions, design and social factors, and the result quality is determined by the waiting time, punctuality and valence. For more than a decade, this viewpoint of multi-level structure for service quality has been adopted and recognised by various scholars and considered to be the mainstream viewpoint of service quality constitution.

The dimensions of service quality proposed by the above scholars are aimed at the traditional service industry. With the development of information technology, some scholars explored and studied the dimensions of e-commerce service quality and mobile commerce service quality. In the domain of e-commerce, Barnes and Vidgen [178] put forward five factors including usability, design, information quality, trust and empathy, as constituting the key dimensions of network service quality. Wolfinbarger and Gilly [186] developed a quality scale of electronic retail service, proposing that the dimensions of online shopping service quality include website design, reliability/performance, privacy/security and customer service. Parasuraman et al. [137] thought that the dimensions of electronic service quality consist of effectiveness, performance, system availability and privacy.

In the domain of mobile commerce, Lu et al. [9] considered mobile security as an example to propose a multi-dimensional structure for mobile e-commerce service quality. The main dimensions of this structure include interaction quality, environment quality and result quality, in which, interaction quality is composed of attitude, expertise, problem solving and information; environment quality is composed of equipment, design and location; and result quality is composed of punctuality, tangibility and valence. Tan and Chou [176] proposed a structural dimension of mobile service quality based on the motivation theory and flow theory, which integrates external and internal service attributes including perceived usefulness, perceived ease of use, content, diversity, feedback, exploration and personalization, by conducting a study on mobile information and mobile entertainment services. Akter [5] developed a multi-dimensional multi-level structure of

mobile medical service quality which includes system quality, interaction quality and information quality, in which, the system quality consists of reliability, effectiveness and privacy; interaction quality consists of cooperation, confidence and solicitude; and information quality consists of utilitarianism and hedonism.

To sum up, the attributes and structural model of service quality has constantly evolved with the change in the industrial environment, particularly the service quality composition of service industries and traditional industries exhibited significant differences between them. Seth et al. [158] accumulated all the research documents of service quality published from 1984 to 2000 and concluded that academia has not agreed on a standardized attributes of service quality owing to the differences in the arguments about the structural model of service quality in different industries. Undeniably, the academia's knowledge of service quality composition is deepening and advancing recently. The previous viewpoints on service quality composition are bound to be confronted with the problem of adaptability when applied to a new service environment. Thus, it is necessary to improve the classical viewpoints of service quality composition according to the individual characteristics of specific service environments, to present a comprehensive understanding of service quality in order to help management personnel to improve service quality and customer satisfaction.

2.2.3 Service quality model

A wide range of service quality models have been proposed in the past which will be reviewed in this section.

A. Technical and functional quality model

Also known as two-dimensional quality model, the technical and functional quality model was proposed by Grönroos, in the early 1980s, and is still considered as one of the most classical and authoritative service quality models by the academia (shown in Figure 2-1).

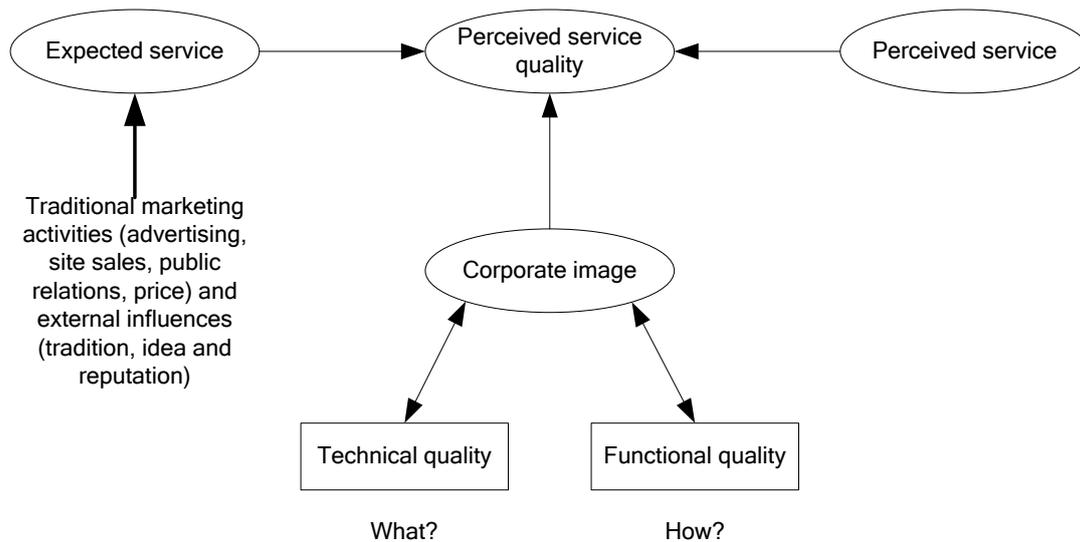


Figure 2-1 Technical and Functional Quality Model

Based on: Grönroos C. A service quality model and its marketing implication. *European Journal of Marketing*, 1984, 18(4): 36-44.

Grönroos [58] considered that service quality is composed of three factors such as technical quality, functional quality and corporate image. Technical quality refers to the service results obtained from the interaction between customers and service companies, i.e. "what to get", which is also called as result quality and is very important for service evaluation by customers. Functional quality describes how customers obtain the technical results, i.e. "how to get", which is also called as process quality and is vital for the services received by customer perception; corporate image is the result of how a customer perceives an enterprise, which is primarily based on the technical quality and functional quality of enterprise services and is also influenced by other factors including external factors (such as tradition, ideology and word of mouth, etc.) and traditional marketing activities (such as advertising, promotion and public relations).

B. Gap model

Parasuraman, a representative of North American school and others [226] carried out a more extensive research on service quality model based on Grönroos' research and proposed the service quality gap model through a gap analysis (as shown in Figure 2-2). Parasuraman et al. [136] stated that service quality is a differential function of expectations and performance in each quality dimension.

The model consists of five gaps which are described as below:

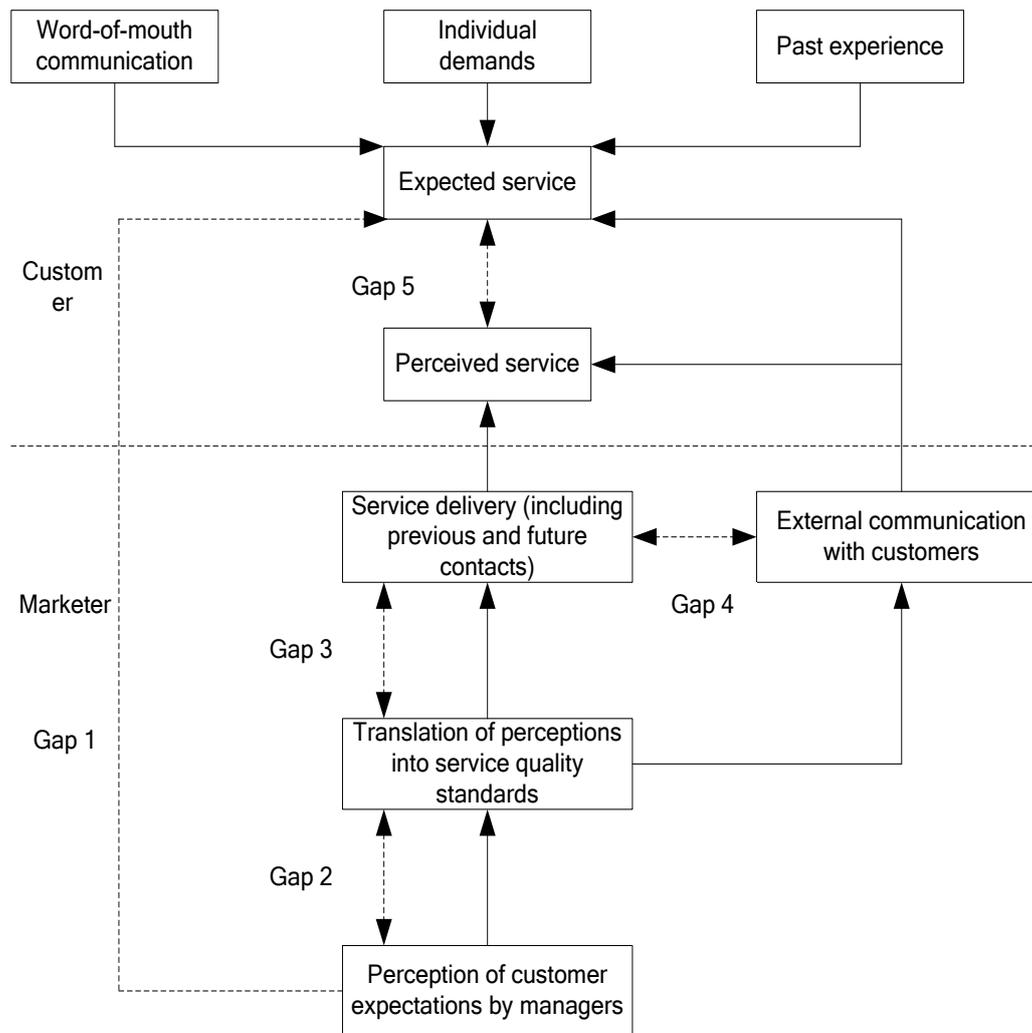


Figure 2-2 Service Quality Gap Model

Based on: Parasuraman A, Zeithaml V A, Berry L L. A conceptual model of service quality and its implications for future research. *The Journal of Marketing*, 1985, 49(4): 41-50.

Gap 1 (knowledge gap): the gap between customer expectations and manager-perceived customer expectations. For example, managers do not know and cannot estimate customer's service expectations.

Gap 2 (standards gap): the gap between manager-perceived customer expectations and service quality standard transformation. For example, although managers can perceive customer expectations, they cannot translate customer expectations into standardized service designs.

Gap 3 (delivery gap): the gap between service quality standards and actual service delivery, namely, enterprise service performance gap. For example, although an enterprise has established strict service processes and standards, some employees still fail to provide services in accordance with the service standards, resulting in gaps.

Gap 4 (communication gap): the gap between service delivery and external customer

communication about service delivery. For example, the actual delivery of services failing to match the commitments initially made to customers.

Gap 5 (service gap): the gap between customer expectations and perceived services. Gap 5 depends on the size and direction of the other four gaps associated with service providers during service quality delivery, and is a result accumulated by the other four gaps.

According to this model, service quality is a function of perceptions and expectations, expressed as:

$$SQ = \sum_{j=1}^k (P_{ij} - E_{ij})$$

where, SQ refers to the overall service quality, k refers to the number of attribute dimensions of service quality, P_{ij} refers to the perceived performance of attribute j of subject i , and E_{ij} refers to the expectation of service quality attribute j by subject i . If the perception is higher than the expectation, the service quality is positive, indicating that the customer expectation is satisfied; if the perception is lower than the expectation, the service quality is negative, indicating that the customer expectation is not satisfied.

On the basis of exploratory research on service quality model, in order to scientifically and effectively measure the customer perceived service quality (gap5), Parasuraman et al [135] continued to develop the famous SERVQUAL (service quality) model, which reduced the original 10 dimensions of service quality to 5 dimensions including reliability, responsiveness, tangibility, assurance (combining the original 5 dimensions of communication, competence, trust, courtesy and security) and empathy (combining the original 2 dimensions of understanding/familiarity with customer and availability), and formed a service quality measurement scale consisting of 22 questions in 5 dimensions (described later in detail). At the same time, they further expanded the initial gap model to form a new service quality gap model, as shown in Figure 2-3.

C. Multi-dimensional multi-level model

In the past, most of the service quality models are based on the two-level multi-dimensional models, including two-dimensional model of technical function, five-dimensional model and three-dimensional model of SERVQUAL, etc.

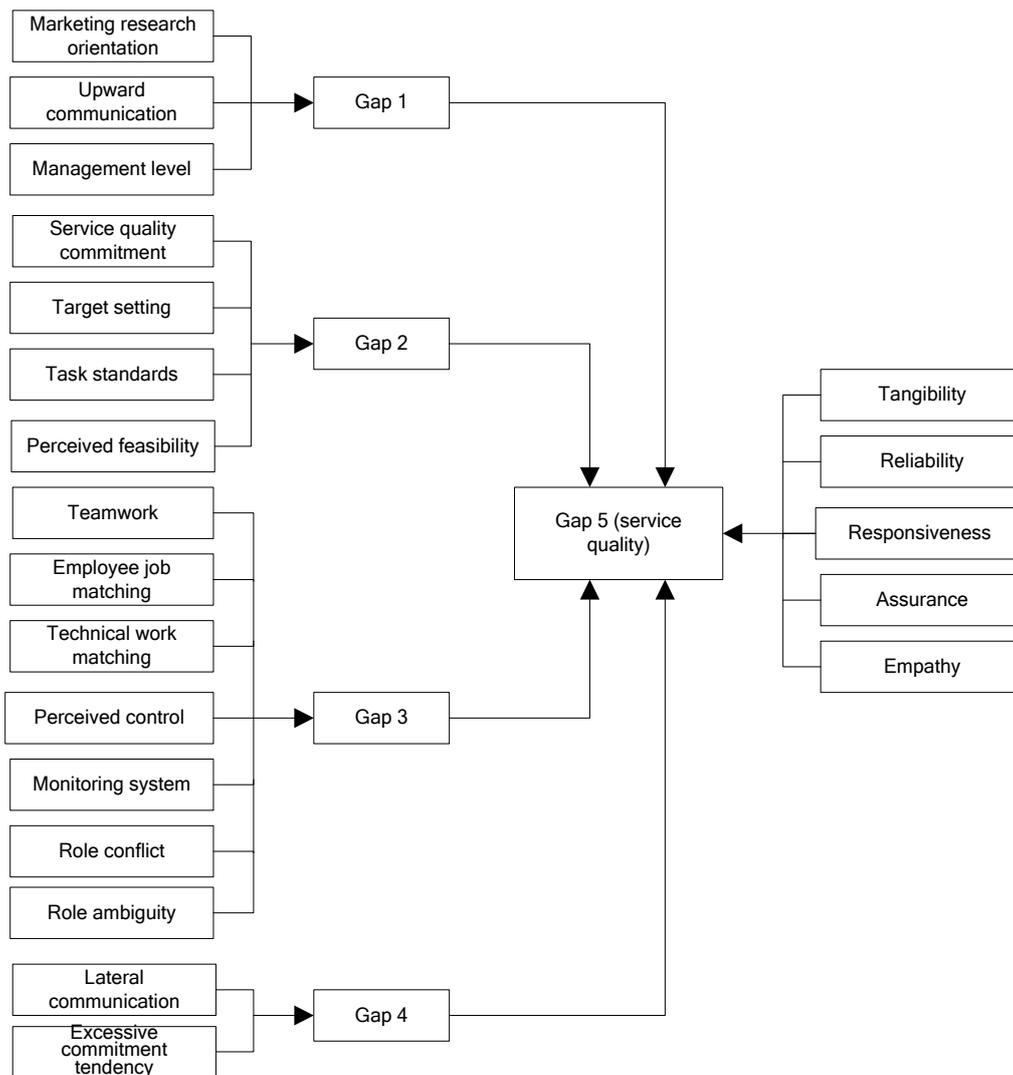


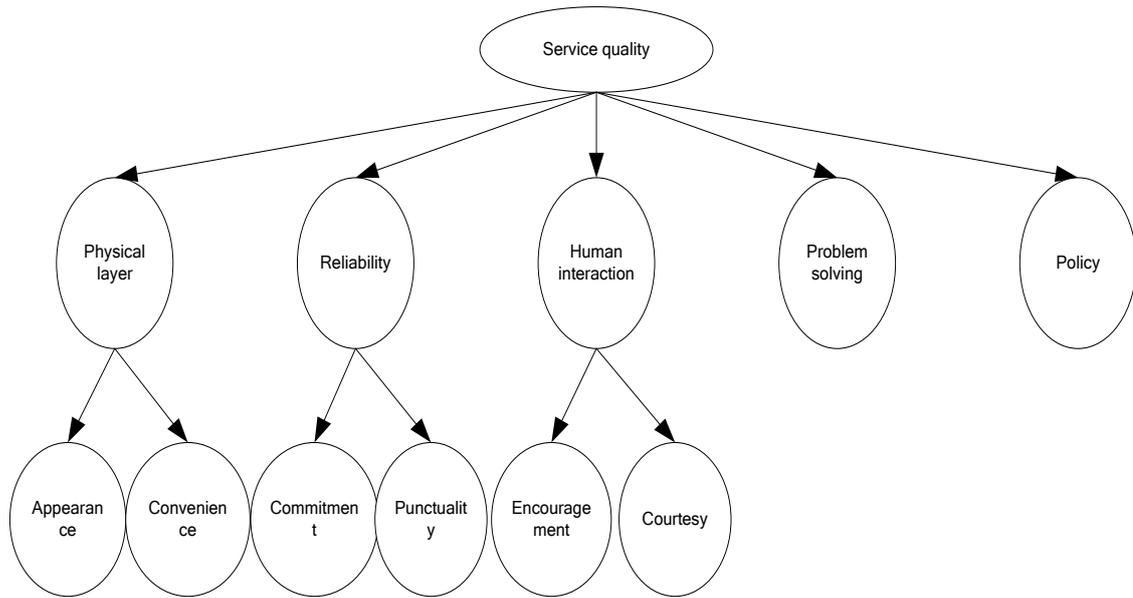
Figure 2-3 Extended Service Quality Gap Model

Based on: Zeithaml V A, Berry L L, Parasuraman A. Communication and control processes in the delivery of service quality. *The Journal of Marketing*, 1988, 52(2): 35-48.

Dabholkar et al. [44] considered that the previous models did not reflect the complexity of customer perceived service quality, and especially questioned the applicability of SERVQUAL in retail industry. For this reason, the multi-dimensional multi-level structural model was proposed for retail service quality, as shown in Figure 2-4.

It is evident from this model that a customer's perception of service quality is carried out progressively by three levels, namely, overall service quality, quality of level 1 dimensions and quality of level 2 dimensions. The level 1 dimensions include physical layer (tangibility), reliability, human interaction, problem solving and policy, in which, tangibility is decided by appearance and convenience, reliability is decided by commitment and punctuality, and human interaction is decided by encouragement and courtesy. Because this model is mainly aimed at retail industry, it

may lack a general applicability in other service industries. Later, scholars Brady and Cronin [9] constructed a multi-dimensional multi-level model with better applicability on other service



industries.

Figure 2-4 Multi-level Model of Retail Service Quality

Based on: Dabholkar P A, Thorpe D I, Rentz J O. A measure of service quality for retail stores: scale development and validation. Journal of the Academy of Marketing Science, 1996, 24(1): 3-16.

D. Internal service quality model

Frost and Kumar [46], based on the gap model of Parasuraman et al. [226], developed an internal service quality model for large-scale service organizations, as shown in Figure 2-5, which divides the employees within an organization into two categories such as front-line staff, i.e. internal customers and supportive employees, i.e. internal suppliers.

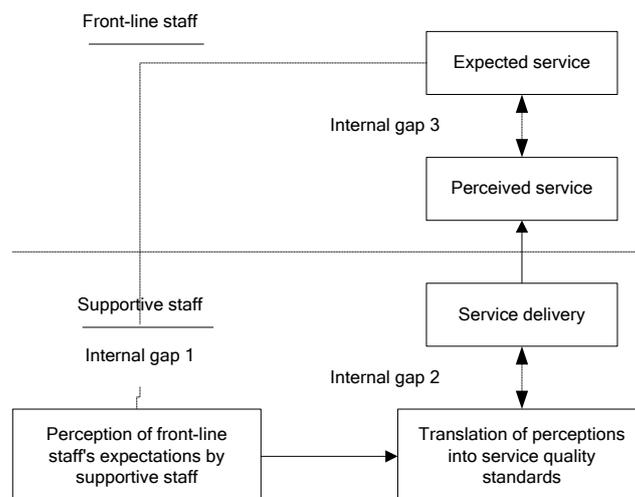


Figure 2-5 Internal Service Quality Model

Based on: Frost F A, Kumar M. INTSERVQUAL—an internal adaptation of the GAP model in large service

organization Journal of Services Marketing, 2000, 14(5): 358-377.

In this model, the dependent variable is the internal quality service (ISQ), and the independent variables are the tangibility, reliability, responsiveness, assurance and empathy in SERVQUAL. Among them, the internal gap 1 refers to the perception of front-line staff's (internal customers) expectations by supportive staff; the internal gap 2 refers to the difference between service quality standards and actual service delivery; and the internal gap 3 refers to the gap focusing on front-line staff, namely, the gap between front-line staff's expectations and perceptions of the service quality delivered by supportive staff.

E. Service quality integration model

The early service quality models are mostly static and are limited to a single construct and ignore the relationship between service quality and other factors, hence such models loose practical significance. After the 1990s, some scholars began to pay attention to this problem, and proposed a dynamic model or relational model of service quality, by incorporating more related elements into the previous service quality models. One of the representative views is the service quality integration model proposed by Dabholkar[43], which is a model built on the antecedent model of service quality with an emphasis on satisfaction as a mediator, as shown in Figure 2-6. The left half of the model is the antecedent model of service quality, which uses the relative dimension of service quality as its antecedent factor, and the right half is the satisfaction mediation model, which contains the antecedents and consequences of customer satisfaction. This integrated model clearly depicts the relationship between service quality and other factors.

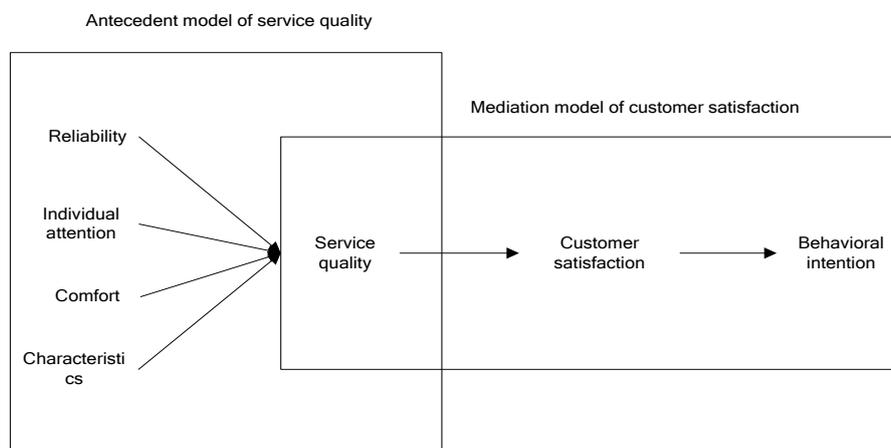


Figure 2-6 Service Quality Integration Model

Based on: Dabholkar P A, Shepherd C D, Thorpe D I. A comprehensive framework for service quality: an

investigation of critical conceptual and measurement issues through a longitudinal study. *Journal of retailing*, 2000, 76(2): 139-173.

2.2.4 Evaluation of service quality

For a scientific and effective evaluation of service quality, some academics have developed a wide range of evaluation methods, among which the most popular and profound method is the SERVQUAL scale (difference comparison method) jointly developed by three American academics: Parasuraman, Zeithaml and Berry [135]. In addition, typical evaluation methods include the SERVQUAL evaluation method revised by PZB and the SERVPERF evaluation method (direct measurement method) developed by Cronin and Taylor [20]. An analysis on the origin and development of above three evaluation methods are given as follows.

A. SERVQUAL evaluation method

a) SERVQUAL origin

SERVQUAL is the acronym of 'Service Quality' and interpreted as the 'quality of service'. This evaluation method is initially developed by three American academics Parasuraman, Zeithaml and Berry, detailed in the famous *Journal - Journals of Retailing* on the spring issue of 1988 titled "Servqual: A multiple-item scale for measuring consumer perceptions of service quality". In the initial SERVQUAL scale, PZB designed 10 dimensions of service quality including tangibility, reliability, responsiveness, communication, credibility, security, competence, courtesy, understanding/knowing the customer and access, and raised 97 questions in total for evaluation, with around 10 questions for each dimension. After an initial multiple scale purification, the 10 initial dimensions were reduced into 7 distinct dimensions with 34 evaluation questions, in which 5 original dimensions including tangibility, reliability, responsiveness, understanding/knowing the customer and access maintain differences and similarities were retained, and the other 5 dimensions including communication, credibility, security, competence and courtesy were reduced to 2 different dimensions, and the evaluation questions were developed from the original 5 dimensions. To further evaluate the robustness of these 34 questions, they conducted a second stage of scale purification, with which they evaluated samples from four different sectors including banks, credit card companies, electrical maintenance companies and inter-exchange carriers. After a series of data analysis, dimensions were further reduced to 5 and 22 evaluation questions, among which three

dimensions including tangibility, reliability and responsiveness were retained, while communication, credibility, security, competence and courtesy were integrated and named as assurance, and two dimensions including understanding/knowing the customer and access were integrated and named as empathy. Although only 5 distinct dimensions were obtained at the end, and they included the full connotation of the original 10 dimensions. Concrete implications of these 5 dimensions are described as follows:

Tangibility: tangible physical implementation, equipment and dressing of service staff, etc.; includes 4 questions.

Reliability: ability to reliably and accurately perform promised service; includes 5 questions.

Responsiveness: willingness to help customers and offer fast and immediate services; includes 4 questions.

Assurance: staff's knowledge, courtesy, capacity to encourage customer for trust and confidence; includes 4 questions.

Empathy: cater to customers for giving customers personalized attention; includes 5 questions.

PZB named the finally determined scale with 5 dimensions and 22 questions as "SERVQUAL" (see Table 2-4), and it is clear that SERVQUAL is a service quality measurement scale based on quality attributes or features (Attribute-based), and the scale can effectively measure the level of customer awareness service quality. The SERVQUAL evaluation method is customer-oriented. By measuring the customer's expectation and perception value of a service and by calculating the difference between them, important inferences for judgment on service quality is extracted. The calculation formula for SERVQUAL evaluation method is as follows:

$$SQ = \sum_{i=1}^{22} (P_i - E_i) \quad (2.1)$$

where,

SQ —the total perceived service quality;

P_i —the perception mark of customer for the i th indicator;

E_i ——the expectation mark of customer for the i th indicator.

If weight factors are considered, the formula for the model is:

$$SQ = \sum_{j=1}^5 w_j \sum_{i=1}^n (P_i - E_i) \quad (2.2)$$

where,

w_j ——the weight for the j th dimension;

n ——the indicator number of the j th dimension;

P_i ——the perception mark of customer for the i th indicator;

E_i ——the expectation mark of customer for the i th indicator.

The SERVQUAL evaluation method is a simple multi-indicator evaluation method, which can comprehensively measure the quality of service and therefore has wider application significance. Firstly, SERVQUAL can help enterprises to better understand customer's expectation and perception process for services, thereby providing inferences to improve the service quality level. Secondly, SERVQUAL can be employed to evaluate and compare the service level of relevant enterprises in the industry for the purposes of finding out the gap in the service quality among enterprises, identifying the promotional objectives for enterprises with poor services, ultimately helping with improvement strategies. As SERVQUAL contains 5 dimensions, it can clearly identify the deficiencies of certain dimensions, which is helpful for enterprises to act appropriately to the situation for rapidly improving the service quality. Thirdly, SERVQUAL also provides inferences for evaluating and assessing the service quality of internal staff, thereby it is easy to identify the deficiencies of staff whilst serving customers. This is achieved by exploiting customer's SERVQUAL grading, thereby helping to further improve the service quality of internal staff. Finally, SERVQUAL can also subdivide enterprise customers and can classify them by investigating individual customers' SERVQUAL score. This is achieved by identifying customers with higher scores and investigating their frequency of receiving the corresponding enterprise's services. SERVQUAL can further determine the enterprise's target customers to maintain loyalty and to provide rewards to these customers; meanwhile, it also can aid customers with lower scores to

improve their cognition and satisfaction to the enterprise's services.

Table 2-4 SERVQUAL Scale

Dimension	Composition
Tangibility	1. There are updated service facilities. 2. Tangible facilities are visually attractive. 3. Staff is properly and neatly dressed. 4. Tangible facilities match with service types provided.
Reliability	5. Promises to customers are fulfilled immediately. 6. Concerns and helps are always provided to customers when they are in trouble. 7. The Company is reliable. 8. Promised services can be provided on time. 9. Related services are recorded accurately.
Responsiveness	10. The time to provide customers with services cannot be told accurately (-). 11. Service staff cannot provide services immediately (-). 12. Service staff cannot always be willing to help customers (-). 13. Service staff is unable to respond to customer requests since they are too busy (-).
Assurance	14. Service staff is trustworthy. 15. Customers feel comfortable when they process trading with service staff. 16. Service staff is very polite. 17. Service staff is provided with appropriate supports to offer better services.
Empathy	18. The Company will not improve different concern to different customers (-). 19. Service staff will not provide customers with personalized considerations (-). 20. Service staff cannot understand customers' needs (-). 21. Customers' interests are not put in the first place (-). 22. It is unable to provide all customers with convenient business Chinese (-).

Since SERVQUAL is developed based on the data obtained from the four industrial sectors including banks, credit card companies, electric maintenance companies and liner-exchange carriers, the universality of the conclusions and dependability of SERVQUAL needs more justification and verifications of proofs. In their initial studies, they found that the importance of reliability, assurance, tangibility, responsiveness and empathy can be sequentially reduced, but in other industries, the order of importance might change, as recognised by the three academics. For example, in 1990, in another empirical research, PZB found that the importance of five dimensions was in turn: reliability, responsiveness, assurance, empathy and tangibility. It is clear that empathy is more important than tangibility. Therefore, SERVQUAL should be improved in the two following perspectives: firstly, when SERVQUAL is used for service quality evaluation in different service

sectors or industries, it is necessary to moderate the individual questions to meet the service characteristics of that corresponding industry; secondly, the structure of the 5 dimensions should be adjusted, added or subtracted, and their names should also be modified to suit the specific service type or environment of the service sectors. PZB personally adjusted the two dimensions, tangibility and assurance in a study conducted in 1991.

b) SERVQUAL applicability

After being proposed, the applicability of the SERVQUAL evaluation method has been questioned on a wider perspective. For example, in cross-industrial applications, Carman [21] pointed out that although the SERVQUAL scale was initially designed to be applicable to all service industries, relevant modification have always been a requirement in accordance with the service sector. This means that indicators need to be appropriately increased or decreased under different scenarios. Carman also envisaged that, in most industries, service quality may not necessarily fully characterize the five dimensions of SERVQUAL, i.e., reliability, assurance, responsiveness, empathy and tangibility. The number and category of service quality dimensions will vary depending on the categories and needs of individual industry. Finn and Lamb [47] found from their empirical research on retail stores that the five dimensions of the SERVQUAL scale and the measurement framework of the 22 indicators may not suit the retail industry. Thus, further postulated that the SERVQUAL scale should be revised and modified for evaluating service quality across different industries and enterprises. Based on an analysis of data obtained from different industries, a considerable number of changes in the dimensions of SERVQUAL were proposed. Babakus and Boller [12] applied the SERVQUAL model to gas companies and postulated only one dimension for evaluation of service quality; Bouman and Van der Wiele [13] applied the SERVQUAL model to automotive service industry and postulated 3 dimensions.

In cross-cultural aspects, by considering customers in developed and developing countries as research objects, Malhotra [118] studied the determining factors of service quality of UNIQUAL in more detail and found that there are differences in customer's perception of service quality across different countries. Winsted [187] conducted researches on how customers of the United States and Japan evaluate service contact questions. Based on the research results, she puts forward a model and specific measure indicators on service quality for customers in both the countries and insisted

that cultural differences should be incorporated whilst evaluating service quality. With an emphasis on the role of culture in the formation of customer service quality expectations, Donthu and Yoo [42] stated that both the general service expectation of customers and each dimension in these service expectations are strongly influenced by cultural differences. In other words, cultural factors must be considered when measuring service quality. Mattila [117] and other academics have also conducted researches on the cross-cultural applicability of SERVQUAL, and presented similar conclusions. Based on Hofstede's cultural value orientation dimension and the SERVQUAL method, Furrer et al. [48] investigated the relationship between cultural value orientation and service quality perception and found that cultural value orientation of customers determines their perception of service. For instance, customers from different cultural backgrounds vary greatly in their way of prioritizing the importance of five dimensions for service quality.

Some scholars in China have conducted studies on the cross-cultural applicability by introducing SERVQUAL into Chinese application scenarios. Wei Fuxiang and Han Jinglun [197] have studied the cross-cultural applicability of SERVQUAL, and put forward a series of conclusions, for instance, there are differences in the service quality perception of customers with different cultural backgrounds, and so on. Chai Ying [32] empirically analysed the impacts of customer's cultural value orientation on service quality evaluation, and found that, if the customer's cultural value orientation is different, then his/her evaluation on a service is different, so service enterprises are required to formulate corresponding strategies according to the customer's cultural value orientation. Based on Hofstede's cultural dimension and the SERVQUAL method, Chai Ying and Wei Fuxiang [33] constructed the cultural service quality index and found that customers with large power distance and collectivism have a higher evaluation on service quality while customers with small power distance and individualism have a lower evaluation on service quality, and customers with moderate power and collectivism or individualism have a general evaluation on service quality. Based on Kano's theory of 22 indicators in the SERVQUAL model, Shi Guohong, et al. [166] showed that the SERVQUAL model is not very convincing for the evaluation of library service quality in Chinese universities. The credibility of the SERVQUAL model has also been challenged in various perspectives. The SERVQUAL model is strongly influenced by the cultural background when it is applied in China. The model needs to be amended and added with some specific service indicators under the country's cultural background, in order to develop a native model to sensibly

evaluate the service quality of libraries in Chinese universities.

To sum up, it is necessary for the SERVQUAL model to be prudent for effectively evaluating the service quality for respective service industries. A wide range of researches have demonstrated that the five attribute factors with the 22 indicators determining the service quality cannot be applied without modification in different service sectors. Therefore, when the SERVQUAL evaluation method is applied to different industries or organizations, necessary modifications on the questions in the scale should always be made for the SERVQUAL model to dynamically adapt the respective needs of individual service sectors. Appropriate adjustments can be made to the five dimensions of service quality to meet the specificity of research under different types of organizations. While in cross-cultural application, the SERVQUAL model is strongly influenced by the cultural difference, and as customers from different countries have different evaluation methods or perceptions of service quality, the SERVQUAL model should necessarily incorporate such inter-industry and cross-cultural differences, particularly when applied for service quality evaluation in Chinese university libraries, and should increase/decrease the original dimensions and the indicators according to the specific service environment.

B. SERVQUAL correcting method

The SERVQUAL scale has been developed strictly in accordance with the psychological measurement procedures. It has high reliability and effectiveness, but the original SERVQUAL still has many defects and deficiencies. The SERVQUAL model has been verified and revised by several western scholars based on different research objects, and its reliability and validity has also been reassessed, along with presenting plenty of profound insights. PZB were also aware of the limitations of their model, and have carried out many researches successively, and constantly revised and perfected the SERVQUAL model through comparative analysis and also by exploiting the research results from other scholars.

In 1991, PZB [140] conducted a follow-up study on the basis of a creative research carried out in 1988, and further redefined SERVQUAL with application study by selecting five well-known corporate customers in three major Chinese industries (including a telephone company, two insurance companies and two bank companies) as samples. Firstly, questionnaires consisting between 1,800 – 1,900 questions were distributed to each company. Although the rate of recovery

was low, a large number of samples improved the reliability of their results. Secondly, they changed all the rhetorical questions into interrogative questions in the original questionnaire and modified some of the lengthy expressions into the more concise and defined sentences, which improved the speed and authenticity of customers whilst fill out the questionnaire, and also increased the convenience of data processing. Thirdly, they revised the mood of questions, for example, by improving the modal particles such as "should" to "would". The average score of customer's expectation for services is generally more than 6, from which it is clear that the service deviates from the customer's actual expectation level. This improved sentence pattern and mood reduces the impact on customer's correct judgment. The final research results show that the revised SERVQUAL evaluation method has a higher reliability and validity than the original scale. At the same time, some interesting findings have been obtained, for example, the importance of the order of five dimensions has remained the same in the three industries, and however the reliability is still the most important dimension. This might be due to the fact that the research objects selected are very similar and the difference between the service sectors is also insignificant. In addition, it has been found that there are certain crossover phenomena among the five dimensions, for instance, the crossover among assurance, reliability and responsiveness is relatively obvious, and the tangibility dimension can be separated into five sub-dimensions. It is also important to note that this amendment retains the two-column questionnaire, which measures the customer's expectations and perceptions respectively.

In 1993, PZB [227] made a theoretical modification to the model of perceived service quality gap, which is initially proposed by them in 1985. The modification is intensively reflected in the zone of tolerance which was incorporated into the model, especially the concept of expectation is decomposed and refined. Customer service expectation can be divided into two parts such as Desired Service and Adequate Service. The difference between desired service and adequate service was the customer's zone of tolerance. On this basis, PZB created innovations on the originally created gap model. The gap 5 in original gap model has been divided into two parts: First is the comparison between desired service and perceived performance, which is called as the Perceived Service Superiority Gap; and the second is the comparison between adequate service and perceived quality, which is called as the Perceived Service Adequacy Gap. A smaller perceived service superiority gap reflects a higher superiority in the service quality; while a smaller perceived service

adequacy gap reflects a higher adequacy in the service quality. The objective of narrowing down gap 5 is also divided into two parts from a management perspective, such as paying attention to the superiority of enterprise service and also considering customer's capacities for minimum service level. This is of great significance to the management as it helps to find the origin of service quality problems, thus enabling managers identify aspects with which the service and data can be monitored and managed. Meanwhile it also helps to pay attention to problems among customer's tolerance to service quality, thus identifying whether customers are unsatisfactory resulting from their "high expectations" or "lower perception". That is to say, first of all, it is necessary to ensure customer's satisfaction, and then strive to further enhance the quality, so as to eliminate the gap, solve problems with respect to critical points and provide direction for improvement in service quality in the future.

In 1994, PZB [141] again supplemented and expanded the SERVQUAL evaluation method based on their previous researches, which changed the SERVQUAL model in various perspectives. Firstly, they adjusted the original two-column questionnaire into three sets of questionnaires, including one-column, two-column and three-column questionnaires, and these three sets of questionnaires were integrated into their expected concept expanded in 1993, but the original 22 indicators were still retained, with only the expression of questions were shortened, and a 9-point system was employed. This change was mainly aimed to carry out empirical research and quantitative analysis on the concept of expectation and zone of tolerance proposed in 1993. The analytical paradigm of the difference comparison was still not abandoned, but more determined, although it has been criticized by many scholars. Secondly, they expanded the number of questionnaires once more, with over 10,000 copies, and conducted a statistical analysis on the difficulty level and error rate of questionnaire, which has not been found in previous researches. Finally, the research was mainly aimed to empirically verify the theory of zone of tolerance for service quality and to make extensive discussions on the management significance of the Perceived Service Superiority Gap (PSSG) and the Perceived Service Adequacy Gap (PSAG).

After being revised twice, the SERVQUAL evaluation method had important practical significance and application value at this stage of development, for example, an enterprise can conduct targeted adjustments and manage its service quality level by calculating the customer perceived service quality and the zone of tolerance, along with determining the position of its own service level.

According to PZB, SERVQUAL has more explicit application value, since individual perceptual performance score is easy to blur its management significance. Hence, enterprises either having failed to obtain accurate judgment on service level or having over-predicted their service quality level, and thereby ultimately neglecting the need of improvement, can be benefitted since the difference score of SERVQUAL is more conducive in finding current service defects and remedial measures. However, PZB also pointed out the defects of SERVQUAL, for instance, the direct measurement method is more effective in predicting the enterprise's service quality, but to identify gaps between quality services, there is no other effective method than SERVQUAL.

C. SERVPERF evaluation method

Cronin and Taylor [20] vigorously challenged SERVQUAL and put forward a service quality evaluation method to measure the perceived performance based on the SERVQUAL model and named it SERVPERF, acronym for Service Performance. One of the strengths of SERVPERF is that it replaces the difference comparison measurement method of SERVQUAL with the direct measurement of service performance, which is more convenient and practical. They critically analysed the advantages and disadvantages of SERVQUAL, and further revised SERVQUAL and SERVPERF through empirical researches, and postulated that the SERVPERF method is simpler, more practical and effective.

On the whole, SERVPERF is just a kind of an inheritance of the SERVQUAL evaluation method, and there are many similarities between them. For example, SERVPERF retains the service quality dimensions and their indicators of SERVQUAL, so that the five dimensions and 22 questions were still used in the questionnaires of SERVPERF. Besides, all contents and tone of questions have not changed to notable level, and even the proportion of interrogative and rhetorical questions was still the same to that of the original SERVQUAL model. But, the definitions of service quality and its dimensions were different from those of PZB. However, through careful analysis, it can be observed that SERVPERF has some innovations based on SERVQUAL, and the specific differences are mainly represented in the following three aspects.

Firstly, it is a different research paradigm. The SERVQUAL evaluation method is based on the gap analysis paradigm, i.e., service quality reflects the difference between the customer perceived service performance and the customer service expectation, and the formula is represented as

$SQ=P-E$ in the revised SERVQUAL model, and service quality is the product of the difference between the customer perceived service performance and the customer service expectation with an emphasis on each service quality dimension, and the formula is represented as $SQ= (P-E) * I$. PZB considered that this difference paradigm reflects both the characteristics of service quality and psychological processes of customer's service quality judgment. However, through empirical researches and based on research results from previous scholars, Cronin and Taylor [20] hold the opinion that it is unscientific to measure the customer perceived service quality and service expectation at the same time. One of the most important reasons is that customer's expectation for services at a given time may be affected by the previously accepted service, that is, customer's expectation at a given time is not the true expectation of the customer at the moment during which he/she accepts that service, and it may be the result of expectations accumulated in the past experience of service acceptance for several times. Due to this reason, Cronin and Taylor hold the opinion of evaluating the customer perceived service quality using the analytical paradigm of direct measurement, that is, customer perceived service quality is equal to the customer perceived service performance, its formula can be expressed as $SQ=P$ or $SQ=P*I$. Their empirical results demonstrated that SERVPERF is superior to SERVQUAL in terms of reliability and validity. It should be noted that, according to PZB's definition of customer perceived service quality, service quality should reflect customers' attitude, while in the measurement of customer's attitude, most scholars employed the direct measurement method, which also provides a strong theoretical evidence for SERVPERF to manifest its rationality.

Secondly, the statistical analysis technique of SERVPERF is different to SERVQUAL. The research methods used by Cronin and Taylor [20] for data analysis are different from those used by PZB. They [141] employed statistical methods such as factor analysis, T-test, partition validity, aggregation validity, etc. to compare the two evaluation methods in terms of credibility and validity. For example, in factor analysis, the reliability coefficients α of SERVPERF for four industries including bank, pest control, dry-cleaning and fast food are adopted respectively as 0.925, 0.964, 0.932 and 0.884, while the same of SERVQUAL are respectively 0.89, 0.901, 0.9 and 0.849. Therefore, it is obvious that the former has a higher reliability for each industry than the latter. However, in the total variance for factor accumulation interpretation, the percentages for the above four industries in SERVPERF are 41.1%, 57.5%, 42.6% and 29.1%, respectively, while the same for

SERVQUAL are 34.8%, 37.4%, 33.8% and 23.6%, respectively, thus, the former is superior to the latter. In addition, the SERVPERF is also better than SERVQUAL in validity.

Finally, SERVPERF is different in its depth of research contents. In the process of creating SERVQUAL, PZB specially discussed the relationship between customer perceived service quality and customer satisfaction as well as their repurchase intention, but unfortunately, they did not carry out any empirical research in any depth. Cronin and Taylor conducted a deep exploration of the correlation between three variables. According to PZB, the service quality firstly affects customer's satisfaction and then the satisfaction affects the repurchase intention. However, after the SERVQUAL model has been proposed, many scholars have found that PZB's viewpoint is wrong through empirical researches, and the appropriate relationship model is that customer's satisfaction firstly affects the customer perceived service quality. Cronin and Taylor [20] verified the correctness of PZB's view through empirical researches, and deepened their previous theoretical discussions based on the relationship among these three factors.

To sum up, the advantages of SERVPERF are obvious, especially when compared with SERVQUAL, as it can predict the trend of service quality better, and importantly it also predicts customer satisfaction and re-purchase intention, which is important managers to focus on customer satisfaction in order to retain customer. However, SERVPERF is, after all, a measure of customer service perception (performance) scores, so information on the service quality that can be provided is not as abundant as that of SERVQUAL, which, in turn, is one of the biggest advantages of SERVQUAL.

2.2.5 Study and discussion on service quality

This section discusses four aspects of service quality including connotation, composition, model and evaluation, and presents a general summary of relevant researches on service quality conducted both in China and overseas. Despite abundant research results, there are still several outstanding issues to be discussed and resolved in this context.

A. Composition questions of service quality. There is no doubt that the service quality is a multi-dimensional complex construct, and the division of its dimensions has not been concluded yet. However, the most classic conclusions are the two-dimensional (technical and functional) structure

from the Nordic school and the five-dimensional structure from the North American School, both these constructs have been recognised and respected by the majority of scholars. It can even be said that there have been no new progresses in research on the composition of service quality in the last thirty years. However, when applied to a specific industry, the need for necessary modification in the evaluation model has been realized. Furthermore, the psychological mechanism of customer perceived service quality is a very complex process, and if the multi-hierarchy of service quality is gradually accepted, this hierarchical feature should be taken into account when building the service quality evaluation model for a certain industry.

B. Cross-cultural applicability of service quality evaluation methods. In the past, cross-cultural problems have not gained enough importance in the methods of service quality evaluation. Researches in the context of cultural issues are also inadequate. Since the relatively mature evaluation methods at present are originated from the cultural background of developed countries in Europe and America, the adaptability of cross-culture should be taken into consideration when implemented locally. However, there is no authoritative research conclusion to prove the applicability of these evaluation methods in a cross-cultural scenario. Therefore, more empirical researches are required to determine the dependability of these evaluation methods in a cross-cultural universal environment and to identify the areas of necessary modifications in terms of the inherited evaluation dimensions.

C. Reliability and validity of service quality evaluation methods. Although there has been a large number of studies conducted to demonstrate the reliability and validity of these methods, some evaluation methods exhibited different reliability and validity when applied to different industries. No convincing conclusions have been reached yet to assist the selection of appropriate evaluation methods in a given industrial context for achieving higher reliability and validity. Since the evaluation methods might present distinctive ranges of reliability and validity, it is important to support the dependability of the evaluation methods for different service sectors with more empirical analysis. This may help to obtain a more universal research conclusion about the reliability and validity of the evaluation methods in cross-industrial applications.

D. Measurement of service quality. The difference comparison between service expectation and service experience has been regarded as one of the most effective ways to measure customer's

perceived service quality. However, with the deepening of research on service expectation in academia, the controversy over this method [141] is also increasing. It is undeniable that expectation has an important and even decisive impact on customers' perceived service quality service. When an enterprise gives excessive explicit or implicit service promises to customers, then customers will certainly have a very high expectation for the enterprise's service quality. However, when the customer is actually experiencing the service, he/she may reduce the perceived level of service quality, even if the quality of service provided by the enterprise is already high. However, the key to this problem is that it is difficult to measure an expectation since scientific measurement criteria are often missing, and so conclusions about dimensions of expectations are difficult to be drawn. Due to this reason, the SERVQUAL measurement method has been questioned by several scholars. Several scholars hold the view that, if a structural model of customer perceived service quality needs to be verified by empirical research without using the comparative paradigm, the research objectives can be achieved just by employing the perception method or scores directly, and it is also easy to deal with the process of statistical analysis. If the gap between customer perceived service and expected service needs to be understood, then it may be suitable to seek improvements using the comparative paradigm.

2.3 Theories Related to Library Service Quality

2.3.1 Connotation and composition of library service quality

A. Connotation of library service quality

The concept of library service quality comes from other disciplines, especially with references to the general definition of service quality from service marketing scholars. In the field of library information science, the library service quality is usually defined by scholars as the difference between the user's expectation and the actual performance of user perception (Calvert [16]). That is, service quality can be deemed as a tool that can reduce the gap between library user's expectations and actual perceptions. Many scholars around the world have defined the connotation of library service quality from different perspectives.

Coleman et al. [24] defined the library service quality as the difference between the minimum accepted value, perceived value and expected value of the performance level from customers in

terms of five dimensions including tangibility, reliability, responsiveness, assurance and empathy for services.

Wang and Shieh [188] defined the library service quality as the overall advantages for library service to meet user's expectations.

Nitecki et al.[129] believed that the library service quality is to meet or surpass customer expectations, or the difference between customers perceived and expected services.

Zhang Cunjuan [230] believed that the library service quality refers to the specific performance of service behaviours and service environments in the process of the library's application of resources to meet reader's demands for literature information.

Lu Xiaoping [113] proposed that the library service quality can be understood from two aspects such as the reader's perspective and the librarian's perspective, in which the former is called as an external service quality while the latter is called as an internal service quality.

B. Composition of library service quality

In the division of dimensions of library service quality, scholars' opinions are also diversified.

Through an investigation and factorial analysis of key users in 21 university libraries in Taiwan area, Chang and Hsieh [18] put forward 6 decisive factors for library service quality as competence, moderation, convenience, tangibility, communication and sufficient personnel.

Andaleeb and Simmonds [3] put forward that the dimensions for service quality of university libraries are composed of perceived resource quality, librarians' responsiveness, perceived librarian's competence, perceived librarian's behaviours and perceived library's overall appearance.

Majid et al. [119] determined that the most important dimensions for library service quality are collection, equipment and physical facilities through a questionnaire survey.

Through a literature review and a focus group interview, Martensen and Grønholdt [120] put forward that the key dimensions determining library service quality include electronic resources, thesis publication collection, other library services, technical equipment, library environments and personnel.

Nagata et al. [130] conducted empirical researches and obtained 4 dimensions of academic library

service quality such as service impact (individual), library as place, collection and acquisition, library as place (organizational).

Through focus group interviews and exploratory factor analysis, Jayasundara et al [83] found that library service quality attributes are composed of personnel services, architectural environments, collection and access, equipment and facilities, technology, service delivery and network services.

Considering a library of in a Pakistan University as an example, through focus group interviews and exploratory factor analysis, Awan and Mahmood [2] confirmed that the library service quality is composed of six dimensions including access, reliability, responsiveness, assurance, communication and empathy.

In references to the evaluation model of Danish library service quality, and by assessing the actual conditions of libraries in Chinese universities with a preliminary investigation of library users, Luo Man [114] put forward six dimensions of library service quality based on SERVQUAL, including electronic resources, printed publications, other services, technical facilities, library environments and librarians.

Based on an extensive literature and empirical researches conducted in consideration of the characteristic of Chinese libraries, Yue Jiangjun et al. [223] proposed a multi-dimensional and multi-tiered structural model for library service quality with an integration of technical quality and functional quality, in which the technical quality consists of two sub-dimensions including library environment and resource access, and the functional quality consists of three sub-dimensions including service emotion, service guarantee and service charm.

Based on user demand research, Wu Dongman [200] proposed that the dimensions for the research on library service quality include literature resources, convenience to access, environment and facilities, librarian and services.

2.3.2 Library service quality evaluation

A. Historical evolution of library service quality evaluation

In the work published by Shi and Wang [166] under the no.5 Issue of Journal of Library Science in China in 2009, Chinese library service quality evaluation is divided into three periods including

introductory period, growth period and evolution period. However, they have not explicitly stipulated the boundary for each period, and the specific time nodes are vague. Based on the above work, this thesis identifies the evolution of library service quality evaluation methods in four different stages as emerging stage (before the 1990s), exploration stage (1990-1999), mature stage (2000-2009) and development stage (2010-today). All such stages are comprehensively reviewed as follows.

Before the 1990s, the library service quality evaluation of business and academia was still immature and considered to be in an emerging stage. Some libraries have not adopted any specific concepts of library service quality. In general, the library service quality was evaluated by traditional evaluation method based on the library area size, collection amount, etc. Since 1974, Association of Research Libraries (ARL) evaluates the subscription library with the help of service data statistics. Such evaluation strategies keep expanding within the library service contents and has become a relatively extensive and complete evaluation system in 1995. Chinese library business has faced a rapid development since this reformation and opening-up policy. During this period, a wide range of researches have been conducted on library service quality. However, all of them remained in theoretical research and revolved only around the ideological impact. Most of them provided relevant suggestions appealing to improve the library service quality or quality level only from the aspects of value judgment. Similar to this scenario, collection amount, dwelling environment and personnel quality also served as the key factors to improve service quality, but scientific evaluation indicator system has not been established. Therefore, it is greatly affected by subjectivity in practical applications.

Since the 1990s, with the establishment and development of theories related to service quality in service marketing area, the library academic community started to pay attention to library service quality, and the quality evaluation method of profit making service department has been gradually introduced into non-profit organization department, and further the concept of library service quality was formally established during this period. During this period, library service quality evaluation received an ongoing controversy in academia. Performance evaluation (including input and output measurement) has been used to evaluate library service quality, and such evaluation has obtained objective data for libraries to prove their own service value. However, Hebert [64] discovered that the evaluation standard set in the library cannot demonstrate the goodness of the

library service from the user's aspect. Thus, this discovery appealed for occurrence of user centred evaluation methods. Whitehall [183] reviewed the library quality management documents and indicated that many evaluation indicators (such as service promptness, service convenience, etc.) were used by the library to "Listen to" the user's thinking. Pritchard [138] studied the academic library quality management and emphasized the importance of monitoring and meeting the user's demand. However, Quinn [143] completely objected the service quality model of profit-making industry to academic libraries. But, the relationship between target and method, staff and user in academic community is far more complicated than in the profit-making manufacturing industry. Quinn further argued that the academic libraries should use such models to serve the users without the need for narrowing the gap between direct expectation and perception, which can help the users with intelligence enhancement and individual development. Quinn further indicated that the information in professional library about user's requirements seems to be closer to the essence of service quality mode. In general, the library document research indicates that library quality evaluation has transferred from performance measurement initially focused on traditional input and output for measuring user feedback.

At the end of 1990s, some western libraries correctively applied technologies and methods from profit making enterprise to the libraries. Many scholars and institutions have achieved successful evaluation of the service quality with some modifications and innovation on the SERVQUAL model. The largest scale research plan for library service quality evaluation initiated by Association of Research Libraries (ARL) —LibQUAL+™ is very influential. In 1999, in cooperation with Texas A & M University Library, Association of Research Libraries (ARL) made alterations to SERVQUAL, and finally developed LibQUAL+™ scale which has a greater significance. This marked that the library service quality evaluation history has begun to enter into a more mature stage gradually by then. Since 2000, LibQUAL+™ has been widely used and continuously rectified, and gradually becomes the mainstream tool for library service quality evaluation in different countries. It still has powerful appealing and influence up to now.

However, along with the rapid development of information technology and the approach of new information era, the defect and deficiency of LibQUAL+™ begin to show up gradually. Especially since 2010, with the issuance of 3G and 4G licenses, opening up of national microblog and WeChat era and the popularization of smart phones, society has begun to fully embrace vigorous growth of

mobile Internet era, and mobile instant messages. In 2014, the mobile Internet has entered into a flourishing explosion stage, and the trend of vigorous development has been irreversible. Internet has totally changed Chinese living habits in the aspects of life, entertainment, shopping, education, medical treatment and other. This also has facilitated huge changes in the library service environment. Traditional service quality evaluation methods can no longer be fully applied in order to scale the demand under the new information environment, and the library service quality evaluation has started to enter a brand-new development stage. For university libraries, it is both an opportunity and a challenge.

B. Library service quality evaluation based on SERVQUAL

Library service quality research is still in the process of maturing. Among the evolution of the evaluation methods, SERVQUAL and LibQUAL+® are the most outstanding models. Since 1990s, libraries in European and American countries have started to focus on enhancing the library service quality with the help of relevant theories in service marketing domain. Many scholars and institutions have incorporated the SERVQUAL scale into library service quality evaluation and conducted applicability amendment and innovation research.

Humphries and Naisawald [65] applied the SERVQUAL model to libraries for the first time for evaluating the online search service of health science library based on the SERVQUAL model indicators. Hebert [66] documented the first academic dissertation in the context of SERVQUAL application in library as a place. She measured the user perception and expectation of inter-library borrowing service quality in 28 urban public libraries in Canada using the SERVQUAL model, in order to identify the correlation existing between the measurement tools and traditional measurement methods. This study found that mismatching is quite common between the library service and the customer measured service quality. Libraries measure the performance of inter-library borrowing service quality on the basis of supply ratio and cycling time, and customers measure the service quality using the gap theory.

Coleman et al. [22] attempted to apply the SERVQUAL model for evaluating the total quality management of library services and demonstrated its strong applicability. They directly adopted the original dimensions of SERVQUAL and its 22 questions, and investigated the readers with minimum acceptable value, expectation and perception, and then analysed the existing gap in

various dimensions through the zone of tolerance. Finally, it has been discovered that reliability is the most important service performance in the customer's mind, the same also needs improvement at a quicker pace.

Cook and Thompson [25] applied the standard SERVQUAL tool in the library domain, and analysed the minimum expectation, expectation and perception respectively, further sampled several dimensions. The resulted dimension was not consistent with the original SERVQUAL dimension, which again insists the need for necessary modification when SERVQUAL model is applied in the library domain.

Van Dyke et al. [180] conducted research on the applicability and effectiveness of SERVQUAL in the library domain. This research again showed that the original SERVQUAL should be amended the library domain. In a research on user satisfaction in university library, Andaleeb and Simmonds [1] discovered that the original 22 indicators and five quality dimensions can only explain 64% of the library service quality, and the original SERVQUAL cannot provide a complete evaluation of the library service quality. Carman [21] also indicated that the dimensions and factors of SERVQUAL were inconsistent when applied across different departments. Therefore, it has been suggested to formulate the SERVQUAL model for each different service department.

Although many scholars have raised concerns about the universality of SERVQUAL, it is still regarded as one of the most widely used library service quality evaluation methods. It is not only widely used in library service quality evaluation in America, but also widely adopted across the world. Based on a theoretical research on SERVQUAL, Nagata et al. [128] added a few technological quality indicators into the SERVQUAL model and obtained 4 dimensions of academic library service quality including service impact (individual), library as place, collection and acquisition, library as place (organizational). Velnamby and Sivesan [179] rectified the original SERVQUAL dimension and question and extracted four factors to evaluate the university library service quality in Sri Lanka after complicated factor analysis. The factors include convenient opening Chinese, timely information, rich collection and convenience of data acquisition.

Hossain[61] also rectified the original dimension of SERVQUAL (including 26 observation items), and investigated the library service quality of public university and private university in Bangladesh through disconfirmation pattern analysis, in order to analyse the service items which cause user

satisfaction or dissatisfaction. Malik and Malik [116] extended the SERVQUAL scale to 30 questions, adopted two-column test, conducted gap analysis on user expectation and perception for service quality in a public library in Pakistan, and discovered a significant difference in the grading results among different groups. Hossain and Ahmed [62] also postulated amendments for the questions in the SERVQUAL model, adopted a three-column questionnaire, and measured user's desired expectation, minimum expectation and perception. This study found that the previous gap analysis method deviates from reality, and so the concept of real service expectation has been proposed to offer new enlightenments in university library evaluation.

It is inevitably harder to determine whether SERVQUAL is suitable for all the service sectors or not (including the library). However, it is obvious that when SERVQUAL is applied to evaluate library services under different cultural backgrounds, even under the new information environment, the original dimension and indicators of SERVQUAL must be rectified to further improve its applicability.

C. Library service quality evaluation based on LibQUAL+®

In the library domain, LibQUAL+® has been regarded as the most thoroughly rectified representative of the SERVQUAL scale. Based on four different large-scale applicability tests conducted during 2000-2003, the initial scale was rectified and perfected effectively, to form LibQUAL+®, (as shown in Table 2-5) which is composed of 3 core dimensions and 22 measuring indicators. The 3 dimensions include effect of service, information control and library as place respectively, which basically cover all the aspects of library service quality. Thereafter, it remains unchanged, and it has been proved to exhibit strong applicability for library services.

LibQUAL+® is an evaluation method or tool used to “Listen to” the user’s opinions and is also known as “Total market survey”. LibQUAL+® is triggered by at least three types of cooperative relation: firstly, between ARL and Texas A & M, secondly between all the involved libraries and their staff and thirdly thousands of users who always provide value feedback. LibQUAL+® is mainly established under the leadership of Cook and Heath from ARL and Texas A&M University. Initially, LibQUAL+® served as an experimental project to evaluate the library perception service quality and was initiated in 13 member libraries of ARL. With an inspiration from capital fund, LibQUAL+® has been developed rapidly, and 20,416 users from more than 43 universities have

participated in the network questionnaire. Through a reliability and structural inspection of the collected questionnaire scores, four basic dimensions that constitute user perception library service quality were obtained, including effect of service, individual control, information access and library as place. These dimensions have effectively solved the incompatibility problem of traditional library service quality evaluation in SERVQUAL.

Table 2-5 Evolution Process of LibQUAL+[®] Scale Dimension

Year	2000	2001	2002	2003-2014
Item	41 questions	56 questions	25 questions	22 questions
Dimension	Effect of service	Effect of service	Effect of service	Effect of service
	Library as place	Library as place	Library as place	Library as place
	Reliability	Reliability	Individual control	Information control
	Collection resource	Autonomy	Information access	
	Information access	Information access		

Source: analysis of the research

Later, LibQUAL+[®] has been used to conduct large scale tests in libraries except for ARL. After a series of iterative process of qualitative and quantitative methods, the LibQUAL+[®] version executed in 2003 further simplified the original four dimensions into three dimensions for the purpose of measuring three basic aspects of library service quality including effect of service, information control and library as place. Therein, individual control and information accesses were merged into information control, since large number of users cannot accurately distinguish the contents (information access) and entrance mechanisms (individual control). In 2003, 300 libraries participated in LibQUAL+[®] application. Some libraries in Britain conducted a comparative analysis between LibQUAL+[®] and other local evaluation methods and believed that this project can provide useful evidences to improve library service quality in British environment through reliability and validity analysis. This finding has also been confirmed in German, Swedish, Japanese and other language environments. In other words, when English version (no matter American English or British English) of LibQUAL+[®] is translated into other languages, it can exhibit effective applicability. The empirical test demonstrated that cross-cultural translated version has the same credibility and effectiveness as the original version, and the three dimensions of library service quality can also be adequately supported in dynamic scenario. Until 2009, LibQUAL+[®] has been translated into 17 different languages, and has been applied in 19 countries, including Finland, Canada, Japan, Germany, Thailand, Malaysia, Israel, etc. The summary of empirical research results

in other countries indicated that the evaluation dimension of library service quality has exhibited extensive similarity.

From 2003 to 2013, more than 200 libraries have participated in the annual survey of LibQUAL+[®] every year, obtaining more than 100,000 users' feedbacks from the survey, and more than 50,000 users have provided valuable comments on their library usage.

Therein, effect of service refers to the personnel interactive dimension about service quality, including empathy, responsiveness, assurance, reliability and other aspects; information control has been used to measure the scope of library service contents from the information resource contents and acquisition perspectives including convenience, easy navigation, promptness, equipment availability and reader autonomy of information service; library as place presents information about how the library satisfies the user's personalized demand, and measures how to perceive its physical environment in practicability, utility, symbolism and other aspects. The biggest disadvantage of this scale is that it is produced and evaluated only in developed country environments (Ladhari and Morales, 2008).

LibQUAL+[®] is a complete set of service. Libraries can use it to ask for, track, understand and conform to the user's perspectives on service quality. Such services are provided by Association of Research Libraries (ARL). The core of this scheme is a strict test on the basis of networking. It can help the library to evaluate and improve the library service, to change the organization culture, and to improve the public praise of library services. Since 2000, more than 1000 libraries around the world have participated in the development and perfection of LibQUAL+[®], including academic library, community college library, health science library, academic law library and various other public libraries. Currently, LibQUAL+[®] has been extended worldwide with more participating organization throughout Asia, Africa, Australia and Europe. It also has an independent specialized website <http://www.libqual.org/>, which is aimed at cultivating an excellent library service culture, helping the library to better understand the library service quality of user perspective, collecting and understanding the feedback from library users systematically in the long term, providing comparable evaluation information for the library from the aspects of peer institutions, confirming the best practice of library services, and improving the library staff's analytic skills for data explanation and processing.

2.3.3 Library service quality

The concept of customer service and customer awareness service quality in the field of service marketing can not only be applied to business enterprises, but also can be suitably applied in other organization. In the traditional evaluation methods, the collection and size of libraries are generally considered as the major evaluation standards. However, such methods are obviously no longer suitable for the environment of current libraries (Nejati and Nejati, 2008). Due to the increasing footstones of teachers and students in scientific research, library service has become an integral part in education quality chain. Thus, libraries are not only to serve the people works in the universities, but to serve the personnel served by them.

In addition, it is noteworthy that some high-quality thesis about library service quality published internationally are mostly from the developed countries. Uzun [177] has accumulated all the thesis published by 21 core Journals in the field of library and information science from 1980 to 1999. This study showed that only 7.9% among the 14,400 published theses is from the developing countries. Similarly, Jain and Gupta [84] also discovered that few scholars in developing countries had relatively influential achievements in service quality measurement scale research. This thesis also found that only a few of the previously published works have author affiliations from developing country (including India, Nigeria, Bangladesh, Iran, Malaysia, Pakistan, etc.). Thus, it is evident that most of the library service quality evaluations are still mainly focused in the developed countries. Notable number of research works on library service quality is also being published in Chinese library and information Journals in the recent years. Therefore, there is a certain disparity between China and other developed countries on the whole.

2.4 Summary

Reviewing the history of service quality research, theories on service quality evaluation are centred on customer awareness service quality based on a principal method of distance analysis paradigm, and the main contents of such theories are composed of service quality connotation, structure, and model and evaluation research. As an important area in service quality research, library service quality has obtained rich research results, and a relatively mature evaluation framework system has been developed. However, the service quality research under new information environments is still

in its development stage, and the issues prevailing in this context demand a prompt solution with respect to connotation, structure and evaluation problems of E-commerce service quality and mobile commerce service quality, and a systematic theory is yet to be formed. Under the new information environment, the university library service quality is entering into a new horizon and provides an extensive research space. With an absorption of and reference to the existing service quality theories, library service quality theories and other theories, this research carries out a systematic research on university library service quality evaluation based on a character analysis of the new information environment, in order to further enrich the evaluation framework for evaluating the university library service quality, and provides important reference values to help universities to achieve efficient library service quality.

Chapter 3: Service Quality and Connotation

Attribute of Perceived Service Quality

3.1 Service in University Library and Its Users under new Information Environment

3.1.1 Overview of new information environment

The new information environment is taking a different dimension from the traditional information environment, with the rapid development of information technology, especially the changes witnessed in the communication technology and mobile technology, information environment is not just limited to computers. The concept of the new information environment emerged very early and had different views on its connotation and characterized novel features than those of the traditional information environment. The new information environment under this study refers to the information environment that involves new information technology and its applications, such as pervasive computing, cloud computing, 3G or 4G networks, Wi-Fi, TR code, intelligent terminal, micro service, cloud storage, mobile APP, associated data, virtual desktops, and so on, and the term 'new' is mainly reflected in the new network environment, new technology environment, new resources and new information demand environment. These new changes make the new information environment to characterize digital, pervasive, interactive and personalized features.

Digitization is the main environmental feature of the information era, in which people's lives are completely surrounded by digital entities such as computers, mobile phones, tablets and other terminals. This also leads to the digitization of the information content; thus, the traditional information resources are digitalized and are usually presented in the form of lively writing, pictures, sound, video, with the objective of effectively conforming user's consumption demands and habits. In addition, the new information technology makes both information subjects and information objects to be ubiquitous, including the types of information resources and their generators, information recipients, information receiving terminals, user's information demands, user's information behaviours, user's information applications [1]. This makes the information

services more efficient, which has long been constrained by both space and time. At the same time, interpersonal interaction among people has become more weakened over this development, and the human-computer interaction gradually became the mainstream, that is, many services are independently completed by users through technical intermediaries. Human-machine interaction has a wide range of interactivity, including but not limited to the interaction between users and service systems, the interaction among users and online service personnel, between other users and the service personnel of third-party providers. The characteristics of individuality are usually the features of the human demands and behaviours granted by the new environment of information, mainly in four aspects including the intelligent tendency, various carriers, and context-awareness and user adaption. The intelligent tendency describes the user's concerns about the information or knowledge that can solve the problem at any time anywhere; various carriers refer to the user's access to the information through highly diverse means or terminals, context-awareness refers to the new information technology which can perceive the context of user and provide appropriate information or services, user adaption refers to the new technology which fully integrated and adapted human cognitive structure, which makes use of user's cognitive behaviour and context as well as other knowledge to dig out the user's internal needs and service information.

The characteristics of the new information environment had profound impacts on the library service and its users. The university library has become the new information resource centre, where the processing and organization of literature resources are more diversified; and thus user's information needs, behaviours and capability should also follow the changes of the new information environment.

3.1.2 Service changes in university libraries

A. Changes in service modes

The development of information technology has changed the way of service offerings at the university libraries. Such changes at the university libraries are tremendous and can be witnessed from different perspectives. The first is the depth of informationisation. The digital library in China has undergone developments both digitization and informationisation, in the aspects of library portal websites, subject information portals and other service with obvious information characteristics. Especially with the development of new information technology, the

informationisation of university library services have become more obvious, and the depth and friendliness of information services have also significantly improved. Second development perspective is the degree of ubiquitous. In a traditional library environment, most of services are intrinsic centralized at the location of the library, but the services in the digital library helps the services to reach out to the localized environments of users, for instance students in the dormitory or teaching classrooms can access to library services through hand held mobile terminals anytime anywhere, such an anytime-anywhere paradigm has a major impact in the development of digital library services. Third is the enrichment of user experience, the university library services are paying more attention to individual user experiences, by the way of providing pertinence service in order to users to maximize user's satisfaction and loyalty. Thus, the new information environment is user oriented and aims to provide users with the best service possible, therefore the university library should have the supplements of providing diversified information services, so as to provide ubiquitous "On-demand" services of the new information ecosystem, in order to constantly optimize the service experience of users.

B. Changes in service function

The service function of university library has also changed significantly, mainly in the following aspects. Firstly, the transformation from library management to knowledge management. Under the traditional environment, the management of books in the university library mainly includes collection, classification, cataloging, shelving and so on; this process can be viewed just as a preliminary combination of knowledge. This traditional library management function has been gradually transformed into knowledge management function, such that the manual classification and cataloging have been replaced by automation, with which librarians only need to master the technology and can quickly identify and manage the literature resources. The second is the transformation from possession and collection of resources to access of resources. In other words, libraries can exploit information technology to share resources to and from other similar libraries or other providers of information resources, this offers users with a wide range of resources to access not only in their own library but also the resources from other libraries. This new access mode determines the service capability of the university library; such transformation is of a greater significance to the digital libraries. The third is the transformation from knowledge dissemination to knowledge creation. University libraries played the role of knowledge dissemination for a long time.

But, in the new information era, this function is gradually infiltrating into the upper stream of the knowledge value chain, through the way of processing, integration and transformation of knowledge. Such a knowledge development and creation function includes textual analysis, information visualization, and large dataset mining, and so on. The fourth is the transformation from information development to intellectual development. The main purpose of information development is to provide users with new information services or products, and intellectual development is to improve the user's knowledge and creativity on the basis of providing the information services. When the university library plays the heart of school knowledge, it should also have the educational function at the same time; meanwhile in the provision of information services, it should cultivate user's intelligence.

C. Changes in service form

Under the traditional environment, the service form of university libraries can be simply summarized as book service or literature service, and the service activities mainly involve borrowing and returning of books and literature. However, with the development of information technology, user's needs are no longer confined to simple borrowing and returning of books, the bottom line is that users are no longer required to sieve their desired resources from massive amount of available literature. At the same time, the role played by the library has also changed such that librarians are performing the role of provisioning knowledge to users rather than provisioning just books. This knowledge service of university library is more prominent, with the important focus being the subject service. Subject services emphasize that the university library should deeply penetrate into the user's environment and provide direct support for user's researches and should centre on user's needs using the new information technology, and should provide user with the knowledge-based, subject and professional services, so as to enhance the scope and depth of services. This helps improving the efficiency and effectiveness of library information resources, promoting the dissemination of information and knowledge flow.

An important feature of such new form of knowledge service is the change in the user's passive acceptance of services in the library, which is replaced by an active form of push service overcoming the constraints of time and space. The new information technology improves the remote service capability of university library and makes the "position only service" of university library gradually weakened, so that the library services will be completely free from the constrains

of time and space, this ubiquitous service form will enable the university library services to be truly unleashed. In addition, the knowledge service form of university library also focuses on the transformation from traditional education of information literacy to education of intellectual accomplishment. In comparison with the information literacy, the intellectual accomplishment puts more emphasis on making use of new information technology to allow users to integrate, utilize, evaluate, transfer and share the information, and drives intellectual production, transformation and innovation during the process. Beyond just driving educational revolution and user's intellectual accomplishments, such functionalities and characteristics of university libraries directly reflect their pride and prestige in the society. Professor Zhu Qiang [246], the curator of Beijing University Library, pointed out that the form of the university library will change, such that library premises are no longer important for the readers, and the modern library system will soon lead to the emergence of several storage centres with substantive amounts of documents, datacentres of digital resources, service centres for provisioning of shared resources and software supplements for enabling such services. Given the fact that collection of resources is no longer important, user's needs will shift more towards software tools to effectively deal with the digital collections in order to extract efficient and effective utilization out of the digital resources. To this end, the roles of library and librarians will be regarded as creation and distribution of resources, and enabling teachers, researchers and other readers to make better use of these "collections" .

D. Changes in the role of librarians

Under the traditional environment, the roles of university librarians are mainly to collect, collate and protect the literature resources, as well as to provide users with borrowing, reference services, etc. With the development of network technology, the role of librarians has begun to be diversified and specialized, such that librarians not only need to manage the collection of thesis, but also should focus on time management in order to make use of the development, utilization and maintenance of network information resources. The roles of librarians have undergone some new changes over the years. For instance, librarians will be no longer only the organizers of information resources, but also be the management experts of information resources, thus librarians should have the capabilities of information screening, selection and filtration, so as to provide users with more valuable information resources to meet the growing information needs of users. The emergence and development of virtual (digital) services has also put forward the new requirements to librarians,

especially with the impact of new information technology, the embedded reference service has attracted much attention. The interaction between the librarians and users will be continuously transforming from the face-to-face desk services to virtual reference services, using the new information technology. The embedded reference services will be incorporated between librarians and users; for example, librarians embed the information technology into user's heterogeneous environment, and provide personalized reference services based on the needs of individual users.

The traditional service capabilities already held by the librarians are just not enough for them to adapt to the requirements of the new information environment, thus librarians need more knowledge and skills, including library and information science, management science, social science, computer science and other relevant knowledge and skills. More importantly, the information behaviours of users are more mature under the new information environment, which introduces new challenges to the librarians, such that librarians must keep abreast with time and evolution of latest knowledge and skills of information services. For example, librarians should be able to use new social software to build the virtual community with users [2], such as Blog, Podcast, RSS, Instant Messaging, Wiki, Vodcast, Web Conferencing and QQ, Micro-blogging, WeChat, etc.; only by taking advantages of these new technologies, librarians can better play the information service roles for availing better services for users.

3.1.3 Changes of information needs, behaviours and capabilities of users

The new information environment not only affects the development and innovation of the university library, but also has a very sharp influence on the changes in the information demand, behaviour and the capability of users, and these changes need to be paid attention by the university library. The library curator of Beijing University Zhu Qiang [246] mentioned that the new information technology and its applications continue to affect users such that users may generate more demands and needs; and change and improve the users' behaviours and capabilities. If libraries cannot keep up their pace and adapt to changes in the user behaviours and capabilities, libraries may easily lose their users and may face the crisis of survival .

A. Changes in information needs

With the rapid development of mobile technology, user's internet access environment has been

greatly improved. At the same time, intelligent mobile terminals are becoming more and more popular, and the mobile internet applications (APP) and their contents are becoming richer, and user's information needs have also undergone significant changes in various perspectives. Firstly, the increasing demands for free information. Internet is full of massive amounts of free information; users naturally produce ratcheting effect on free information, and shrink back at the sight of charged information. Now, the Internet is characterizing a lot of open access and publically available resources, including many open access journals, free databases, and such information has brought with much convenience to users, however some high-quality information is still being charged. Since users are more accustomed to the free access resources, such pay to use resources are often more difficult to accept in the psyche of users. At present, many periodical literatures of university library are still charged, which is incompatible with users' dependence on the free information, therefore demand for such resources will become increasingly higher. The second is the change in the space requirement of information. From the perspectives of users' psychological needs, users naturally hope to obtain the desired information at the discretion of minimum effort, so the demand to gain access to information nearby or from their own environments has been the preference of users. With the increasingly mature electronic services of library, the requirements for remote or mobile access to the library information resources will become increasingly intense; getting the resources closer to users would certainly help the libraries to satisfy the user needs. Third is the change in time requirement for information, the users' time requirements of access to information will be increasingly higher. Even at the discretion of zero-time difference, users always have a desire that their requirements are satisfied at the first service attempt, or as soon as their resource requests are sent, regardless of their place, location and type of requirements. The declining time tolerance of users puts forward new challenges for university library services, university library should actively accept the new information technology to resolve the time delay issues of information services, so as to meet the user's time requirement. The fourth is the demand in the change for information tools. With the development of mobile technology and the popularity of mobile terminals, it has become a reality that users obtain the information resources of university library through the smart phones, tablet PCs, electronic readers and other tools. This development of new information technology will enable users with the access to information through more diversified medium, and at the same time, the demand for information acquisition tools will also become more diverse. The fifth is the change in the content requirements of the information. Under new information environments, users will

become more critical about the information content, and are no longer limited to unitary information service. Traditional borrowing services of university library will face more challenges in meeting the users' needs of information under the new information environment. In addition, users' demand for more diversified information will become increasingly intense. Therefore, to the traditional services, users' demand for provisioning of more electronic services, image services, audio services, digital services provided by university library will be increasing. In particular, visualized performance will be more in line with the user's demands for information content, such services should be easily assimilated and understood by users.

B. Changes of information behaviour

Information behaviour is a series of information actions or activities produced by users in order to meet their own information needs; it contains many aspects, such as information perception and expression, information search, information selection, information using, information integration and information exchange etc. The user's information behaviour generally follows the "minimum effort principle", that is, obtaining the required information at the minimum cost in terms of time and space. This information behaviour of users mainly has changed in four aspects. First is the change in the user's cognitive behaviour. Given the fact that users are developing trust with the libraries in terms of getting their desired information, the role of university library as an information centre has undergone subtle changes. Factors including longer Internet access time, lower cost, and user's trend of easily relying on the network information will naturally lead to an indifference in the cognitive attitude of users towards the university library. Although the construction of digital information service in university library has been very effective, the majority of users and the information research do still not recognise it, and users have already surpassed the integration capabilities of many librarians. The significance of the role played by university library is reducing in the information era, even the opinions of information experts on the library has gradually become blurred in users' mind [3]. Second is the change in the search behaviour. In the past, most users have searched for information through the librarians, but now users are mainly obtaining the information through the various types of search engines. With the innovation and development of search engine technology, integrated with other technological advancements such as social media, videos, download of software applications and other types of information, development and launch of new search products, users become more dependent on the search engines due to the

improvements achieved in search accuracy, enhancements in user experiences and the newly achieved series of initiatives. Challenges always coexist with the opportunity and developments; the university library should embrace the new technology and should develop academic and information search engines, subject portals, toolbars, etc., to meet the features of services required by teachers and students of university, ultimately to attract more users through effective marketing tools. Further, the search experience of users should be continuously improved in order to retain a positive reflection of the library services among the users. Third is the change in the consumption behaviour. Users' viscosity of information access channels or tools to obtain information is decreasing and the time tolerance among user whilst obtaining information is becoming increasingly lower, and the consumption behaviour of information is getting more and more impatient. For example, the reading habits of teachers and students of university library in scientific research have changed, such that they would like to skip through the academic web sites, thus the average time spent on electronic journal websites is very short since users often tend to quickly scan through the titles, summary and textual sections. Next, users are now developing the trend of generating their own contents, thus users are considered as both recipients and providers of information. Fourth is the change in the reviewing behaviour. Mobile reviewing has become the main form of users' reviewing pattern, more users read the e-books or resources through the (mobile) networks, whereas the number of users read the resources in the traditional way is gradually decreasing.

C. Changes of information capability

First is the improvement in the cognitive ability. Information cognition is the basis for users to generate information; information cognition includes the understanding and mastery of information resources, generating process, transferring process, accessing process and so on. Through the process of information cognition, users generate sensitivity and consciousness on the information, so as to determine whether the information is useful or not. The user's capabilities of information cognition have been significantly improved, especially the selecting ability of users from massive amounts of information, by easily filtering out useless information. The change in the user's cognitive ability of information makes the information services provided by the university library more stringent. Second is the improvement in the information search ability. With the network information resources being enriched every day and the search engines and relevant tools are

becoming more popular among users, user's searching ability of information has been greatly improved, which brings an end to the user's dependence on librarian for retrieving their desired information. In fact, the information searching capabilities of many users are even superior to the librarians of university library. Third is the improvement in the processing capacity. The development of new information technology has given birth to a lot of tools and technologies of information management and knowledge management, including artificial intelligence technology, database technology, multimedia technology and various literature management tools. With the outreach of information technology, the ability of users in using these tools and technologies has been greatly improved. Fourth is the change in the sharing capability, the ways of information dissemination and communication are becoming more and more diversified; these include a variety of instant messaging tools, social media, so as to make the dissemination and communication of information to be quicker, also to accelerate the communication of dispersed places, and break the geographical and time constraints. Because of these changes, user's information sharing capabilities have been greatly improved. Under the current environment, digital services of university library have not exploited user's capabilities and a lot of information resources are still facing certain restrictions on use, which is slowing down the progress of libraries in terms of achieving effective sharing of resources.

3.2 The Impact of New Information Environment on Service Quality of University Library

3.2.1 The impact of new Information environment on users' expectation of service

The comparison between service expectation and service perception has been regarded as one of the most effective methods to measure the quality perception of customer service. The prerequisite of the influence of new information environment on service quality of university library is the users' expectation and perception of service. Expectation is an extremely important concept in the history of Western marketing research and it is one of the important factors affecting people's satisfaction. Oliver [131] systematically studied the concept of expectation in the field of service marketing and put forward the famous Expectation Confirmation Theory (ECT), to study the impact of expectations on consumer satisfaction. In the mid-1980s, the well-known American service quality

management expert Parasuraman and others made further developments on the theory of customer perception of service quality and put forward the theory of Service Quality Gap Theory (Gap Theory). In general, a higher expected value reflects on a lower value on the perceived service quality, and vice versa. Therefore, it is of great significance to fully understand the impact of the new information environment on the expected services, perceived services and users' evaluation of service quality of university library. Enhancements in the service quality of library, and rapid development in mobile digital technology and network service technology, all have enriched and deepened the service contents of university library. Meanwhile the hierarchy of user's needs have also gradually increased, thereby increasing the expectation of library service quality among users. New information environment changes witnessed in the communication technology and mobile technology, information environment is not just limited to computers. Taking the electronic literature database of the library as an example, the construction of the digital service of the university library have demonstrated an rapid increase in the users' demands of the research databases as well as the quantity and quality of collected periodic thesis, dissertations, conference thesis, professional book ,etc. Especially the expectations for access to free documents have increased rapidly. In addition ,the new mobile information technology(Ubiquitous technology) provides more possibilities for effective services in the university library. Under 4G environment, users tend to use mobile phone to search required documents firstly rather than to search at library. At present, most University users' tend to be 90's generation, they are quite familiar with these new technologies and often expect the library to provide matching services. But in fact, many university libraries are facing difficulties following the developments of new information technology, and are also subjected to budgetary pressures, therefore it is difficult to provide services which effectively complies with users' expectations, especially cannot satisfy the instant search service. Besides these objective factors which affect the user's expectations, the subjective personnel services will also have an impact on user's expectations. Users may expect the capabilities of university librarians to be qualified for new information technology and information service, and such expectation should be satisfied in the new information era.

3.2.2 The Impact of new Information environment on users' perception of service

The resources, services and facilities of the university library adapt a distributed state under the new information environment, which makes the perception of the university library services more

complicated. Such complexities mainly manifest in the digital resource services of the university library. Under the traditional environment, user's service perception of the university library mainly revolves around the collections of resources and the librarians. But the degree and the area of user's perception usually characterize a higher expectation for digital collection and services under the new information environment, which increases the complexities of the service perception of libraries.

The recent development in the mobile technology has changed the way of users accessing the university library services. Trends in accessing university library services have become more diversified and ubiquitous, in such a way that users can access the library's digital services at anytime from anywhere. But this ubiquitous nature of university services is impacted by a wide range of heterogeneous factors such as the nature of the university library, network operators, mobile equipment manufacturers, information portal providers and so on. To this end, users are also affected by the service perception of university library, thereby impacting user's judgement on university library services.

The university library service process values user's self-determination and self-services, whereby users obtain services by interacting with the information system via intelligent devices. This way of accessing services from users is different from the traditional face-to-face interaction with librarians. Digital supplements greatly improve the service efficiency of university libraries. In the field of service marketing, the process of service interaction is termed as service contact or "Interactive instantaneity". Service contact is fundamental for customers' perception, and customers usually form their perceptions and attitudes about the service quality in the process of service contact. In the past, university library services characterize a higher level of contact service, in terms of face-to-face interaction between users and librarians. But modern-day libraries characterize a lower level of interaction between users and librarians achieved through digital communication. Both the type of user interaction has their respective impacts on users' service perception of the university libraries. Services based on the lower level of contact usually incur more problems of service complaints and service remediation, and often the service librarians cannot provide suitable remedies for enhancing the service efficiencies, which directly affects the user's perception and judgment of the services.

The lower level service contact process may have favorable impacts on consumers' service

perception of university library; it may also promote the library services and create the opportunities to enhance the users' identification of suitable services. This is due to the fact that the subjective judgements of user's perception on service librarians can be reduced by standardization and binding between users and librarians. Further, tangible services, techniques and system quality are the main criteria impacting users' perception of library services. In this sense, users' service perception of university library services depends more on information technology, electronic resources and other objective elements of services, so that users' perception is more likely to become rational and objective, thereby improving the stability of users' service perception of university library services, this may enhance the users' service recognition of university library. While the importance of user's perception of response, reliability, empathy and other dimensions of service quality of university library have been the focus under the traditional environment, the importance of perception on trust, security, expertise and other factors have been given more consideration under the new information environment.

3.2.3 The impact of new information environment on the quality evaluation of university library's service

As mentioned earlier, the new information environment has impacted the user expectations and perception on service quality of university libraries. The existing quality evaluation system of library service is not efficient enough to fully adapt to the requirements of the new information environment. Traditional evaluation indicators mainly focus on the traditional service content and service mode of the university library, and the attention to the quality of digital service is in suffice and rarely involves mobile digital information service content and quality issues. With the deepening of the new information environment and its impact on the service of university library, it is important to incorporate novel indicators for the evaluation of service quality of university library, along with adopting novel methodologies of service quality evaluation.

At present, digital services offered by Chinese university libraries are availed by third parties and then packaged for use by local users. Such phenomenon is popular not only in Western countries but also in China. Because university libraries cannot make and provide all of the related services by themselves. For example, Wanfang Data, a leading information contents provider in China, cooperates with most Chinese higher education institutions. This company focuses on digital

resources, such as journals, dissertations, conference proceedings, patents, standards, Chinese companies, providing information on Chinese studies, TCM (Traditional Chinese Medicine), Chinese Business, Law, Government, Defense, Military, Science, etc. From this perspective, libraries just play the intermediary role in the service provide process. In this case, when users evaluate the service quality of university library, besides the evaluation of the library's digital services, users are more likely to evaluate the service quality of third party service providers, such as forementioned Wanfang Data.

In the context of the evaluation indicators of university library services, previous library evaluation tools such as SERVQUAL and LibQUAL+® mainly evaluate the attitude and skills of service librarians, and the physical environment of the library, and the indicators relevant to information technology have not given enough importance. The evaluation content of university library service should focus on information technology, system platform, interactive interface and other human-computer interaction content, and should appropriately reduce the evaluation of interpersonal interaction and the physical environment of the library. Such an interaction of users is often interpersonal, and mainly achieved through the platform of library system using a variety of social media technologies. Thus human-computer interaction needs more focus on the service quality evaluation of libraries in spite of increasing user participation. However, until now, the study of quality evaluation of interpersonal (human-machine) interaction among the library users has not gained enough attention from researchers[144].

3.3 Connotation Attribute of Perceived Service Quality of University

Library

3.3.1 The formation mechanism of perceived service quality of university library

A. The formation basis of perceived service quality of university library

Chapter 2 presented a systematic review of the connotation of service quality; most scholars define and measure the quality of service in the "customer-oriented" paradigm. Customer's expectation of service is an important source of perceived service quality, and the gap between expectation and perception forms the core of customer perceived service quality. It is obvious that this formation process is determined by the subjective characteristics of the customers. Despite many objective

factors affecting the quality of service, the perception of service quality is different for different users. However, from the perspective of individual users, the subjective expectations are still the main factors affecting the perceived service quality. Therefore, customer's expectation should be considered as an important criterion for the formation of perceived service quality in order to identify the formation mechanism of the user perceived service quality of university library. This further necessitates an in-depth analysis of the user expectations. In an attempt of understanding the formation process of user perceived service quality, marketing scholars have conducted a wide range of research on user expectations, among them, the definition, classification and the influencing factors of expectations have been the main focus so far.

The concept of expectation in service marketing originated from the manufacturing field during late 1980s, and with the deepening of academic research on service quality and satisfaction, the concept of expectation has been systematically defined. In simple words, expectation is a belief or anticipation of users before receiving some kind of services. There are a lot of classification criteria of user expectations, a classification standard that was widely adopted in the history of service quality research is the division according to the degree of expectations. Whereby user expectations are divided into appropriate expectation and eager expectation; the gap between the eager expectation and appropriate expectation is called as the tolerance zone (described in detail below). In general, user perceived service quality falling within the tolerance zone is considered to be better. The eager service and appropriate service of users are usually affected by a number of factors, which are illustrated in Figure 3-1.

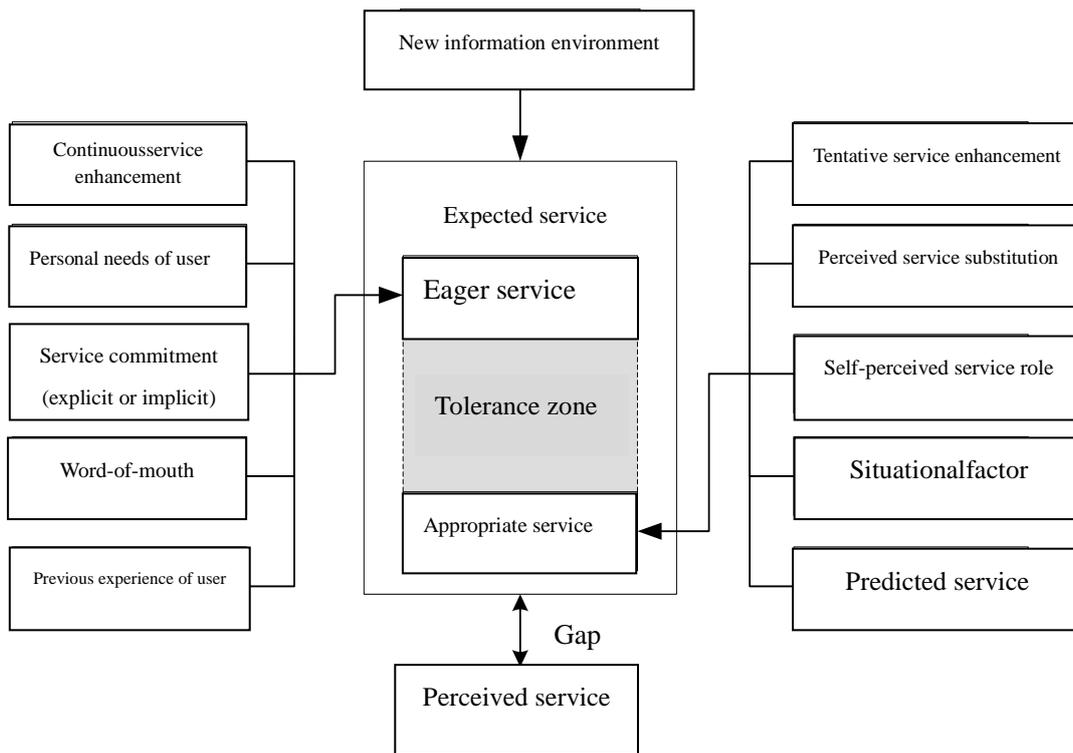


Figure 3-1 The influential factors of user's expected service

The factors impacting the eager expectations of users in university library are mainly the individual needs and persistent service enhancement. Individual needs refer to factors those are necessary for the user's psychological and physical health, which are the key factors in the formation of eager service expectations. For instance, users who have higher interest in literature will naturally have higher expectation on the literature collection of library. Persistent service enhancement is a more relatively stable and independent factor and can be divided into derived expectation factor and personal service concept. While the former refers to the impact of other user' expectations, the latter refers to the user's general attitude towards the services offered by the library. In addition to these two major factors, the eager expectations of university library users are also influenced by service commitments (including explicit and implicit) of library, word-of-mouth and previous experiences of users [227]. Explicit commitment refers to the definite service commitment made by the university library to the users, and the implicit commitment is not usually explicitly stated by university library, but the users can be aware of the perception through the tangible elements of the library. When the university library makes an explicit commitment, it should pay attention not to undertake an excessive commitment; and in the implicit commitment, attention should be paid to the attractions of tangible elements of library services to users. Word-of-mouth implies that the

evaluation by other users of the university library will also affect the user expectations, especially the initial impression and evaluations of expectations on the library through the word-of-mouth of senior students. The previous experiences of users will also have greater impact on the service expectations, for example, users may develop expectations from the received services in other universities or public libraries. From their previous experiences, users may set benchmarks on their perceived service quality expectations, and the eager service expectations of their own university library will also have a considerable impact.

The factors affecting the services of university library are mainly the tentative service enhancement, perceived service substitution, self-perceived service role, situational factors and predictive service [225]. The tentative service enhancement factors are certain short-term personal factors, and usually exist for a shorter term to strengthen the user's demand for a given service, such as a selected graduation project of a graduate about the research issues of service quality. During the project duration, the student's demand for service quality related books in the library will be very high within a shorter time, thereby the tolerance zone will also be shortened. The perceived service substitution refers to the possibility that users can choose other libraries, including public libraries, professional libraries and other university libraries. Self-perceived service role refers to perception degree or its impacts on a user during a service, such as borrowed books due to expire. Now, the user can renew or return the books through the self-service borrow/return system of the library, then his appropriate service level will be slightly improved. The situational factors refer to some other university libraries or random factors and cannot be controlled by users. For instance, when the library is closed on statutory holidays, the expectation level of appropriate services of users will be reduced, thereby expanding the tolerance zone. The predictive service is also a kind of user expectations, but it is essentially different from the eager service and appropriate service in such a way that the predictive service usually refers to the user's expectation during the next service interaction process. Eager service and appropriate service are usually the cumulative expectations formed through longer term. The predictive service may incur a considerable impact on the appropriate service, for example, a higher level of user's predictive service for university library reflects a higher appropriate service level, and a narrow tolerance zone.

In addition to these aforementioned factors, users' expectations of university library will be affected by the new information environment, such as information technology, network environment and

other factors, and the impacts of these technical factors are increasing rapidly, so that the factors impacting the formation of user perceived service quality of university library have changed abruptly over the years. With the rapid development of information technology, users' expectations for the university libraries to provide new information technology-related services will also increase, such as mobile electronic resources, LBS, two-dimensional code and so on. All of these factors together impact the overall expectations of university library users, and thus affect the gap between user expectations and perception, at the same time forming the basis for user perceived service quality of university library.

B. The formation mechanism of perceived service quality of university library

Scholars generally believed that the core of the formation mechanism of service quality is the customer's perceived gap of service. The representative achievements are the Nordic School's Customer perceived service quality model and the North American school's 5-Gap model, in particular, the North American school's tolerance model is considered to be the most important theoretical achievement in the research of formation mechanism of service quality. This thesis presents a comprehensive description of the formation mechanism of the perceived service quality of university library users in reference to the tolerance model.

In the Nordic school model, it has been described that the perceived quality of service of the customer depends on the difference between the expected service and the perceived service of the users, but this model neither considers the generation of the gap and nor the factors affecting the gap. On the basis of the Nordic school's model, the North American School puts forward the 5-gap model of customer perceived service quality and the tolerance zone model, and further divided the customer expectations and perceived gap. Eventually this model presents a more detailed explanation about the formation process of customer perceived service quality, also provided the corresponding theoretical basis, which helps understanding the formation process of user perceived service quality of university library under the new information environment.

It has been identified that the gap analysis paradigm of service quality formation under the traditional environment is still applicable. The gap paradigm directly describes the formation process and its relevant causes of perceived service quality. However, it is risky to simply assume the perceived quality of service as the gap between expectation and perception.

These issues make the evaluation approach more complicated. After developing the gap model, the North American School has conducted a more in-depth study on the customer perceived service quality, particularly this model extends the definition and classification of the concept of expectations. Zeithaml, Berry and Parasuraman[225]classified the customer’s expectations into two categories such as Adequate Expectation and Desired Expectation. On this basis, they introduced the concept of "Zone of Tolerance" (ZOT) and built the tolerance zone model of customer perceived service quality, and further redefined and discussed the formation process of customer perceived service quality. The tolerance zone refers to the existence of customer’s tolerance zone between the eager service and the appropriate service. Services falling within the tolerance zone are generally acceptable, such that customers will be satisfied with services beyond this zone and will be unsatisfied with services falling below the tolerance zone. The size of the tolerance zone depends on two factors affecting customer expectations. The generation of tolerance zone is determined by the heterogeneity of services, and it is used to indicate whether the customer's service expectations are within the desired range or not.

In reference to the original model of the North American School, this thesis depicts the formation mechanism of the perceived service quality of university library users, as shown in Figure 3-2.

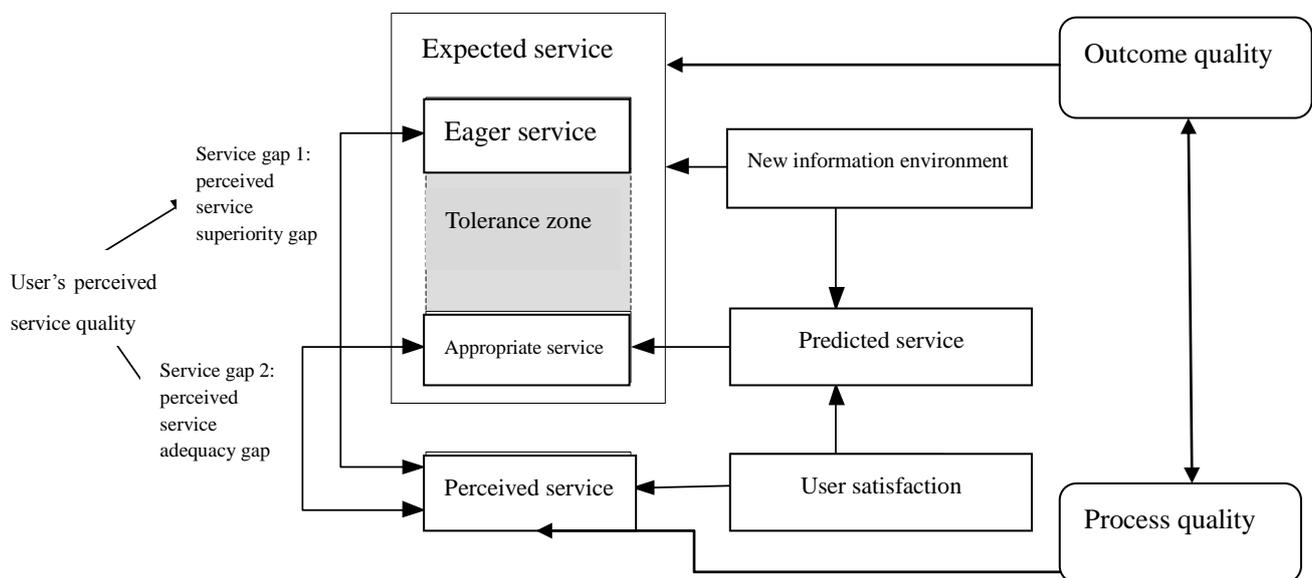


Figure 3-2 The formation mechanism of user perceived service quality of university library

It can be observed from Figure 3-2 that the perceived service quality of university library users still originates from the gap among eager service, appropriate service and perceived service. Firstly, user’s expected service is divided into eager service and appropriate service, and the area between

the two is the tolerance zone of users. The tolerance zones of different users are usually different, the tolerance zone of a given user is not usually static, and changes dynamically due to the impacts of the factors affecting user expectations. Such impact factors of expectation have been analysed in detail in the previous section. These factors not only depict the user's personal needs, previous experience and other traditional factors, but also include the new information environmental factors. In the tolerance zone model, user's appropriate expectations are affected by predictive services [227], since the predictive services refer to the expected estimation (transaction expectation) of user's current or next service, and the appropriate service and the ideal service are both the expectations (cumulative expectations) which include several service interaction processes for the overall service of the university library. Under normal circumstances, the ideal service is more stable than the appropriate service, because it is mainly affected by the long-term service and personal needs. Such factors are relatively stable and difficult to change; but the appropriate service is more greatly affected by the short-term service enhancement, new information environment and other short-term factors, so that the volatility is also higher, and the impact on the tolerance zone is obvious. A higher level of appropriate services reflects a narrower range of tolerant zone.

Next, the comparison gap (that is, the user gap in the aforementioned gap model) between perceived service and expected service is divided into two parts. First is the comparison gap between ideal service and perceived service (service gap 1 which is the, perceived service superiority gap). A smaller gap implies a higher user perceived service superiority of the university library. Second is the comparison gap between appropriate service and perceived service, (service gap 2 which is the perceived service adequacy gap, the smaller the gap). A higher user perceived service reflects an adequacy of the university library services. Such division provides a powerful theoretical support for an effective management of service quality of the university library. It should also be noted that the tolerance zone model also makes a comparison between the user perceived service quality and the evaluation of user satisfaction, as shown in Figure 3-2. User satisfaction is usually the difference between the perceived service and the predictive service. The perceived service quality is the difference between the perceived service and the expected service. Therefore, distinguishing the difference between user satisfaction and evaluation of user perceived service quality is important. It is worthy of note that the changes in the user expectations within the tolerance zone have no significant impact on customer satisfaction.

3.3.2 The conceptual connotation of perceived service quality of university library

Due to the inseparable nature of the services, service quality is determined when a service is presented, which means that the customers not the providers determine it. Reviews of previous studies on the connotation of service quality found that most researchers have agreed to define or measure the service quality from the customer perspectives. A vast majority of definitions of service quality adopt a "customer-oriented" paradigm [56], that is, customers are the main body of the evaluation of service quality, and service quality is a subjective perception on the assessment of the customer. In addition, it can be observed from the formation process of perceived service quality of university library that the gap between user expectation and actual perception forms the core mechanism of service quality.

In fact, the paradigm of service variance or the non-recognition paradigm (which is difference between the service expectation and service experience) has been always regarded as one of the most effective ways to measure the customer perceived service quality. A wide range of scholars in the library community has applied this theory or concept to the library scenario. Therefore, this article also follows the service quality variance paradigm, thus the service operation quality of university library is defined as a subjective overall judgment or impression formed by the difference between the expectation of service process and service results and the actual perceived performance. In particular, it is necessary to specify the following:

A. The university library has a broader meaning and extension than the digital library; the university library not only constitutes the service environment of digital library and the newly emerging mobile library, but also composes the traditional service environment. Therefore, the main features of information technology services are held essential with the services of the traditional university library as a supplement in the evaluation of service quality.

B. The definition focuses on the process and results of the services, which is used to explain that the psychological process of user perceived service quality is more complex, and further it not only contains the results of the services, but also the service process, so to the evaluation of service quality should include these two aspects into account.

C. User's evaluation of service quality is a subjective behaviour; service quality is based on the comparative difference between users' expectation and perception, rather than the objective factors,

so that the user's subjective score is mainly used in the evaluation.

3.3.3 The constituent attribute of perceived service quality of university library

The section discusses the formation mechanism of the perceived service quality of the university library. In reference to the Nordic school's Customer perceived service quality model proposed by famous scholar Grönroos, this thesis holds that the perceived service quality of university library still includes both the outcome quality and the process quality, in terms of attributes, in order to generate a new connotation of service quality.

A. Outcome quality

The outcome quality refers to the actual service result obtained by the user in the interaction with the university library service, that is, the user can perceive the output of university library services. The result includes multifaceted factors, not only containing the high-quality services obtained by user, but also containing the perceived elements of service scene, such as facilities, equipment, decorations, and so on. One of the most important elements is the service itself, that is, the user obtains the previously committed service from university library, regardless of whether the university library's commitment is explicit or implicit. The outcome quality can be intuitively perceived or evaluated by user, and therefore becomes the important criterion or basis for user in the evaluation of service quality of university library. The outcome quality is also called as technical quality, it describes the user's evaluation of the received service, because it is mainly related to the tangible elements of technical aspects, therefore the user's evaluation of the outcome quality is more objective.

B. Process quality

The process quality describes how the university library service is delivered to the user. In reference to the perceived service quality in the context of service contact or interaction between users and service personnel of university library and its service system, process quality also reflects the quality of the delivery process of university library services. Process quality is mainly reflected in the two processes. First is the interpersonal interaction process, which includes the attitude, behaviour and skills of the service personnel during the interaction between users and librarians, thus characterize a strong subjective judgment. Second is the process of human-computer

interaction, which includes perception, experience and so on during the interaction between users and service systems of university library, such experience is often different from person to person. Process quality is also called as functional quality; users often take a subjective way to perceive the process quality, thus an objective evaluation is often difficult to achieve.

It is worthy of note that user's expectations and perceived parts of the library services include the outcome quality and the process quality. This means that users will not only form the expectations and perception of service results, but also the expectations and perception of service process, and therefore form the perceived service quality of university library under the new information environment is evaluation based on the perceived difference between the two aspects.

3.4 Chapter summary

This chapter described the conceptual connotation of the new information environment, and further comprehensively presented its new features. Then, the changes witnessed in the university library and in users' behaviours have been reviewed in detail from four different aspects such as service mode, service function, service form and role of the librarians. It has been highlighted that the user's information needs information behaviour and information capabilities have also changed over the years. Further, the influence of the new information environment on the service quality of the university library has been analysed from three aspects including the users' expected service quality, users' perceived service quality and evaluation of service quality. Finally, this chapter focused on the discussion of formation mechanism and connotation attributes of users' perceived service quality of university libraries. From the perspectives of tolerance model to reveal the formation mechanism of university library under the new information environment, this chapter defined the conceptual connotation of service quality of university library and further elaborated the constituent attributes and connotation of the service quality of university libraries from two different perspectives including outcome quality and process quality.

Chapter 4: Amendment and Applicability Study for SERVQUAL Under New Information Environments

With the motivation of achieving an efficient evaluation on the service quality of university libraries and its connotation properties under the new information environment, this chapter presents suitable extensions to the traditional SERVQUAL evaluation scale in various perspectives. Firstly, the influential factors and models for university library service quality under the new information environment are established in reference to the service quality factors of SERVQUAL; Secondly, on the basis of the original SERVQUAL scale, a suitable evaluation scale for university library service quality under the new information environment in combination with a deductive and inductive method is developed. Thirdly, the developed scale is further enhanced through questionnaire pretest. Fourthly, the applicability of the amended SERVQUAL for university library service quality is analysed.

4.1 Influence Factors of University Library Service Quality

4.1.1 Characteristic factors that affect university library service quality

Service quality is complex, and it is formed under the comprehensive effects of several influencing factors. It is worthy of note that the essence of “influencing factors” of university library service quality under the new information environment constitutes several internal factors of service quality instead of antecedent factors. All such influential factors consider the user experience whilst perceiving the service quality evaluation, and they will have crucial influence on the results of the user's service quality perception, thus characterize an intrinsic structure. Such influential factors are regarded as the property factors of the target concept, with similar connotation. To avoid confusion, in this thesis, the property factors are referred as the characteristic factors affecting the university library service. In reference to the five factors of SERVQUAL evaluation scale of North American school, the characteristic factors of university library service quality under the new information

environment are evaluated from five aspects in this thesis, and then the measurement items of each crucial factors are rectified according to both the characteristics of new information environment and the service nature of university library under such environment. Further the evaluation questionnaires are modified according to the service scenario of the university library, in such a way that the intensities of the questions are appropriately decreased or increased in order to incorporate service characteristics of the university libraries under the new information environment. The five characteristic factors include tangibility, reliability, assurance, responsiveness and empathy, which are specifically elaborated as follows.

A. Tangibility

In SERVQUAL, tangibility refers to the tangible physical implementation, equipment and dressing of service staff. As for the university library service under the new information environment, tangibility has more extensive connotation. In addition to the physical environment of real service scenario, it also includes the environments of the virtual service scenario, such as the physical entities in network environment. In the new information environment, the tangibility of university library service includes two parts. The first part is the physical environments of the university library, including physical scenario, facilities, equipment, etc. Dress codes of the librarians have also been listed in the evaluation factors of tangibility by some scholars. This thesis believes that the university library is different from other commercial organization or service department and is even significantly different from public library. Generally, university libraries do not have a strict requirement on the dress code of the librarians. Thus, dress code is not a mandatory requirement whilst evaluating tangibility. The second is the network environment of university library, which mainly represents the interface design of library website or mobile website. The service scenario usually has a significant influence on the service contact process, since it is intangible in nature. Service contact is a behavioural process rather than materialistic. In general, users cannot accurately perceive the services. Therefore, the basic impression of the service process will be formed by tangible factors in the service scenario. Under the new information environment, the tangibility of university library service embodied in the integrated environment, facility layout of the library, expression and presentation of modern equipment, and also the interface and aesthetic design of electronic service system. Both the tangible factors in real service scenario and the tangible factors in virtual service and will have a significant influence on the service results of user perception.

There are six indicators in the characteristic factor of Tangibility:

- A1. Clean and comfort internal environment of the library
- A2. Reasonable arrangement of internal facilities of the library
- A3. Library contains space provisions for team study and discussion
- A4. Clear and easy-understanding navigation of the library's website
- A5. Beautiful interface of the library's website
- A6. User's interface of mobile library is very attractive

In this sector, $A1+A2+A3+A4+A5+A6=0.887$ (Cronbach's α), which is higher than 0.7 (close to 1), it shows high credibility and will demonstrate the detailed testing result from page 95 to page 96.

B. Reliability

In SERVQUAL, reliability reflects on executing the promised services reliably and accurately. The connotation of reliability has an extended notion for university library services under the new information environment, which refers to the degree to which the university library can accurately accomplish service promises and ensuring the availability of resource collections. From the user perspective, reliability is the most important factor in the service quality perception process, since users always look the extract the most from the process of university library application. University libraries failing to accomplish service promises (including dominant and recessive ones), would disappointment users, thereby decreasing user's perceiving impression on service quality, and finally results in customer loss. Under the new information environment, reliability also reflects on the availability of library collection resources, in addition to reliability. The collection of resources in modern libraries mainly refers to the digital electronic resources. For example, modern day university libraries have introduced many Chinese and language databases and avails them to user at free of cost. However, there are still some payable documents, users can download and obtain their required documents only after accessing the internal network of the library. All the resources in the library cannot be normally obtained and used in the user's heterogeneous environment, which may affect the user's existing expectation, and further affect their perception of service quality.

There are five indicators in the characteristic factor of Reliability:

B1. Service awareness of librarian is consistent with the description

B2. Service of the library is consistent with the description

B3. Users can retrieve their expected information and resources easily

B4. Electronic resources (e.g. database) of the library meets user demands

B5. Users can access the electronic resources anytime and anywhere

In this sector, $B1+B2+B3+B4+B5=0.872$ (Cronbach's α), which is close to 0.9 (very close to 1), it shows high credibility and will demonstrate the detailed testing result from page 95 to page 96.

C. Assurance

In SERVQUAL, assurance refers to the staff's knowledge, courtesy, and capacity to encourage customer for enhancing trust and confidence among users. In the process of delivering university library services under the new information environment, the connotation of service assurance has an extended notion. Namely, the service librarian of university library should have a friendly service attitude, competent service skill and service knowledge across various subject disciplines. The librarian's service attitude towards the user has a very important influence on their service contact and interactive communication with users. Service contact is also called as "real moment". Users upon failing to realize the warmth and friendship from the service librarians would lose their impression on the entire service interaction process, thereby user's perception for service quality will be further affected. In addition to attitude, service librarian's service knowledge and personal skills are very important, since only the service librarians with relevant service knowledge and service ability can establish trust among users. It is worthy of note that the service librarian's attitude and skills are indispensable. Unfriendly attitude will make the users unhappy and incompetent work will lead to the user's lack of confidence. Therefore, both the friendly attitude and competent ability are essential to build a positive image on user's mind, and with which the user's confidence and favorable impression towards the service librarian and university library service can be strengthened, so as to improve the service assurance.

There are six indicators in the characteristic factor of Assurance:

C1. Librarian is friendly

C2. Librarian always receives users politely

C3. Librarian understands the user's demand well

C4. Librarian is capable of answering questions from users

C5. Consulting librarian of each discipline is proficient

C6. Librarian possesses knowledge in relation to the new information technology

In this sector, $C1+C2+C3+C4+C5+C6=0.931$ (Cronbach's α), which is higher than 0.9 (very close to 1), it shows higher credibility and will demonstrate the detailed testing result from page 95 to page 96.

D. Responsiveness

In SERVQUAL, responsiveness means willingness to help customers and to offer fast and immediate services. As for the university library service under the new information environment is concerned, responsiveness includes not only the rapid response of service staff, but also the rapid response of network. Therefore, responsiveness of university library service under the new information environment is also embodied in two aspects: first is the service librarian's active care for the users to provide timely and rapid services, and second is the good responsiveness of the library network. The ability of answering user queries rapidly and timely is the basic service quality that each service librarian should possess. In the case of low efficiency of librarian's service, user may easily feel dissatisfied, which always leads to the user's lack of patience and tolerance. Especially when users encounter problems or mistakes appearing in the service, responsiveness in such situation becomes more necessary to provide timely service remediation, which can make up for the user's obsession caused by service failures. Under the new information environment, users mostly interact with the service system of university library, thus the responsiveness of the information system may have significant influence on the quality of human machine interaction process. Given the user's expectation of service efficiency under the new information environment, their tolerance time for information service acquisition is becoming shorter. Therein, the response speed of the information service system plays the most important role, in terms of the network connection quality, webpage loading speed, etc.

There are five indicators in the characteristic factor of Responsiveness:

D1. Librarian deals with opinions and suggestions from users on time

D2. Librarian remedies the fault on time

D3. Online librarian can answer the user questions on time

D4. Website and resource downloading facilities of the library are smooth

D5. Few errors exist in the website link of the library

In this sector, $D1+D2+D3+D4+D5+D6=0.869$ (Cronbach's α), which is higher than 0.85 (also close to 1), it shows high credibility and will demonstrate the detailed testing result from page 95 to page 96.

E. Empathy

In SERVQUAL, empathy means to cater customers with personalized attention. As for the university library service under the new information environment is concerned, the connotation of empathy has not changed much from that of the traditional environment. Empathy refers to the individualized consideration for the users, provided by the university library service staff and the service system. It includes not only the individualized consideration for users shown by the librarian via face-to-face service contact between the service librarian and the users, but also the individualized consideration for users provided by the library service system during the process of interaction with the user. Empathy has a slighter edge in determining the service quality, which necessitates the need to provide more meticulous intimate services for the users based on existing service. Usually the service librarians care for their users spontaneously and sincerely, and they want to understand the actual demand and potential private demand of users and provide them with personalized solution. Personalization is also an important characteristic of the new information environment. As the user's demands are often more personal, the electronic resource service system of the university library should provide personalized services for users, which will make the human machine interaction process more humanizing, and further enhance the viscosity of user's university library electronic service resources.

There are four indicators in the characteristic factor of Empathy

E1. Convenient and considerate service is available for users

E2. Library cares customized demands of users

E3. Library provides customized online services to users

E4. Library provides training to users

In this sector, $E1+E2+E3+E4 = 0.898$ (Cronbach's α), which is close to 0.9 (very close to 1), it shows higher credibility and will demonstrate the detailed testing result from page 95 to page 96.

4.1.2 Integrated model for influence factor of university library service quality under new information environment

It has been previously postulated that the constitution attribute of service quality of university library under the new information environment includes result quality and process quality. Both two attribute factors have significant influence on the university library service quality under new the information environment. Therein, the result quality refers to the service result that is actually received by the user, including not only the service but also the visible factors in the service scenarios. Actually, after Grönroos [58], the representative personage of Nordic school proposed a two-dimensional model of customer perception service quality, and scholars (Rust & Oliver, 1994) have later proposed supplementary and extensions to the initial model and included the environmental factors as new dimension. Therefore, it has been postulated that service quality is composed of three factors, namely, service produce, service delivery and service environment. Such division is of theoretical and practical significance, and Grönroos also admitted that he had neglected the visible factors in the process of service occurrence. Actually, before Rust & Oliver, North American school has pointed out such problem, and the tangibility dimension has been included in their initially proposed ten-dimensional structure of service quality. Thereafter, the ten-dimensions are reduced to five-dimensions, which forms the SERVQUAL model. Therein, tangibility still serves as a single dimension for investigation. It has been illustrated that environment factor of service quality is very important and has important influence on the user's perception of service quality. However, after careful analysis, it has been discovered that environment is a part of service results. Since environment actually exists in the service scenario as a visible factor in the process of service contact, environment will not make a direct service interaction or service contact with the users, but will be presented to the users as a part of the

service. Users will form a visual perception for such visible environmental factors through their own sense and cognition. It is a part of service results obtained by the user. Therefore, it also falls into the category of factors used for evaluating user's perception of service results, and the service result quality will have a more extensive connotation. In fact, many scholars (such as Brady & Cronin [9]; Cook & Heath [19]; Yap et al., [208]) have classified and investigated the environment factors or visible factors as a part of service result quality, with good empirical support. Therefore, this research thinks that tangibility factor has a direct influence on the service result quality of university library. In addition to tangibility, reliability factor also has a significant influence on the result quality. Because of the fact that reliability must be perceived by the users after the service is completed, reliability would fully express the major connotation of result quality.

The process quality refers to the service quality perceived by the users in the process of service contact or interaction with the university service staff and their service system, and it describes the way in which the university library services are availed to the users. According to the above description of assurance, responsiveness and empathy, it has been discovered that these three factors are related to the process of service delivery. Therefore, it has been considered that they have significant impacts on the process quality.

The following sections of this chapter mainly discussed the development of university library service quality under the new information environment and its applicability problems. Based on this, a formal evaluation scale is determined, and further empirical tests and research focused on multi-level integrated models for analyzing the influencing factors of university library service quality under the new information environment are presented in the next chapter.

4.2 SERVQUAL Model and Research Under the New Information

Environment

Based on the evaluation of the influential factors of user's perception of the university library service quality under the new information environment, this thesis proposes amendments to the SERVQUAL scale for achieving effective evaluation of the university library service quality under the new information environment. This will lead to the establishment of a service quality evaluation tool for university library in China that complies with the new information environment. This chapter further discusses and rectifies the SERVQUAL applicability problem.

SERVQUAL scale is still postulated to be adopted under the new information environment due to the following three reasons: ① SERVQUAL scale has been developed with several strict empirical tests, and has higher credibility and validity; ② SERVQUAL has been widely used in previous service quality researches, has an extensive applicability in both academia and industry, and it has also been recognised as one of the most mature scales in the field of service quality research. But the original SERVQUAL needs modifications as it originates from pure service department under the American cultural background and the problems in the scale are not suitable for cross-cultural scenario, thus the original SERVQUAL is not universal, and the problem cannot cover all the service aspects or contents. Actually, SERVQUAL is being researched and rectified by many Chinese library scholars and has relatively higher approval degree for library background. To this end, new requirements are proposed for the evaluation of library service quality the under new information environment. Therefore, SERVQUAL can only be used for library service quality evaluation under the new information environment after proper amendments.

Whilst proposing extensions to the original SERVQUAL scale, the following three aspects should be incorporated: ① Cultural difference. SERVQUAL originates from western country, and its evaluation procedures are established under the North American background. However, there exists a great difference between Chinese and Western cultures, in the aspects of industrial development, personal attributes and behaviour styles of the readers. Therefore, whilst evaluating the service quality of Chinese university libraries with SERVQUAL, attention must be paid to the peculiarity of Chinese cultural background and cross-cultural limitations of western theoretical scale. Such difference should be analysed carefully during the amendment process, and the scale should be closely focused on local culture. ② Continuity in time. SERVQUAL's presentation to creation, inspection, maturity is a lengthy process, and a lot of situations and factors may change in this process, which challenges the continuous feasibility of SERVQUAL. With the development of information technology, the traditional service mode has undergone various changes over time, which puts lots of uncertainty upon SERVQUAL's reliability on explaining the quality of service characteristics and user behaviours. Thus, the 22 measuring factors of traditional SERVQUAL are not effective under the new information environment, such issues are inevitable whilst extending SERVQUAL. Thus, the extensions of SERVQUAL should conform to the new environment along with preserving its original characteristics. ③ Comprehensiveness of measurement items. The

measurement items not only ensure that the target concepts are measured accurately and comprehensively, but also guarantee that the different subjects can be measured in general, rather than being specific.

In conclusion, modifications should be adopted based on the above three aspects whilst SERVQUAL is deployed in cross-cultural, cross-industrial and cross temporal and spatial scenarios. Furthermore, suitable scientific methods should be adopted to eliminate and reduce the inadaptability of the scale in such situation, this is the first problem to be solved for achieving an efficient SERVQUAL evaluation of university library service quality under the new information environment.

4.2.1 Development of initial scale

A. Scale building process

Strict qualitative analysis and empirical testing procedures are necessary to develop a scale with high reliability and validity. The basic procedures (as shown in Figure 4-1) for the development of university library service quality evaluation scale are developed based on the consulting scale compilation procedures raised by Churchill [29].

The development process of university library service quality evaluation scale on the basis of SERVQUAL is complicated and rigorous. The process mainly contains qualitative research and empirical research. Each stage also contains several theoretical derivation and/or statistical analysis. It also includes rigorous and strict empirical test processes as a whole to ensure scientific and effective development of university library service quality evaluation scale.

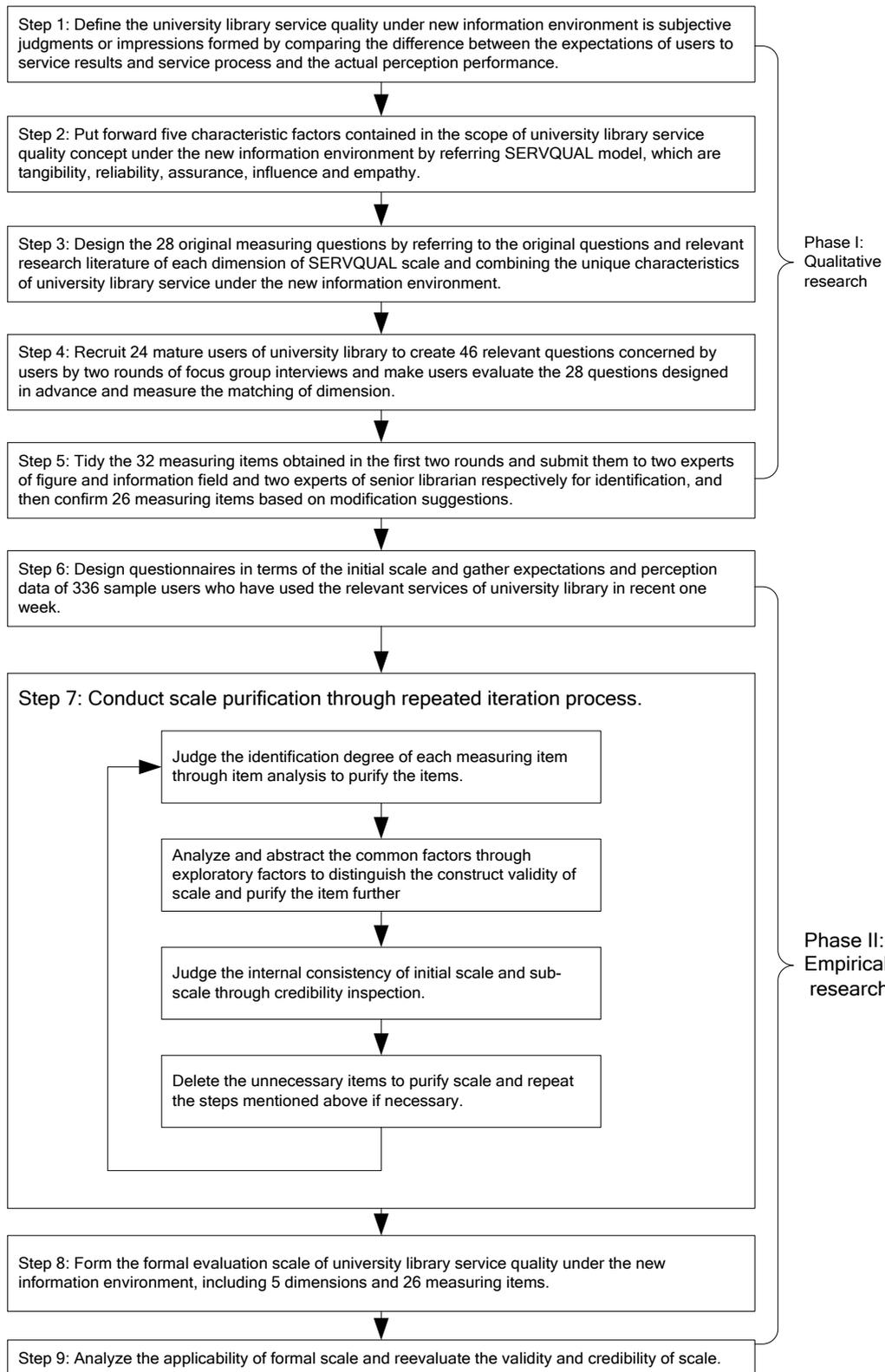


Figure 4-1 Development Process of University Library Service Quality Evaluation Scale

The qualitative research stage is mainly divided into five steps: the step 1 and the step 2 involves the explanation of research objects and target concepts, including operational definition of university library service quality and their inner compositions, and the operationalization of the

characteristic factors in order to clearly define the theoretical boundary or range of target concept. The step 3 to the step 5 involves the qualitative development process to generate the initial scale measuring items. The step 3 is to design the initial measurement item in combination with the unique characteristics of university library service in compliance with the original SERVQUAL scale and their related research literature in both China and overseas. The step 4 is to excavate relevant items concerned by users through user focus group interviews and to evaluate the measuring questions designed in advance along with the matching attributes among each measuring dimension. The step 5 is to submit and present the measuring items to two experts of figure and information field and two experts of senior librarian in university library respectively to screen the final measuring items of initial scale through deep interview and evaluation for the scale.

The empirical research stage includes four steps as following: The first is to design relevant questionnaires in terms of the measuring items of initial scale and pre-test the users to obtain user testing data; The second is to conduct the iteration process for scale purification on the basis of perception data of users; The third is to form the formal evaluation scale and the fourth is to analyse the applicability of the formal scale and to re-evaluate the validity and credibility of the scale.

B. Scale development process

As shown in Figure 4.1, the first task in the process of scale creation is to accurately define and explain the target concept. This article has defined the concepts and connotations of university library service quality under the new information environment specifically, the subjective judgments or impressions formed through a comparative analysis between user's expectations of service results and service process and the actual perception performance. Moreover, the five characteristic factors (actually, those are the inner structure of target concept) have been explained and stated in the beginning of this chapter. Therefore, the formation process of the initial items of university library service quality evaluation scale is mainly described in this section. From the perspectives of the questions researched in the thesis, this research combines a deductive method with an inductive method for developing the scale items, based on a mature SERVQUAL and previous related literatures. The methodology also includes gathering relevant measuring items relevant to the research target concept through interviews in order to improve the existing items (inductive process). These process modes can not only improve the content validity of the scale, but also improves the applicability of the developed scale in realistic scenarios of university library

service under the new information environment.

a) Create initial items in reference to the original SERVQUAL and the relevant research literatures.

Firstly, this thesis is based on the original SERVQUAL scale, and then investigated a more mature version of relevant research literatures in China and overseas for carrying out a comparative analysis on the scale items. The SERVQUAL model originates from the profit seeking industries in western culture. However, university libraries are non-profit service organizations. Owing to its cross-cultural and cross-industrial features, therefore, it needs to be revised. On this basis, in combination with the characteristics of the new information environment and its service characteristics discussed previously, user needs and behaviours of the university library, this thesis attempts to improve, adjust, add or delete relevant scale items through brainstorming after explaining the target concepts, connotation and definition of the characteristic factors. 28 initial measuring items of the university library service quality evaluation scale under the new information environment are initially formed. These questions are formed not only based on the service scenarios of the original indicators of university libraries, but also in consideration of the background characteristics of the new information environment. For instance, indicator "A7 Abundant book collection " is deleted. Because book collection is always an important indicator to evaluate the university library, but in thesis book collection has been weakened under the new information environment. Indicator "A8 Library provide food " is deleted. Because in China, most library users tend to go to university canteen.

b) Develop the relevant items correspondent with the connotation of target concept through user focus group interview.

The aforementioned 28 indicators are produced based on the original SERVQUAL scale, and relevant research literatures. But uncertainty still revolves in the following: Does users concern these items generally? Which items reflect the basic needs of users? Which items are specialized for the particular needs of users? Can they comprehensively reflect all the aspects of university library service quality? In order to answer these questions, this thesis decides to develop more appropriate items through focus group interviews. 24 mature students of university have been recruited and further divided into two groups of 12 students, based on the suggestions of Griffin & Hauser [53] stating that 90%~95% of the customer requirements could be inferred by interviewing 20~30

customers. Then, the two groups of mature users are subjected to a deeper and semi-structured interview respectively. The interviewing time of each group is set to 30 minutes. The main interviewing content include the following: please describe your basic feeling of using library services; the basic requirements for library service quality; what concerns you the most during the service process? What are your expectations for library services, etc. This research integrated 46 measuring items of service quality concerned by users, extracted from the focus group interviews.

The scales designed are then handed out to the 24 group members in a later period, containing measuring items without the characteristic factors (that is the measuring dimensions). Firstly, the interview demanded each group member to mark out the items concerned or unconcerned by them in order to acquire their acceptance degree; Secondly, it explained the connotations of target concepts and characteristic factors to the group members. Next, the matching relationship between the five characteristic factors and all the measuring items are assessed, by matching all the 28 items with the five measuring dimensions. Then the statistics of the matching degree between all the characteristic factors and the measuring items are collected after the group interview. The result demonstrated that the matching degrees of the five factors exceeded 80%, with most of the matching results being the same as Chinese expectation, thus the design of the initial items helped to define the basic degree of acceptance for users with higher content validity.

Finally, 46 items are extracted from the user focused group interviews, which are then compared with the 28 initial items. The items with repeated expression and similar notions are combined together. The individual items “unconcerned” by users are deleted (the items identified as important in this research are reserved temporarily). 32 measuring items are reserved after this round of integration.

C. Formation of initial scale

After conforming the measuring items of the initial scale of university library service quality under the new information environment in three stages of scale development process, this research selects 10 graduate students randomly from university to pre-test the clarity, understandability and ambiguity of the developed expressions. Then, question expressions are moderated according to their suggestions and feedbacks in order to form the final initial scales including 26 measuring items of university library service quality under the new information environment.

4.2.2 Questionnaire pretest and scale purification

a) Data sources and samples

This thesis collects data through questionnaires and further purifies the scale through questionnaire pre-test. Firstly, questionnaires are designed according to the initial scale. The questionnaires contain three components: Part 1 is the basic information of users to be researched, including gender, age, education, identity of the users and the frequency of using university library services, etc. Part 2 is questionnaire subject, namely the measuring questions of the initial scale of university library service quality under the new information environment. Three responses returned, including minimum acceptance value, ideal expectations and actual experience value, are adopted for each question in this component in reference to the original SERVQUAL questionnaire form and also to the formation mechanism and research results of university library service quality under the new information environment presented in Chapter 3. This component is intended to obtain a more comprehensive service quality information and to identify the prominent problems of current service quality. This component presents inferences about which service quality should be improved, in order to provide more practical guide and suggestions for improving the service quality of university libraries. In addition, a 7-point Likert scale method is adopted for measuring the range of each response column. The score scope is from 1 to 7, where 1 shows disagreement to a great extent, and 7 shows agreement fully. This scale aims to distinguish the user perception in an even better fashion. Component 3 is the overall perception, opinions and suggestions of users for university library service quality.

This preliminary investigation is carried out with the students of three universities in Zhenjiang and Nanjing, including Nanjing University, Jiangsu University and Jiangsu University of Science and Technology. The research lasts from 3 March, 2014 to 10 March. The primary methodology involves questionnaires in the teaching buildings, study rooms and libraries of each university, focused on students who used relevant services of library within the last one week in order to ensure authenticity and objectivity of results, to reflect the expectations and perceptions of users. Finally, 381 questionnaires in total are obtained from the three universities through investigation. 45 invalid questionnaires with more missing values or very serious tendency of filling are eliminated, resulting in 336 valid questionnaires with effective rate of 88.19%, of which, Nanjing University presents 94,

Jiangsu University presents 132 and Jiangsu University of Science and Technology presents 110 questionnaires.

b) Factor analysis

Factor analysis aims to evaluate the concept validity and construct validity. Construct validity is the accuracy of measuring items, namely the conformance degree of the content of measuring items and concept definition. Actually, most of the scale evaluations are related to the concept validity of measuring scales in order to evaluate the measuring degree of scales for the target concepts.

Most of the researchers have adopted an exploratory factor analysis (EFA) to evaluate the construct validity of initial scale to purify the scales. Although this research has identified the formative factors of the target concepts, it is still uncertain whether the created initial measuring items would be able to reflect and represent the target concepts and factors to be measured. Although this research extends on the initial scale based on the mature SERVQUAL scale, most of the measuring items are modified to suit the service scenarios of university library under the new information environment.

To this end, all the measuring items can be measured together, to conduct exploratory factor analysis for the scores. Then, the strengths and weaknesses of the construct validity are evaluated based on the load value of the factor. Specifically, measuring items of common element or attribute can be gathered together, in such a way that items with high factor loading value can be integrated with items with low factor loading value. This indicates that the inner structure of the initial scale is clear with good convergent validity and discriminant validity, thus the construct validity of overall scale is favorable. Through the exploratory factor analysis, this thesis identifies the measuring items having weaker relationships with target concepts (low load value) and distinguishes the measuring items which are not in compliance with the theory of building expectation (when the maximum load value is not complying with the expected factor). Then, this information is analysed comprehensively to determine which measuring items can be deleted and which can be added, etc.

When no measuring item needs deletion in the process of item analysis, the original user perception value is used for factor analysis. Before the exploratory factor analysis, it is important to test whether the entire scale and each measuring items are suitable for factor analysis.

A. Checking suitability of the entire scale for factor analysis

KMO (Kaiser-Meyer-Olkin) value and Bartlett Test of Sphericity (Bartlett-Test-of-Sphericity) are usually adopted to identify the common factors between variables (measuring items). KMO is considered as the suitable measurement test, with the KMO value ranging from 0 to 1. A KMO value closer to 1 implies that there are more common factors among the measuring items and it is more suitable for factor analysis. When the KMO value is less than 0.5, as per the opinions of Kaiser [88], it is not suitable for factor analysis; when the KMO value is higher than 0.6, it is suitable for factor analysis; when the KMO value is higher than 0.9, it is highly suitable for factor analysis. KMO value of the entire initial scale is 0.936 (as shown in Table 4-1), obtained by SPSS 19.0 calculation. Thus, it is suitable for factor analysis to a very large extent, which proves that there are more common factors among the measuring items.

Bartlett Test of Sphericity aims to test whether the net correlation coefficient matrix is a unit matrix, namely, whether the net correlation coefficient of each measuring item is zero. If so, each measuring item is mutually independent, and each item is suitable for factor analysis. The standard of Bartlett Test of Sphericity is that it is suitable for factor analysis when the significance probability is less than 0.05. The significance probability P value of Bartlett Test of Sphericity is 0.000 (as shown in Table 4-1), which is far less than 0.05. This reflects that common factors exist in the overall correlation matrix, and the entire initial scale is suitable for factor analysis.

Table 4-1 KMO Test and Bartlett Sphericity Test

Kaiser-Meyer-Olkin measure of sampling adequacy		.936
Bartlett Test of Sphericity	Approximate chi-square distribution	7020.924
	Degree of freedom	325
	Significance	.000

B. Test whether each measuring item is suitable for factor analysis

It is important to test whether each measuring item needs factor analysis or not, which is usually assessed through the measures of sampling adequacy (MSA) of the measuring items. If the correlation coefficient between a measuring item and other items is significantly narrow, the measuring item is not suitable for factor analysis and the current MSA value is rather small. If the MSA value is close to 1, it is more suitable for factor analysis. Generally, when the MSA value is less than 0.5, it is not suitable for factor analysis; when the MSA value is greater than 0.8, it is

highly suitable for factor analysis with more common factors existing among the measuring items. MSA values of all the measuring items are identified to be greater than 0.85, identified through the image relation coefficient matrix. This higher MSV value insists that the measuring items contain more common factors and are thus more suitable for factor analysis.

C. Factor extraction

Principal component analysis is adopted to extract factors, and orthogonal rotation is conducted on the factor matrix, supported with the maximum-variance algorithm. The number of factors to be extracted depends on characteristic value which is higher than 1, as proposed by Kaiser [89].

Table 4-2 presents the result of total variance explanation for factor extraction gained through principal component analysis, where the transformation is achieved using the maximum-variance algorithm of orthogonal rotation. Table 4-2 mainly contains three components including initial characteristic value, extracting square and loading & rotating square & loading. “Total” column of initial characteristic value presents the characteristic value of each principal component. The sum of all characteristic values is 26 (number of measuring items). A greater characteristic value reflects a more important principal component, when the variance of the 26 measuring items is explained; the second column “percentage of variance” represents that each extraction factor can explain the variance of 26 measuring items, and the explained variance is equal to the characteristic values divided by the number of measuring items; the third column “percentage of accumulation” represents the cumulative percentage when the variance of the 26 items are explained. When the number of factors extracted is equal to the number of measuring items, the percentage of cumulative variances is 100%. “Extracting square and loading” column is the data of each column which is higher than 1, this reflects the characteristic value in the “initial characteristic value” column. The characteristic value higher than 1 is regarded as the standard for the extraction factor. There are five components with characteristic values greater than 1. Therefore, the five components are the common factors for extraction. The five common components can explain 71.682% of variance in total, reaching more than 60% to that of the standard, and so the five extraction factors are suitable. “Rotating square and loading” data is obtained by orthogonal rotation of maximum-variance algorithm. The characteristic values of the five common factors usually changes after rotating, but the sum is unchangeable, and the total explainable variance is still 71.682%. The difference among the characteristic values of the five common factors is higher before rotating, but reduced after

rotating.

Table 4-2 Result of Explained Total Variance

Component	Initial characteristic value			Extracting square and loading			Rotating square and loading		
	Total	Percentage of variance	Percentage of accumulation	Total	Percentage of variance	Percentage of accumulation	Total	Percentage of variance	Percentage of accumulation
1	12.925	49.711	49.711	12.925	49.711	49.711	4.050	15.576	15.576
2	1.779	6.843	56.554	1.779	6.843	56.554	3.960	15.231	30.807
3	1.466	5.640	62.194	1.466	5.640	62.194	3.619	13.918	44.724
4	1.323	5.089	67.283	1.323	5.089	67.283	3.569	13.726	58.450
5	1.144	4.399	71.682	1.144	4.399	71.682	3.440	13.231	71.682
6	.846	3.254	74.936						
7	.764	2.938	77.874						
8	.641	2.465	80.338						
9	.538	2.070	82.408						
10	.518	1.992	84.401						
11	.438	1.684	86.085						
12	.408	1.570	87.655						
13	.381	1.467	89.122						
14	.336	1.293	90.415						
15	.326	1.253	91.667						
16	.308	1.184	92.851						
17	.282	1.085	93.936						
18	.256	.984	94.920						
19	.233	.898	95.817						
20	.203	.779	96.596						
21	.185	.711	97.308						
22	.172	.660	97.968						
23	.154	.593	98.561						
24	.144	.554	99.115						
25	.123	.472	99.587						
26	.107	.413	100						

Extraction method: principal component analysis; Rotating method: maximum-variance algorithm

It is less rigorous to extract the five common factors by only relying on the characteristic values higher than 1. Therefore, the scree plot is referred comprehensively to determine whether the five common factors extracted can be reserved. Figure 4-2 presents the result of the factor scree plot test. The scree plot test can help us determine the number of factors extracted rapidly. The scree plot is used to sort the characteristic values of each main component from high to low, and also to draw a slope line. The evaluation standards of the scree plot test are used to extract the suddenly rising factors on the slope line (screes on the mountain slope) and to delete the suddenly flat factors on the slope line (screes at the foot of mountain). The vertical ordinate in the table is the characteristic value, and the horizontal ordinate depicts the number of measuring items (that is shown as “Number of components” in the orthogonal rotation). In this way, this research identifies that the five left components form a steeper curve, and the horizontal line begins from the sixth component (factor) with the characteristic value being smaller than 1 at this moment, which represents that there are no valuable common factors to be extracted. Therefore, it is suitable to reserve the five factors.

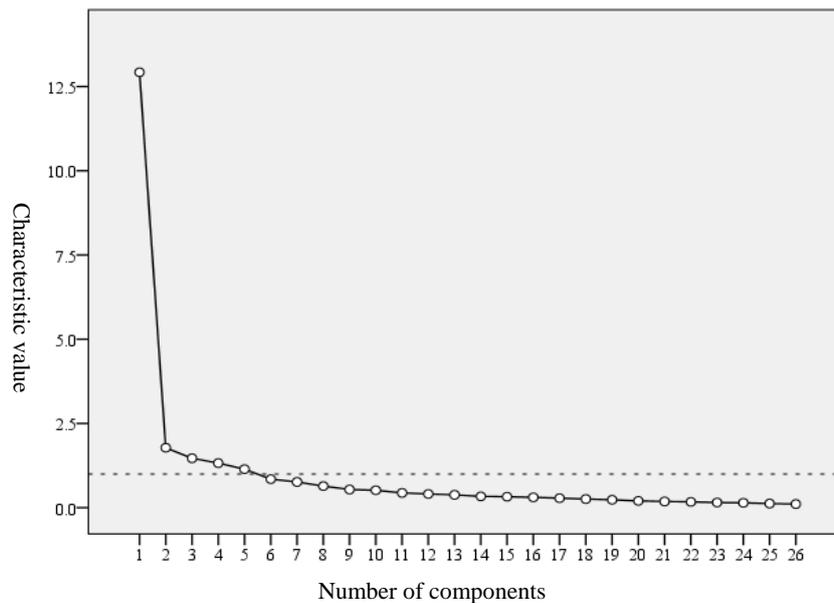


Figure 4-2 Scree Plot of Factor

D. Factor naming

The rotated factor (load) matrix (as shown in Table 4-3) is obtained through extraction with the principal component analysis method and rotation with the maximum-variance algorithm standardized by Kaiser. Item number is arranged by the size of factor load value. The purpose of rotation is to enlarge the factor loading values those are higher before rotation and to decrease the factor load values those are smaller before rotation. It can be observed from the Tables 4-6 that the

common factor 1 contains six measuring items including C1, C2, C3, C4, C5 and C6, the factor loading ranges from 0.529 to 0.827, and the variance explained is 15.576%; the common factor 2 contains six measuring items including A1, A2, A3, A4, A5 and A6, the factor load ranges from 0.528 to 0.795, and the variance explained is 15.231%; the common factor 3 contains four measuring items such as E1, E2, E3 and E4, the factor loading ranges from 0.552 to 0.844 and the variance explained is 13.918%; the common factor 4 contains five measuring items such as B1, B2, B3, B4 and B5, the factor loading ranges from 0.496 to 0.761 and the variance explained is 13.726%; the common factor 5 contains five measuring items including D1, D2, D3, D4, D5 and D6, the factor loading ranges from 0.652 to 0.779, and the variance explained is 13.231%. The percentage of variance of five factors explained accumulatively is 71.682%.

Table 4-3 Rotated Factor Loading Matrix

Items No.	Component					Communality	MSA
	1	2	3	4	5		
C4	0.827	0.195	0.270	0.218	0.152	.866	0.928
C3	0.798	0.214	0.213	0.245	0.160	.814	0.936
C5	0.788	0.262	0.163	0.258	0.156	.807	0.955
C6	0.587	0.257	0.306	0.280	0.345	.701	0.941
C2	0.553	0.250	0.346	0.279	0.306	.659	0.950
C1	0.529	0.360	0.391	0.315	0.269	.734	0.982
A2	0.101	0.795	0.252	0.058	0.188	.744	0.919
A1	0.159	0.742	0.125	0.267	0.157	.687	0.933
A3	0.268	0.728	0.194	0.279	0.150	.740	0.937
A4	0.336	0.727	0.152	0.098	0.169	.704	0.952
A5	0.130	0.634	0.097	0.398	0.248	.648	0.958
A6	0.434	0.528	-0.003	0.059	0.338	.584	0.941
E2	0.201	0.201	0.844	0.197	0.097	.842	0.901
E3	0.221	0.198	0.797	0.289	0.149	.830	0.934
E1	0.275	0.153	0.757	0.288	0.134	.773	0.936
E4	0.202	0.111	0.552	0.396	0.301	.605	0.975
B3	0.207	0.230	0.141	0.761	0.237	.750	0.941
B2	0.203	0.113	0.313	0.707	0.301	.742	0.922
B1	0.271	0.211	0.259	0.680	0.18	.680	0.941
B4	0.213	0.189	0.243	0.641	0.100	.561	0.941
B5	0.276	0.365	0.335	0.496	0.133	.586	0.965
D2	0.068	0.222	-0.029	0.285	0.779	.743	0.892
D1	0.199	0.152	0.053	0.299	0.736	.696	0.901

D3	0.308	0.220	0.395	0.01	0.664	.741	0.908
D5	0.140	0.219	0.246	0.289	0.660	.647	0.936
D4	0.328	0.254	0.392	-0.007	0.652	.750	0.888
Characteristic value	4.050	3.960	3.619	3.569	3.440		
Percentage of explained variance	15.576	15.231	13.918	13.726	13.231		
Percentage of cumulative explanation	15.576	30.807	44.724	58.450	71.682		

Extraction method: principal component analysis; rotating method: maximum-variance algorithm standardized by Kaiser

The five common factors conform to the characteristic factors and items of initial scale built in this thesis. The loading values of each measuring item are higher in the common factors and lower in other factor's loading value. It indicates that the scale has higher construct validity. Therefore, the first common factor is named as "assurance", the second as "tangibility", the third as "empathy", the fourth as "reliability" and the last one as "responsiveness".

c) Credibility test

Credibility refers to the stability and consistency of measuring data gained from the scale or measuring items. After extracting the five common factors, the credibility of five layers (factors) of the initial scale and the overall scale are tested further. The common method used to test the credibility is the inner consistency reliability coefficient, which is Alpha Coefficient (Cronbach's α) proposed by Cronbach. A higher coefficient value reflects a better consistency of the inner scale.

The minimum acceptable value of Cronbach's α coefficient has not been reached an agreement in academia. It is generally recognised that the Cronbach's α coefficient of the total scale should be controlled beyond 0.8, range from 0.7 to 0.8 can be accepted reluctantly; Cronbach's α coefficient of sub-scales (each layer) should be controlled beyond 0.7, and the range from 0.6 to 0.7 can be accepted reluctantly. If the Cronbach's α coefficient of the total scale is lower than 0.7, and the sub-scale is lower than 0.6, then the expressions of scales and measuring items should be modified or some measuring items should be added. This thesis adopts 0.7, proposed by Fornell and Larcker [49], as the acceptable critical value of Cronbach's α coefficient.

Firstly, the entire initial scales are tested for credibility. The results demonstrated that the

Cronbach's α coefficient of total scale is 0.958 (as shown in Table 4-4), and the standard Cronbach's α coefficient is 0.959. All the measuring items of the initial scales adopt a 7-point Likert scale method, thus the non-standardized Cronbach's α coefficient is more suitable [203]. Further, the credibility coefficient of the total initial scale is higher, which represents that the total scales characterize a higher internal consistency, and the reliability of the sample data is very high.

Secondly, the five sub-scales are tested for credibility (as shown in Table 4-4). Considering tangibility sub-scale as an example, the Cronbach's α coefficient is 0.887, and it has better internal consistency. CITC in Table 4-4 depicts the total correlation coefficient of the correction item for sub-scales. A higher coefficient indicates that there is better internal consistency among the items. It can be easily observed that the minimum value of the total correlation coefficient for correction items of tangibility sub-scales has reached 0.597 (A6), which is higher than the recommended value of 0.5. It means that the internal consistency between each measuring item of tangibility and other items is higher. CAID in Tables 4-7 depict the Cronbach's α coefficient of sub-scales those deleted in the item. If this value is increased remarkably after deletion, then the item will be considered for deletion. Table 4-4 shows that the deletion of any tangibility item will not increase Cronbach's α coefficient. Therefore, it is not necessary to delete any item. Among the other four sub-scales, the item with lowest Cronbach's α coefficient is 'responsiveness' with a value of 0.869, and the item with highest value is 'assurance' with a value of 0.931. CITC of all the measuring items for each sub-scale are higher than 0.6. It means that the internal consistency of the other four sub-scales is better. CAID are smaller than before, so it is not necessary to delete any item.

Table 4-4 Credibility Testing Result

Total scales	Cronbach's α	Sub-scales	Measuring item	CITC	CAID	Cronbach's α
University library Service quality Under New information Environment	0.958	Tangibility	A1	0.715	0.865	0.887
			A2	0.726	0.863	
			A3	0.769	0.856	
			A4	0.734	0.862	
			A5	0.673	0.871	
			A6	0.597	0.884	
		Reliability	B1	0.728	0.838	0.872
			B2	0.756	0.831	
			B3	0.746	0.834	
			B4	0.628	0.862	
			B5	0.638	0.860	

		Assurance	C1	0.781	0.920	0.931
			C2	0.749	0.924	
			C3	0.809	0.917	
			C4	0.848	0.912	
			C5	0.809	0.917	
			C6	0.789	0.919	
		Responsiveness	D1	0.680	0.846	0.869
			D2	0.680	0.845	
			D3	0.724	0.835	
			D4	0.720	0.836	
			D5	0.675	0.846	
		Empathy	E1	0.781	0.865	0.898
			E2	0.838	0.844	
			E3	0.844	0.841	
			E4	0.638	0.917	

Remark: CITC represents the total correlation of correction items for sub-scales, and CAID represents the Cronbach's α deleted of the items of sub-scales.

d) Forming the normal scales

No measuring item is deleted in the initial scale determined through purification in three stages of item analysis, factor analysis and credibility testing. The measuring items of university library service quality under the new information environment are confirmed finally, which includes tangibility factors of 6 items, credibility factors of 5 items, assurance factors of 6 items, responsiveness factors of 5 items and empathy factors of 4 items, resulting in a total of 26 items. After confirming the measuring items of the scales, this research also consulted several experts in the library and information domain to validate the suitability of the developed scale. The experts are satisfied with the measuring items of scales. Herein, the final evaluation scales of university library service quality under the new information environment are formed.

4.3 Applicability Analysis of SERVQUAL Model under the New Information Environment

This section analyses the applicability of the confirmed formal evaluation scale for university library service quality based on the revised SERVQUAL model. Xie [104] thinks that the applicability analysis should necessarily include the following components: ① Applicability on concept: whether the target concepts are measured accurately and comprehensively through selected scales? ② Applicability on culture: The original SERVQUAL comes from western developed

country, thus whether the revised scales can be widely accepted and understood by Chinese users

③ **Applicability on samples:** whether the revised scale can be applied to test users in general or is it more specific to a certain group of users? Han Jinglun and Don Jun [74] investigated the applicability of scales using the questionnaire answering time and error rate. This thesis mainly expounds the applicability of the revised SERVQUAL in university library services under the new information environment through correlation analysis, validity analysis, credibility analysis and user score result analysis, etc.

Because no measuring item is deleted during the initial scale purification, the sample data from the pre-test is used for analyzing the applicability of normal scales.

4.3.1 Validity analysis

Validity reflects the degree of scales or measuring tools to which the target concept is measured accurately, namely the measuring accuracy and effectiveness. This research adopts a widely used scale validity test procedure for the purpose of gradually testing the scale validity from three aspects including content validity, construct validity and criterion validity.

A. Content validity

Content validity is also known as the face validity or logical validity, which insist that the content of the scale (measuring items) should reflect and represent the target concept to be measured [68], namely, the degree of conformance and pertinence between scales and target concepts. Generally, a poor reflection of the scale content validity mainly demonstrates three aspects [68]: 1. Ignoring parts of measuring items which can represent and reflect the content of target concept; 2. Covering some irrelevant measuring items with target concept; 3. By not balancing the proportion of each layer or element in the overall content construction, which leads the measuring scores to inappropriately reflect the target concept. Only when the developed scale measuring items reflect or cover the target concept along with their connotation or significance on the layer comprehensively, the scale is considered to possess sufficient content validity.

Most of the previous research have adopted qualitative methods to evaluate the content validity of scales from the following three aspects [104]: ① evaluating the representativeness of each measuring item, to determine whether each measuring item can accurately reflect the target concept

or the content of some aspects of operation definition at a composing level;②determining whether all the measuring items comprehensively cover the theoretical scope or boundary of the target concept, and also determining whether there are appropriate correspondence between the measuring items and the connotation of target concept; ③ determining whether the distribution ratio of the measuring items represent the significance of each layer for target concept, such that no measuring items are concentrated on certain layer. At present, there are a few researchers evaluating the content validity of scales from the quantitative view.

In the process of developing the initial scales, this research fully combines the qualitative methods of literature research, user focus group interviews and in-depth expert interviews etc., thereby not only ensuring the correlation between all the measuring items and the extended connotation of the university library service quality under the new information environment, but also ensuring the coverage of the all measuring items for the university library service quality under the new information environment on each side of the operation layer. Additionally, in combination with the quantitative methods, this thesis investigates the design of the matching degree of the measuring items and each layer of the target concept in the process of the focus group interview. Therefore, the appropriateness and rationality of distribution ratio are improved for measuring items to a certain degree. Overall, the scales built in this research possess excellent content validity.

B. Construct validity

Construct validity reflects the consistency degree between the measuring scales and the target concepts to be measured, which is the maximum degree of connotation or traits of the constructed theory. Generally, the construct validity of a scale is influenced by three factors: first is the deviation caused by incorrect operation definition of the researchers; second, when the connotation and component of the target concepts are not reflected comprehensively by the measuring content of scale, by including some parts which are not to be measured; third is the deviation caused by the credibility of lack of scale.

Construct validity is generally divided into convergent validity and discriminant validity. Convergent validity depicts the higher correlation of each measuring items under the same factor, and discriminant validity depicts the lower correlation among the measuring items under different factors. The process of scale purification has tested the construct validity of the initial scale through

an exploratory factor analysis, which identified the existence and significance of the aforementioned five factors in the structure of the SERVQUAL model in the service scenarios of university library under the new information environment. The confirmatory factor analysis method is mainly adopted here to verify the construct validity of formal scales. As for the evaluation of the convergent validity is concerned, Fornell & Larcker [49] postulated three basic test conditions:① the loading value of the standardized factor should reach a remarkable value (T value should be higher than 2) higher than 0.5;②the value of the composite reliability (CR) should be higher than 0.6; and ③the value of the average variance extracted (AVE) should be higher than 0.5.

Table 4-5 shows the factor loading value and the T value for all the measuring items, demonstrating that all the measuring items are reaching the required level of significance, with the factor loading is witnessed above 0.5 and the T value above 2. Therefore, the first condition of the convergent validity is satisfied. In the aspects of the composite reliability, Table 4-5 shows that the minimum value of CR is 0.867 and the maximum value is 0.931, which satisfies the second condition. The minimum average variance extracted is 0.571 and the maximum value is 0.709, which fully satisfies the third condition. Thus, it can be concluded that the formal scales satisfy all the three convergent validity conditions, exhibiting a good convergent validity.

Table 4-5 Analysis Results of Dimension Credibility and Construct Validity of Formal Scales

Dimension	Item	Cronbach's α	Standard factor loading	CR	AVE	T value
Tangibility	A1	0.887	0.77	0.889	0.574	16.19
	A2		0.75			15.60
	A3		0.84			18.61
	A4		0.80			17.01
	A5		0.73			14.98
	A6		0.64			12.63
Reliability	B1	0.872	0.83	0.875	0.587	18.00
	B2		0.85			18.62
	B3		0.79			16.90
	B4		0.65			12.84
	B5		0.69			13.87
Assurance	C1	0.931	0.83	0.931	0.693	18.56
	C2		0.78			16.68
	C3		0.85			19.31
	C4		0.88			20.31
	C5		0.84			18.86
	C6		0.81			17.77
Responsiveness	D1	0.869	0.64	0.867	0.571	12.75
	D2		0.63			12.35
	D3		0.87			19.60
	D4		0.88			19.71
	D5		0.72			14.66
Empathy	E1	0.898	0.85	0.906	0.709	19.02
	E2		0.90			20.69
	E3		0.91			21.22
	E4		0.69			14.10

For testing the discriminant validity, there are two common methods: ① Anderson & Gerbing [4] suggested to determine whether a 95% confidence interval of correlation coefficient between each factor (latent variable) covers 1.00 through a confirmatory factor analysis. If 1.00 is covered, then discriminant validity is considered to be lacking, otherwise good. ② Fornell & Larcker[49] postulated that the validity can be tested and distinguished by comparing the standardized correlation coefficient square value of each factor (latent variable) with the value of the average variance extracted (AVE) for each factor. If the latter is larger than the former, sufficient degree of discriminant validity is considered to be existing among each factor, otherwise insufficient.

Firstly, the correlation coefficient between each factor and its standard error matrix are gained through confirmatory factor analysis (as shown in Table 4-6). It can be observed from Table 4-6 that the correlation coefficients among factors are between 0.57 and 0.76, and a 95% of confidence interval of correlation coefficients do not cover 1.00, which proves that there are significant differences among factors and the scales possess discriminant validity. In addition, as shown in Table 4-7, AVE of each factor is higher than the square value of the correlation coefficient of a given factor and other factors, which further proves that the scales possess excellent discriminant validity.

Table 4-6 Correlation Coefficients and Confidence Interval among Factors

	Tangibility	Reliability	Assurance	Responsiveness	Empathy
Tangibility	1.00				
Reliability	0.69 (0.59, 0.79)	1.00			
Assurance	0.74 (0.64, 0.84)	0.76 (0.66, 0.86)	1.00		
Responsiveness	0.67 (0.57, 0.77)	0.65 (0.55, 0.75)	0.72 (0.62, 0.82)	1.00	
Empathy	0.57 (0.47, 0.67)	0.71 (0.61, 0.81)	0.71 (0.61, 0.81)	0.61 (0.51, 0.71)	1.00

Remark: the data in parentheses is 95% of confidence interval

Table 4-7 Factor AVE and Correlation Coefficient Square Value Among Factors

	Tangibility	Reliability	Assurance	Responsiveness	Empathy
Tangibility	0.574				
Reliability	0.476	0.587			
Assurance	0.548	0.578	0.693		
Responsiveness	0.449	0.423	0.518	0.571	
Empathy	0.325	0.504	0.504	0.372	0.709

Remark: the data on the diagonal are AVE value of each factor, and the data on off-diagonal are square value of correlation coefficients among factors.

C. Criterion validity

Criterion validity is an external standard used to test the validity of the scale. The test and measurement relationship between the measuring fraction and the criterion is used to determine the relationship between the actual test fraction and the criterion based on an empirical statistical analysis, this is also known as empirical validity [203]. This research chooses the university library

service quality under the new information environment (target concept) as the “criterion” to analyse the correlation between the measuring items of five characteristic factors and the target concept. Considering tangibility measuring items as an example, as shown in Table 4-8, the correlation coefficients between all the measuring items of tangibility and the target concept exceeds 0.6, which proves the existence of strong correlation among them. Similarly, the correlations of the other four measuring items of the characteristic factors with the target concept is obtained through analysis and investigations, where a strong positive correlation is identified to be existing among the factors and the target concept, which proves the criterion validity of the scales.

Table 4-8 Correlation Analysis of University Library Service Quality under the New Information Environment with Each Tangibility Measuring Item

		Target Concept	A1	A2	A3	A4	A5	A6
Target concept	Pearson correlation	1	.660**	.633**	.734**	.678**	.680**	.627**
	Significance (both sides)	.000	.000	.000	.000	.000	.000	.000
	N	336	336	336	336	336	336	336
A1	Pearson correlation	.660**	1	.611**	.698**	.577**	.513**	.487**
	Significance (both sides)	.000	.000	.000	.000	.000	.000	.000
	N	336	336	336	336	336	336	336
A2	Pearson correlation	.633**	.611**	1	.591**	.629**	.565**	.527**
	Significance (both sides)	.000	.000	.000	.000	.000	.000	.000
	N	336	336	336	336	336	336	336
A3	Pearson correlation	.734**	.698**	.591**	1	.689**	.620**	.473**
	Significance (both sides)	.000	.000	.000	.000	.000	.000	.000
	N	336	336	336	336	336	336	336
A4	Pearson correlation	.678**	.577**	.629**	.689**	1	.559**	.497**
	Significance (both sides)	.000	.000	.000	.000	.000	.000	.000
	N	336	336	336	336	336	336	336
A5	Pearson correlation	.680**	.513**	.565**	.620**	.559**	1	.483**
	Significance (both sides)	.000	.000	.000	.000	.000	.000	.000
	N	336	336	336	336	336	336	336
A6	Pearson correlation	.627**	.487**	.527**	.473**	.497**	.483**	1
	Significance (both sides)	.000	.000	.000	.000	.000	.000	.000
	N	336	336	336	336	336	336	336

Remark: ** represents significant correlation above 0.01 level

4.3.2 Analysis of user score results

This research evaluates the stability and applicability of the scales from the user perspective through investigating the score conditions of university library service quality under the new information environment. To some extent, if users consider a lot of volatility or obvious regularity for the average score of each measuring item, then this measurement method might return the results with certain systemic errors, namely, poor design stability of the questionnaire or scale. Conversely, the questionnaire or scale is considered to characterize a higher level of scientificity.

It can be observed from Figure 4-3 that the average score of the 26 measuring items of the evaluation scale in the context of university library service quality under the new information environment is moderate around 4.7, with the lowest value being 4.4, and the highest value being 5.13. It neither presents a greater fluctuation, nor shows obvious regularity. Figure 4-4 represents the average user evaluation scores for the five characteristic factors of university library service quality evaluation scale under the new information environment. It is moderate between 4.64 and 4.85 without any greater fluctuation. Thus, the users participated in this evaluation are able to grasp the overall connotation of the university library service quality under the new information environment, and also can clearly understand and recognise the evaluation scales and measuring items designed in this thesis. This proves that the scale is developed scientifically and effectively.

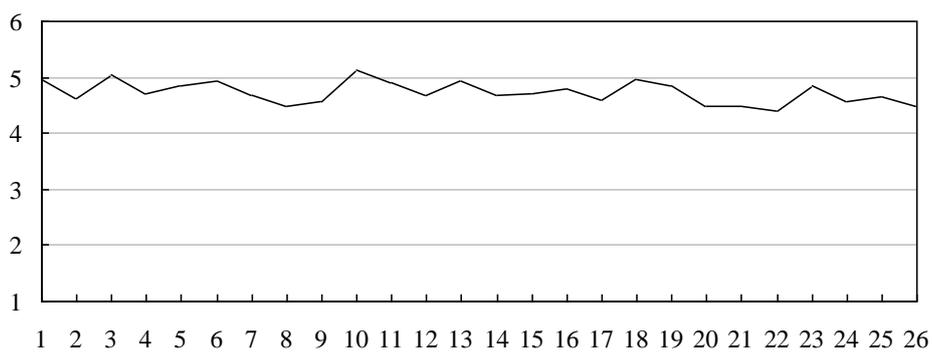


Figure 4-3 Average User Evaluation Score for 26 Measuring Items of Revised SERVQUAL Scale

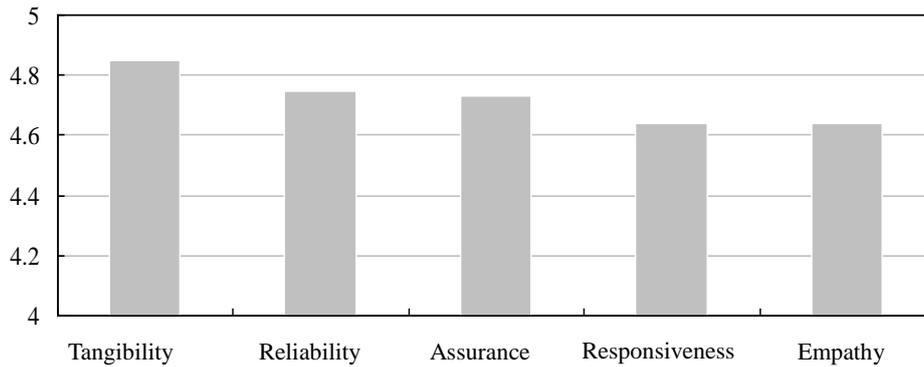


Figure 4-4 Average User Evaluation Score for 5 Dimensions of Revised SERVQUAL Scale

In conclusion, the evaluation scale of the university library service quality under the new information environment built in this research has good credibility and validity. The evaluation scale of the university library service quality under the new information environment based on an extended SERVQUAL also has very good applicability. It can be applied for China's university library service quality evaluation under the new information environment.

4.4 Summary

Firstly, this chapter highlighted the characteristic factors which influence the university library service quality under the new information environment on the basis of SERVQUAL evaluation model. The characteristic factors include tangibility, reliability, assurance, responsiveness and empathy. Additionally, an integrated model for university library service quality influence factors under the new information environment has been built. Secondly, the initial evaluation scales of the university library service quality under the new information environment have been developed based on the original SERVQUAL, through relevant research literatures, user focus group interviews, in-depth expert interviews and other qualitative methods, and then further purified through questionnaire pre-test. Finally, the applicability of the revised SERVQUAL in the evaluation of university library service quality under the new information environment has been expounded through correlation analysis, validity analysis, credibility analysis and user score result analysis, etc. Analysis results demonstrate that the evaluation scale of university library service quality under the new information environment developed based on the revised SERVQUAL in this research exhibits good credibility, validity and applicability. The developed scale can provide valuable inferences for the evaluation and management of university library services under the new

information environment. Additionally, it laid a solid foundation for the verification of multi-level evaluation models of university library service quality under the new information environment.

Chapter 5: Empirical Test on the Multi-Level Evaluation Model of University Library Service Quality under the New Information Environment Based on Revised SERVQUAL

This chapter mainly evaluates the validity and scientific rationality of the proposed multi-level structural evaluation model of university library service quality under the new information environment. Theoretical validation is achieved through an empirical analysis of the revised SERVQUAL model with the extended formal scales of university library service quality under new the information environment. Based on the methods of Hou et al. [79], the developed model validated with sample data, further it is preferable to subject the model with cross-validation checks with another independent sample. With this in mind, the evaluation process is composed of two phases: preliminary validation and cross validation. Firstly, relevant theoretical assumptions for university library service quality under the new information environment are postulated, based on which the multi-structural evaluation models are built. Secondly, the consistency of the formal scales and the initial scales during the process of scale purification is verified, so as to validate the sample data for the preliminary analysis in order to pre-test the theoretical assumptions and the evaluation model; further the validity and scientific rationality of the multi-level models are verified using another dataset.

5.1 Theoretical Assumption and Model Definition

Chapter 4 demonstrated the conceptual models of the influence factors of university library service quality under the new information environment. Due to the consistency among the five common factors extracted through factor analysis and among the five factors of the SERVQUAL evaluation model during the process of scale purification, the basic structure of the theoretical model is not changed.

As per majority of the scholars, service quality is a complex multi-dimensional construct point. However, a definite consensus is yet to be reached on the composition of service quality level. Most

researchers presume service quality as encompassing a two-layer structure, such that service quality characterizes a multi-dimensional two-layer structure. Customers initially evaluate service quality at the layer of service quality dimensions and then form the evaluation results for service quality. Typical research achievements in this aspect include the two-dimensional technology and functional quality structure proposed by Grönroos [58], the pioneer of service quality research, and the SERVQUAL five-dimensional structure proposed by PZB [135] of North American school, and the three dimensional structure put forward by Rust & Oliver [154]. Later, with an in-depth study of the formation mechanisms of service quality and the psychological perceptions of researchers, marketing scholars have begun to unscramble service quality from multi-level perspective. Based on the multi-dimensional and multi-level structural model of retail service quality initially proposed by Dabholkar [44], a more generalized service quality consensus has been popularized and applied by Brady & Cronin [9]. This multi-level service quality structure has been accepted and lauded by plenty of researchers as it reasonably explained the complex mental process of customer aware service quality evaluation to some extent.

This research adopts the aforementioned multi-dimensional and multi-level views to build the evaluation model for university library service quality under the new information environment, since such views have gained theoretical support and empirical validation form numerous researchers (such as Akter[5]; Brady & Cronin[9]; Dabholkar[44]; Zhao[239]). First of all, the multi-dimensional views on service quality are adopted to research university library service quality under the new information environment. The measuring dimensions of service quality are divided into five parts including tangibility, reliability, assurance, responsiveness and empathy. The rationality of such dimensions has been validated through empirical analysis in chapter 4. Secondly, the perceptions of university library service quality under the new information environment are extracted from the users. Studying service quality from a multi-dimensional perspective drives the abstract concepts of university library service quality under the new information environment into a concrete concept. However, the combination of these measuring dimensions concerns the conceptual levels [236]. According to scholars like Dabholkar, this research regards service quality as characterizing a higher-order factor, defined by the main dimensional factors. Each main dimension is explained by several sub-dimension factors. That is to say, user's perception process of university library service quality under the new information environment includes multiple levels,

namely that the service quality is evaluated in three different levels including the sub-dimension level, the main dimension level and the integral level. The integral level is the top layer, where the total service quality of university library under the new information environment is determined by the main dimension. The main dimension level is the middle layer concerning result quality and process quality, which are decided by the encompassing sub-dimensions. The sub-dimension level is the bottom layer, concerning tangibility, reliability, assurance, responsiveness and empathy. Each main dimension and sub-dimension is explained as follows to highlight the research hypothesis in the proposed conceptual model.

5.1.1 Main dimension

Directly evaluating the university library service quality under the new information environment without the sub dimensions would be too abstract. According to Grönroos [58], the main dimensions of service quality evaluation should include service result quality and service process quality, since they cover the basic scope of user evaluation of service quality. Furthermore, service result quality and service process quality have been recognised as the main dimensions of service quality by many other researchers. In addition to these two dimensions, researchers have necessitated the addition of the environment quality dimension to incorporate the effects of service scene elements on service quality evaluation. The division possesses certain theoretical and practical significance. There are no consistent views on whether the environment quality should be considered as a single dimension or not. This research postulates to incorporate the environmental factors into the elements category of result quality, as described in chapter 4.

Result quality depicts the actual service result during the process of university libraries serving users through established contact. For a long time, service marketing academics regarded result quality as an important dimension whilst evaluating service quality, but the related empirical studies are not adequate. Several researchers expressed their views on the inheriting Nordic school. Powpaka [139] is a pioneer of adopting empirical methods to validate the positive effects of result quality on the total service quality under the background of various services. During the last decade, some researchers have also validated the remarkable positive effects of result quality on the perceptions of service quality through empirical study, including traditional service quality (Brady & Cronin [9]; Yue Jiangjun [223]), electronic commerce service quality [23], digital library service

quality and mobile commerce service quality (Brady[9]). In terms of the research results of relevant literatures and the qualitative analysis conducted in this thesis, it has been identified that the result quality has important effect on the user's perception of service quality of university library under the new information environment.

The process quality describes how the university library services are delivered to users, which insist that the perception of service quality is produced whilst users contact and communicate with the university library service staffs and the service system. Process quality also reflects the delivery quality of the university library services. In many cases, the process quality has been regarded as interaction quality or delivery quality by researchers. Due to the inseparability and invisibility of the service itself, it is a general consensus in academia that the process quality has more significant influence on services than the result quality. Many scholars have even defined the service quality as the "real moment" in the service process. The perception for "real moment" is the service quality. A lot of empirical research results have been shown that the process quality has significant positive effects on the perception of service quality. The service scope involved in this research context are extensive, which includes the traditional service quality of business organization (Dabholkar [44]; Brady & Cronin [93]) the service quality of non-profit organization, and the e-commerce quality services under the network environment and mobile commerce service quality (Akter[5]). Based on previous literatures, this research finds that the process quality has an important influence on the evaluation of the university library service quality.

Overall, this thesis adopts the following research hypothesis:

H1: Result quality has a significant positive influence on the perception of service quality of university library under the new information environment.

H2: Process quality has a significant positive influence on the perception of service quality of university library under the new information environment.

5.1.2 Sub-dimensions of result quality

Although result quality has been recognised as having a significant positive influence on customer awareness of service quality in academia, researchers in service marketing domain have different views on the constitutional dimensions of result quality, and even several marketing scholars are

still exploring the structural attributes of result quality. As mentioned above, a series of empirical researches have been conducted on the influential effects of result quality on the total service quality. Most of such analysis has adopted qualitative research methods to explore the constitutional dimensions of result quality. For instance, Richard & Allaway [152] adopted a depth interview method to excavate relevant and decisive factors of result quality; Brady [9] conducted an open questionnaire based interviews, focusing on certain specific properties which influence the perception of service result quality during the process of nearest service experience of interviewees, and then the research results have been encoded qualitatively to identify the attribute factors which influenced the result quality of customer awareness of service quality; Brady [9] combined an in-depth interview method and semi-structured questionnaire method to seek the influential factors of mobile service quality generally concerned by users, ultimately to identify the result quality dimension and its sub-scale through content analysis and coding technology. Various researchers have adopted different research methods to uncover the constitutional dimensions of result quality. The previous studies has demonstrated that there are no potential inherent attributes to explain the result quality so far, and the measuring dimensions of result quality do not form a common and unified consensus. Based on the achievements of previous literatures, this analysis service quality from the connotation and extension of result quality to qualitatively postulate that the sub-dimensions of service result quality of university library under the new information environment contain tangibility and reliability.

Tangibility is an environmental factor integrated with the service process of university library. Tangibility contains not only the environmental factors of the actual service scenario, but also the environmental factors of the virtual elements under the new information environment. Chapter 4 has qualitatively analysed the physical surroundings of the university library and postulated that such elements may have a considerable effect on the result quality. Actually, a few scholars have investigated tangibility as the sub-dimensions of result quality. Their empirical results have shown that the physical surroundings have a significantly positive influence on result quality (e.g. Brady & Cronin [9], Yue [223]). Reliability depicts the degree of university library in accurately performing the service commitments whilst providing users with the access to the collection of resources. The direct effect of reliability on result quality has been empirically supported by various researchers. Therefore, this research postulates both tangibility and reliability as the two main sub-dimensions of

the measurement components of result quality.

Overall, this research adopts the following research hypotheses:

H3: Tangibility has a positive influential effect on service result quality of user perception.

H4: Reliability has a positive influential effect on service result quality of user perception.

5.1.3 Sub-dimensions of process quality

In comparison with the result quality, process quality has an undoubted influence on service quality. Some researchers have even postulated process quality as an equivalent to service quality, since service quality is produced during the process of service delivery and interaction, where users form a direct perception of service quality from their contact established with the service provider. Therefore, researchers generally use interactive quality or delivery quality as an equivalent of the process quality, whilst evaluating its impact on the quality of service. Actually, the process quality mentioned in the research reflects interactive quality. The two main dimensions postulated in this research are based on Gronroos's point of views [58] of process quality. Despite numerous academic researches, consensus about the composition and attributes of process quality is yet to be derived. But, scholars had similar views on the process quality, which makes it easier to identify the constitutional dimensions of process quality. Based on the achievements of previous research literatures and in reference to the structural dimensions of SERVQUAL, this research postulates that the sub-dimensions of university library service quality include process quality under the new information environment. Such sub-dimensions include assurance, responsiveness and empathy.

Service librarians of university library should possess a friendly service attitude, competence in service skills and service knowledge relevant to professional disciplines and information technology. Friendly service attitude can improve the quality of service interaction, and the skills and knowledge of librarians can enhance the trust level among users. Dabholkar [44], through qualitative research, identified that the sub-dimensions affecting the quality of interaction mainly compose inspiration and trust and patience level of service staffs, Dabholkar further postulated such identified sub-dimensions exert a significant influence on the interaction quality. It is obvious that both the aforementioned sub-dimensions belong to the category of assurance. Brady [9], through a combination of qualitative research and empirical study, demonstrated that behaviour and expertise

have a directly influence on the interaction quality. The connotations and questions of behaviour and expertise are similar to skills and knowledge. Such viewpoints have also gained further empirical support at a later stage (Brady [9]; Zhang Long [236]). Responsiveness contains two parts: on the one hand service librarians should take the initiative to care users to provide timely and quick service; on the other hand, library network should also have good responsiveness. Empathy is the individualized consideration for users provided by the service staffs of university library and service system. Yue Jiangjun et al [223] adopted service assurance, service emotion and service charm to measure the quality of service function (process quality). Service assurance is usually consistent with assurance, and there are several similarities between service emotion & service charm and responsiveness & empathy. Lin [105] believed trust, responsiveness and empathy as the key elements affecting interaction quality of user service. Brady [9] proposed three sub-dimensions of service delivery quality including personality, user support and user relationship. The connotations and measuring items of these three sub-dimensions characterize good similarity with the sub-dimensions postulated in this research. Akter [5] divided the sub-dimensions affecting interaction quality into cooperation, confidence and care. Such measuring items are also consistent with the three sub-dimensions postulated in this research. Therefore, this research postulates and adopts assurance, responsiveness and empathy as the three important sub-dimensions to determine and measure process quality.

Overall, this research adopts the following research hypotheses:

H5: Assurance has a positive influential effect on service process quality of user perception.

H6: Responsiveness has a positive influential effect on service process quality of user perception.

H7: Empathy has a positive influential effect on service process quality of user perception.

5.1.4 Model definition

The five factors extracted from the factor analysis during the process of scale purification are completely consistent with the characteristic factors built in this research. It can further be confirmed that the university library service quality evaluation under the new information environment should incorporate the aforementioned five measuring dimensions along with their respective sub-dimensions. The consistency of the proposed dimensions with the factors of the

SERQUAL model validates the correctness of the proposed model, and the fundamental structure of the traditional evaluation model remains the same. In consequence, based on the hypothesis mentioned above, this research constructs the concept model of multi-level evaluation of university library service quality under the new information environment (as shown in Figure 5-1). The integral level in Figure 5-1 presents the overall service quality, the main dimension level represents result quality and process quality, and the sub-dimensions contain tangibility, reliability, assurance, responsiveness and empathy.

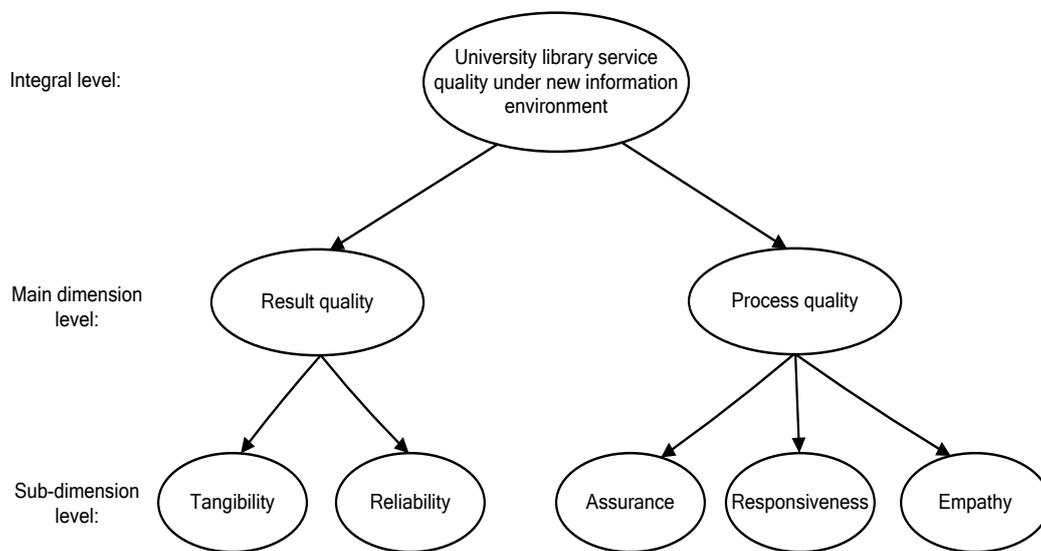


Figure 5-1 Multi-Level Evaluation Model of University Library Service Quality under the New Information Environment

The multi-level construct model built in this research for the university library service quality evaluation under the new information environment reflects the reflection measuring model. Arrows shown in Figure 5-1 depicts the directional flow from higher order construct to main dimension, denoting that the overall service quality is produced from the common factors of the two main dimensions (or main factors). Accordingly, each main dimension represents the common factors of the correspondent sub-dimensions, which is in consistent with the views of previous researches (Akter [5]; Dabholkar [43]; Brady [9]; Lin [105]). However, Brady [9], in his proposed multi-dimensional and multi-level service quality model, regarded the three main dimensions as the constitutive dimensions of service quality. Further, Brady postulated the second order factor structure of the main dimension as the constitutive measuring model and measuring questions for

each main dimension and the overall service quality. That is to say, Brady [9] acquiescently recognised the main dimensions of the antecedent of service quality. However, clear instructions or explanations for the model definition have not been provided, and the testing method of the structural equation model has been adopted to validate the models.

5.2 Model Testing Method

5.2.1 Structural equation modeling

Structural equation modeling (SEM) is a quantitative research method proposed by statistician and psychometrician Jöreskog of Sweden [231]. This approach has become the most important statistical method in the qualitative research of social science and behavioural science field with a wide range of practical application. In short, structural equation modeling is a multivariate statistical analysis method used for testing the relevant observable variable and latent variable, along with the hypothetical relationships among the latent variable, using the data collected to validate the presumptive models built based on theoretical analysis [231]. In general, traditional statistical methods (such as the regression equation) can model the relationship between a dependent variable and several independent variables in one single iteration. When complex relationships exist among multiple dependent variables and independent variables, traditional statistical method should undergo several iterations for modelling such complex relationships. However, the structural equation can not only analyse the complicated relations between the variables, but can also improve the accuracy of the relationship modelling. In addition, the traditional statistical analysis methods do not consider the errors among the independent variables into the inspection category, resulting in an inaccurate estimation of the relationship between the independent and dependent variables, this inaccuracy can even be widely divergent from the actual relationship. However, appropriate structural equations can effectively overcome the limitations of the traditional statistical method. When the structural relationship among the latent variables is analysed, random measurement errors can be culled to highly improve the accuracy of overall measurement.

In comparison with the traditional statistical analysis methods, the structural equation model has been characterized in the following aspects [79][151]: ① SEM can handle multiple dependent

variables simultaneously, and it is affordable to contain measuring errors among both the independent and dependent variables; ② SEM can estimate the relationship between the factor structures and the factors at the same time; however, in the traditional statistical approach, the internal structure of the factors are usually static due to the existence of variations among the structural changes of other factors; ③ SEM offers the measurement models of with greater flexibility, even for the complicated models with higher-order factor. For instance, a measuring indicator in the model can belong to multiple factors, and traditional methods can only allow a given indicator belong to a single factor; ④ SEM can deal with the measurement and analysis of problems at the same time, but the traditional statistical methods cannot deal with the measuring problems during the analysis process. SEM can integrate the measurement and analysis together whilst exploring the relationships among variables; SEM can moderate the measurement errors during the analysis process, thus ensuring that the concept of reliability is integrated into the path analysis and other statistical process; ⑤ SEM facilitates more options of statistical analysis, such as the integration of two different statistical techniques: the factor analysis and the path analysis; ⑥ SEM can not only estimate the structural relationships between the latent variables, but can also estimate the fit degree between different models and the sample data.

Given such characteristics, the structural equation model has apparent advantages in dealing with complex multi-level measurement models. Therefore, this research adopts the correlation statistical method of structural equation to conduct confirmatory factor analysis and testing, for evaluating the third-order factor structural evaluation model developed in this thesis.

5.2.2 Partial disaggregation technique

The stages of testing procedure have been clearly introduced the inspection process and the steps of the multi-level evaluation model, but the specific inspection technology have not been explained. Considering the complexities of the third order factor structure, this research adopts a partial disaggregation technique to conduct the confirmatory factor analysis on the developed model.

Partial disaggregation technique is relative to full dispersion technique, which belongs to the traditional structural equation method. Each item is regarded as independent indicators of their relevant concepts to provide detailed information for the factor structure testing process. Due to the variety of latent variables, along with their measuring items and parameters to be estimated, random

errors are quite common in the testing process. Although the whole dispersion technique can provide better fit index, several number of measurement indicators in each conceptual dimension restrains its efficiency in comparison with the traditional multiple regression analysis (Dabholkar [44]). The partial disaggregation technique combines the measuring items based on the relevancy of the measuring indicators of the concepts. Even though a small number of combined measuring items are used to replace multiple single items, the partial disaggregation technique can be regarded as an effective substitute for the full dispersion technique and multiple regression analysis, thus reducing the number of parameters to be estimated. The advantages of the partial disaggregation technique include reduction in higher percentages of random errors, realization of all the merits of structural equation such as measurement errors estimation, dealing with multi-dimensional variables and testing multi-level factor structure etc. Furthermore, the portfolio approach of the partial disaggregation technique characterizes various methods such as evidence-based, content-oriented and random distribution etc. This research adopts the methods those have been accepted by most of the researchers (Dabholkar [44]; Brady [9]). The measuring items in each sub-dimension are randomly allocated and combined to form 2-3 combined measuring items. Rational random allocation system is used to combine the items under the same dimension, in order to ensure that items under the same dimension are not allocated together. The purpose here is to form randomly combined items for a given dimension in order to obtain similar model fitting effect across the dimensions.

Because the multi-level evaluation model built in this research is more complex, and each sub-dimension contains several measuring items with more parameters to be estimated, the probabilities of generating random errors are higher which can significantly affect the fitting effect of the models. The partial disaggregation technique can effectively resolve this issue. With this in mind, this research adopts the partial disaggregation technique to randomly combine the measuring items in each sub-dimension, thereby benefiting the model testing process with the advantages of the partial disaggregation technique.

5.3 Preliminary Test

Whilst measuring the customer aware service quality to acquire a reliable concept structure, it is sufficient to analyse the customer perception data (Zeithaml [141]). Therefore, this research

analyses a customer perception data to conduct a preliminary test on the multi-level evaluation structure model. Chapter 4 detailed whether the number of samples conforms to the requirements of calculation of the normal distribution, and whether the measuring items approximately confirm to normal assumption or not, which demonstrated that the sample data to be tested can be directly acted up on to analyses and test the structural equation.

In the field of service marketing, a lot of researches have tested the second-order factor model, but none of the previous researches have directly tested the third-order factor model. Because of the lack of a direct testing method, this research adopts the postulations of relevant researchers to validate the third order factor model proposed for university library service quality evaluation under the new information environment, through a three-stage testing procedure. In order to achieve good results, this research adopts the partial dispersion technology to randomly combine the measuring items under each dimension, and further the test fitting and factor loading of each stage factor is achieved through a confirmatory factor analysis. The validation of the entire/partial multi-level structure is achieved through these testing procedures and inspection technologies.

5.3.1 Test of two main dimensions

The first stage of preliminary test involves testing the two main dimensions. The factor models in this stage just contain two main dimensions such as the result quality and process quality, excluding the overall service quality and the five sub-scales, which is called as the first-order factor model of main dimension. As a result, it is not a necessary to inspect the sub-dimensions. The aim of the test in this stage is to validate whether the result quality and process quality are regarded as the appropriate indicators of the overall service quality of the university library under the new information environment and also to determine whether the overall service quality is able to gain the support of research data through result quality and process quality.

Firstly, it is essential to define the measuring items of the factor model. The partial disaggregation technique considers the two main dimensions as equivalent concepts, where the result quality factors contain 11 measuring items, and the process quality contains 15 measuring items. Then, the measuring items of the sub-dimension under each main dimension are combined randomly to form 6 combinations of the indicators as I1, I2, I3, I4, I5, I6 (as shown in Figure 5-2). Considering the result quality as an example, the result quality contains two sub-dimensions such as tangibility and

reliability. Tangibility contains six measuring items A1-A6, and reliability contains five measuring items B1-B5. This thesis regards the 11 measuring items contained in the sub-dimensions of the result quality as equivalent indicators whilst allocating them randomly to form three combined indicators as I1, I2, I3 to test the result quality. The first combined indicator I1 is randomly composed of four measuring items A1, A4, B1 and B4 in the original scale. The second combined indicator I2 is randomly composed of A2, A5 and B2. The third combined indicator is randomly composed of A3, A6, B3 and B5. Correspondingly, the three combined indicators of the process quality are also formed through random allocation of the measuring items of the sub-dimensions. I4 is formed with the combination of five test items C1, C2, D1, E1, E2; I5 is formed with the combination of five test items C3, C5, D2, D4, E3; I6 is formed with the combination of five test items C4, C6, D3, D5, E4. The developed first-order factor model of the main dimension with each measuring indicators are shown in Figure 5-2.

Secondly, LISREL8.80 is used to conduct the confirmatory factor analysis on the first-order factor model of main dimension to estimate and analyse the entire model. It can be observed from the result of the confirmatory factor analysis that the loading values of standardized factors for each combined indicator are very high, and the covariance coefficient of the two main dimensions of the result quality and the process quality are also very high with a value of 0.87, which proves the existence of high-order factors between the two main dimensions. At the same time, the fitting indexes of the first-order factor model in the whole main dimension are very high ($\chi^2 = 9.85$, $df = 8$, $\chi^2/df = 1.23$, RMSEA=0.026, GFI=0.99, AGFI=0.97, CFI=1.00, NNFI=1.00, RFI=0.99) (as shown in Table 5-1). It can be seen from Table that all the fitting indexes are within the range of the recommended value with ideal expectation, which proves that the first-order factor model of main dimension has gained better support from the data.

Thus, it can be concluded that the two main dimensions of result quality and process quality can evaluate the university library service quality under the new information environment.

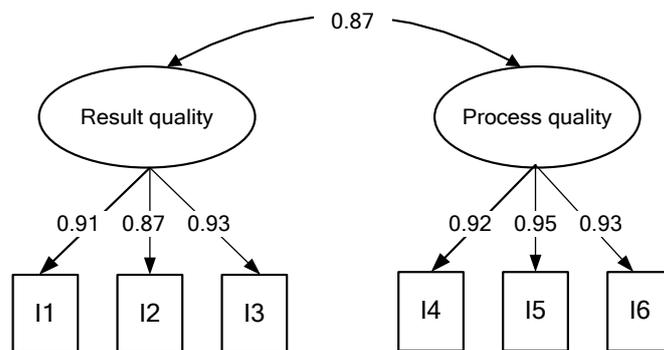


Figure 5-2 Preliminary Test Results of the First-Order Factor Model of Main Dimension

Remark: I1=A1+A4+B1+B4; I2=A2+A5+B2; I3=A3+A6+B3+B5

I4=C1+C2+D1+E1+E2; I5= C3+C5+D2+D4+E3; I6=C4+C6+D3+D5+E4

5.3.2 Test service quality as a higher-order factor

While testing the first-order factor model of the main dimensions, this research identified the existence of a higher covariance between the two main dimensions. Thus, a higher factor is obvious between the two main dimensions to explain the variance (Zhang Long [236]). Therefore, the second stage of testing is to check whether the university library service quality under the new information environment can be considered as a higher order factor of the result and process quality. The aim of testing in this stage is to validate whether the entire service quality can be regarded as a high order factor, namely to check whether users consider the entire service quality on the basis of the two main dimensions whilst evaluating the university library service quality under the new information environment. Factor structure models in this stage are shown in Figure 5-3. The two main dimensions are the primary factors, and the overall service quality is regarded as high order factors of the two main dimensions. Due to the static nature of the first order factors, the measuring items of the main dimension can still use the last stage of the combined indicators.

The entire models are tested through confirmatory factor analysis. The results show that the entire service quality, considered as the second order factor model of the main dimension for higher level factors, possesses a very good fitting index ($\chi^2=9.85$, $df=7$, $\chi^2/df=1.41$, RMSEA=0.035, GFI=0.99, AGFI=0.97, CFI=1.00, NNFI=1.00, RFI=0.99) (as shown in Table 5-1). It can be seen from Table 5-1 that all the fitting indexes are within the range of the recommended value. The model fitting has a good effect in this stage, and the second order factor models are benefitted from the support data. It is obvious that the degree of freedom of the model is reduced by 1 in

comparison with the first order factor models of the main dimension, which indicates that the models are slightly complex. Form the aspects of the model optimization, it is not essential to build a high order factor (Hou [79]). However, the ultimate aim of the model testing in this stage is not model optimization. Researches have commonly tested whether users consider the total service quality as important factors to determine the higher order factors of the result quality and process quality while estimating the university library service quality under the new information environment. Therefore, this research possesses theoretical and practical testing significance.

In addition to the overall fitting index of the model, it also can be observed from Figure 5-3 that the path coefficients between the result quality and its higher order factor, as well as between the process quality and its higher order factor are remarkable with a value of 0.89 and 0.98 respectively. This shows that the two main dimensions and the entire service quality characterize a highly positive correlation, thus validating the authenticity of hypothesis H1 and H2. Thus, both the result quality and the process quality have significant positive influence on the university library service quality under the new information environment.

Thus, this thesis draws the following conclusions. It is reasonable to consider service quality as the second order factor model of the main dimension with high order factor. The university library service quality under the new information environment is composed of result quality and process quality. Users evaluate the entire service quality on the basis of result quality and process quality. The entire service quality explains the common variance between result quality and process quality.

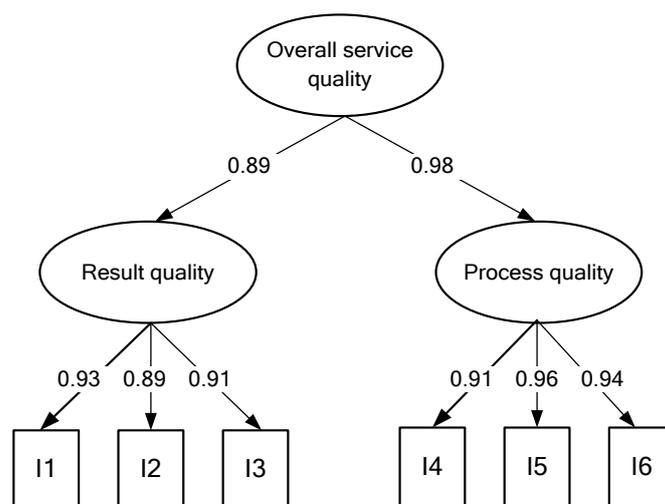


Figure 5-3 Preliminary Test of Service Quality as Higher-Order Factor

Remark: I1=A1+A4+B1+B4; I2=A2+A5+B2; I3=A3+A6+B3+B5; I4=C1+C2+D1+E1+E2

I5=C3+C5+D2+D4+E3; I6=C4+C6+D3+D5+E4

5.3.3 Testing five sub-dimensions

The third stage of testing is to test whether the factor models of the five sub-dimensions are reasonable, namely to check whether the result quality and process quality are considered as the second-order factor of the five sub-dimensions. The factor model test in this stage can be divided into two parts: first-order factor model test (as shown in Figure 5-4) and second-order factor model test, where the result quality and process quality are considered as the second-order factor (as shown in Figure 5-5).

Firstly, the first order factor models of the five sub-dimensions are tested, since a good fitting degree of first-order factor models is a prerequisite for testing the second-order factor models. Result quality contains two sub-dimensions such as tangibility and reliability. Process quality contains three sub-dimensions such as assurance, responsiveness and empathy. The first-order factor model of the sub-dimensions is composed of these five sub-dimensions without the two main dimensions. Before the confirmatory factor analysis, the partial disaggregation technique is used to randomly combine the measuring items under each sub-dimension. Because the measuring items and their quantities under each dimension are different from that of the first two stages, the measuring items are reallocated according to the principle of randomization. The measuring items of each sub-dimension are randomly combined into two combined indicators in this stage. Considering tangibility as example, the original measuring items are randomly combined into I1 and I2. I1 is formed with a random combination of A1, A3, and A6. I2 is formed with a random combination of A2, A4, and A5. Other four sub-dimensions are dealt according to the same principle. The combinations of specific measuring items are shown in the remarks of Figure 5-5.

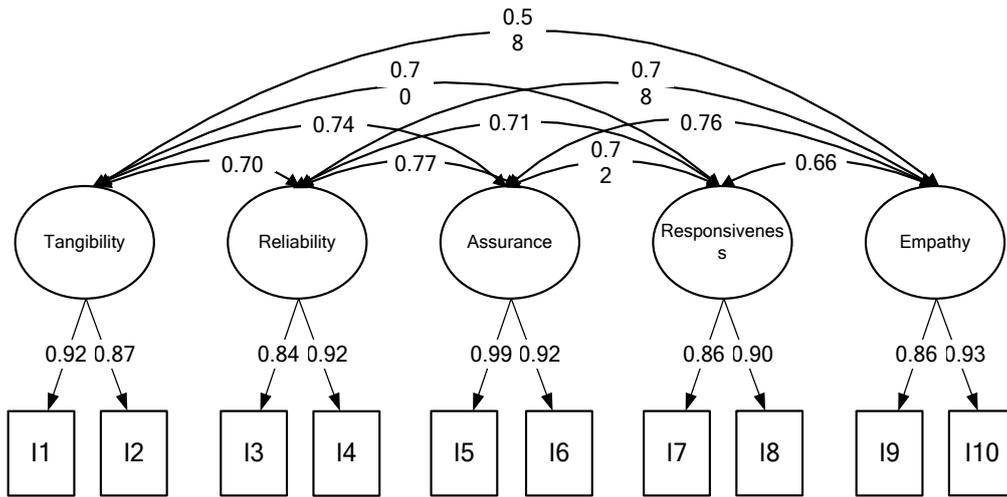


Figure 5-4 Preliminary Test for the First-Order Factor Model of Sub-dimension

Remark: I1=A1+A3+A6; I2=A2+A4+A5; I3=B1+B3; I5=C1+C2+C4
 I6=C3+C5+C6; I7=D1+ D2+D4; I8=D3+ D5; I9=E1+E2; I10=E3+E4

LISREL8.80 is used to carry out the confirmatory factor analysis for the first-order factor model of the sub-dimensions. The result shows that the partial disaggregation technique guides the first-order factor model of sub-dimension to characterize a good model fitting effect ($\chi^2=42.85$, $df=25$, $\chi^2/df=1.71$, RMSEA=0.046, GFI=0.98, AGFI=0.95, CFI=1.00, NNFI=0.99, RFI=0.99) (as shown in Table 5-1). It can be seen from Table 5-1 that all the fitting indexes are within the range of the recommended value, which proves that the first-order factor model has obtained better degree of fitting. At the same time, as shown in Figure 5-4, the loading values of all the factors are very high with a maximum value of 0.99 and a minimum value of 0.84. The covariance coefficients among the five sub-dimensions are also very high, which shows infers the existence of a higher-order factor among the five sub-dimensions. Therefore, it is significant to validate the second-order factor model of the sub-dimensions.

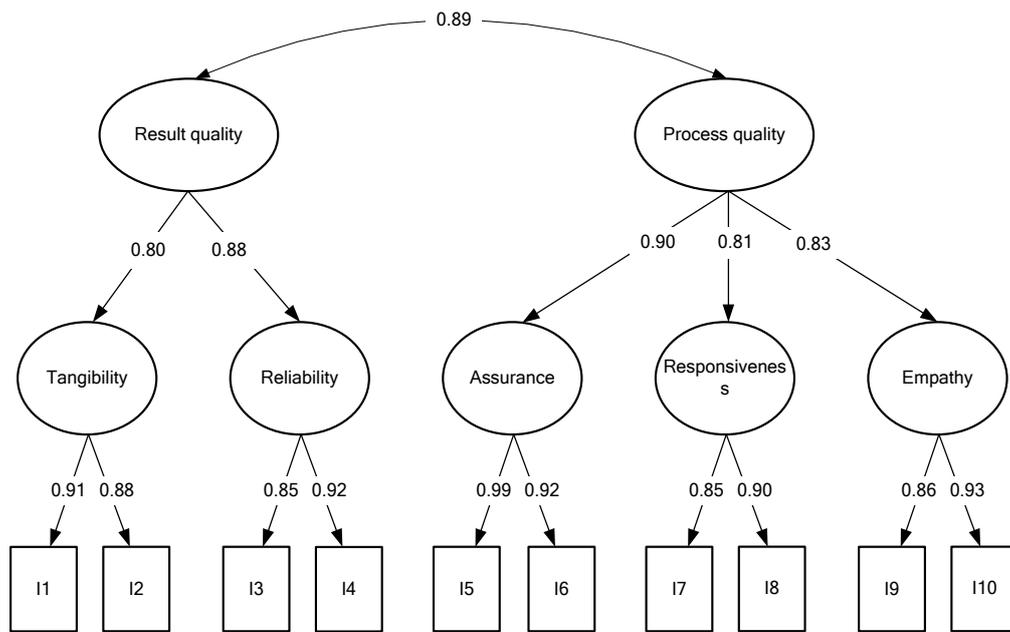


Figure 5-5 Preliminary Test for the Second-Order Factor Model of Sub-dimension

Remark: I1=A1+A3+A6; I2=A2+A4+A5; I3=B1+B3; I5=C1+C2+C4

I6=C3+C5+C6; I7=D1+ D2+D4; I8=D3+ D5; I9=E1+E2; I10=E3+E4

Similar to the first-order factor model, the second-order factor model is also tested through the confirmatory factor analysis. The second-order factor model of the sub-dimensions is shown in Figure 5-5. The five sub-dimensions are considered as the primary factors, and the result quality and process quality of the main dimensions are considered as high-order factors. Confirmatory factor analysis shows that the second-order factor model of the sub-dimension characterize good model fitting effect ($\chi^2=68.38$, $df=29$, $\chi^2/df=2.36$, RMSEA=0.064, GFI=0.96, AGFI=0.93, CFI=0.99, NNFI=0.99, RFI=0.98) (as shown in Table 5-1). It can be observed from Figure 5-5 that all the fitting indexes are within the range of the recommended value, which shows that the second-order factor model of the sub-dimensions has obtained better data support. In addition, as shown in Figure 5-5, the path coefficients between tangibility & reliability and result quality are remarkable with a value of 0.80 and 0.88 respectively; the path coefficients between assurance & responsiveness & empathy and process quality are also remarkable too, with the respective values of 0.90, 0.81 and 0.83. It implies that the five sub-dimensions characterize a good reflection of their main dimensions, thus validating the theoretical assumptions of H3, H4, H5, H6, and H7 established earlier. Therefore, tangibility and reliability have their positive effects on service result quality; assurance, responsiveness and empathy have their positive effects on service process quality.

This analysis leads this thesis to take on the following inferences: Users evaluate the service result quality from two sub-dimensions of tangibility and reliability, and the result quality explains the common variance between tangibility and reliability; users evaluate the process quality from three sub-dimensions of assurance, responsiveness and empathy, and the process quality explains the common variance between assurance, responsiveness and empathy.

Table 5-1 Overall Fitting Index of Factor Model in Each Stage of Preliminary Test

Preliminary test (n=336)	X ²	df	X ² /df	RMSEA	GFI	AGFI	CFI	NNFI	RFI
Test for first-order factor model test of main dimension	9.85	8	1.23	0.026	0.99	0.97	1.00	1.00	0.99
Test service quality as higher-order factor	9.85	7	1.41	0.035	0.99	0.97	1.00	1.00	0.99
Test for first-order factor model of sub-dimension	42.85	25	1.71	0.046	0.98	0.95	1.00	0.99	0.99
Test for second-order factor model of sub-dimension	68.38	29	2.36	0.064	0.96	0.93	0.99	0.99	0.98
Range of recommended value	—	—	≤ 5.00	≤ 0.08	≥ 0.85	≥ 0.80	≥ 0.90	≥ 0.90	≥ 0.90

In conclusion, the three stages of the factor model tests have obtained good data fitting, which shows that the three levels of multi-level structure proposed in this thesis have gained strong data support. It proves that the full multi-level evaluation model of university library service quality under the new information environment built in the research is effective. On the other hand, the testing results also show that users form the evaluation results not only from the comparative evaluation of service expectation and actual perception, but also characterize a multi-level perception while evaluating the university library service quality under the new information environment. These research conclusions are consistent with the previous researches in this context.

5.4 Massive Research

In order to further validate the third-order factor model and the aforementioned conclusions, this research conducts a massive questionnaire-based and pre-form cross validation of the proposed models. Because the results of the pre-test data samples do not significantly deviate from the

original scale, and the formal scale is basically the same as the original scale, the questionnaires for pre-testing are also adopted the same as the original scale. This questionnaire-based research aims to further test the validity of the multi-level evaluation model of the university library service quality under the new information environment developed in this research, so as to lay a solid foundation for the multi-level evaluation model ultimately to improve the evaluation of university library service quality under the new information environment.

5.4.1 Sample Source and descriptive statistics

The questionnaires contain three parts as follows: Part 1 is the basic information of the participating users, mainly including the information of the participating users such as gender, age, education, professional category and their frequency of using university library services, etc. Part 2 is composed of the questionnaire subject, namely the measuring items which are designed according to the formal scale of university library service quality under the new information environment. Three responses including minimum acceptable value, desired value and actual experience value are adopted for each question in this part, in reference to the original SERVQUAL questionnaire and the formation mechanism and research results of the university library service quality under the new information environment, detailed in Chapter 3. This questionnaire presents the advantages of obtaining more comprehensive service quality information and effective identification of the prominent issues of current service quality. Herein, the proposed model can effectively identify the specific elements of service quality that need enhancement in order to provide a more practical guide and suggestions for improving the service quality levels of university library. In addition, a 7-point Likert scale is adopted for measuring the range of each response. Thus, the scope of the response scores are from 1 to 7, with 1 showing disagreement to a great extent, and 7 showing complete agreement. This analysis aims to distinguish user perception in an even better fashion. Part 3 represents the overall perception, opinions and suggestions of users for the university library service quality.

The objects of this massive research include libraries from 16 undergraduate universities in Shanghai, Wuhan, Hangzhou, Nanjing and Zhenjiang. The participating universities include 10 comprehensive key universities from the Ministry of Education, 4 provincial comprehensive universities and 2 finance and economics universities, covering all types of university libraries. The

samples have certain representativeness. Research time lasted from June 15 to June 30, 2014. The questionnaire-based survey has been conducted with a well-trained group of students.

The tested users have been randomly selected from teaching buildings, libraries and other public rest areas on in campus of the universities. It not only ensures the randomness of sample source, but also encourages the tested users to attempt the questionnaires carefully, thereby improving the quality of questionnaires. The massive research lasted for half a month and obtained 604 questionnaire samples. 48 questionnaires containing lots of missing values or obvious random fill tendency have been eliminated, which results in 556 valid questionnaires, with an effective rate of 92.05%. The questionnaires have been further classified to gain the basic information of users (as shown in Table 5-2). It can be observed from Table 5-2 that the ratio of male users tested is 51.44%, and the ratio of female users tested is 48.56%, and the participated users include 54.50% of undergraduates, 36.87% of postgraduates and 8.63% doctoral level students. In terms of the discipline, most of the users are engineering students at 29.5%; 16.19% of economic students, 13.85% of management students, and 11.51% of science students, the cohort of users include students from Literary & History & and Philosophy, Medicine, Law and other subjects equating to less than 10%. In terms of the usage frequency, nearly half of the users (45.68%) use the relevant services of university library 2 to 3 times a week (including physical library and/or digital library), 34.53% of users use the library service for more than four times a week, and 19.79% of users use the library service only once a week or less.

Table 5-2 Descriptive Statistics of Massive Research Samples

Variable	Measuring items	Frequency	Percentage (%)	Cumulative percentage (%)
Gender	Male	286	51.44	51.44
	Female	160	48.56	100
	Total	556	100	
Educational background	Undergraduate	303	54.50	54.50
	Master's degree	205	36.87	91.37
	Doctor's degree	48	8.63	100
	Total	556	100	
Discipline background	Literary, history and philosophy	48	8.63	8.63
	Science	64	11.51	20.14
	Engineering	164	29.50	49.64
	Medicine	37	6.65	56.29
	Law	41	7.37	63.66

	Economics	90	16.19	79.85
	Management	77	13.85	93.7
	Other	35	6.30	100
	Total	556	100	
Frequency of use (Weekly)	4 times or more	192	34.53	34.53
	2 to 3 times	254	45.68	80.21
	Once or less	110	19.79	100
	Total	556	100	

5.4.2 Normal distribution test of samples

Before the cross validation of the multi-level factor model, it is essential to test the samples for normal distribution. SPSS 19.0 is used to analyse the data samples for conducting descriptive statistical analysis of the 26 measurement variables of the university library service quality under the new information environment. The extracted descriptive statistics include maximum value, minimum value, mean value, standard error, standard deviation, variance, skewness, kurtosis, and its standard error, etc. This descriptive analysis is aimed at testing whether the item variables satisfy the hypothesis of following normal distribution or not, and providing the prerequisite for later confirmatory factor analysis and model interaction test. In general, a skewness between -1 and +1, and kurtosis between -3 to +3 in the data samples can satisfy the hypothesis of normal distribution. In addition, certain quantity requirements should also be satisfied to calculate the normal distribution of the sample data, such that the total number of samples should maintain the five times of the measuring items. This research has recovered a total of 556 effective questionnaires from the survey, but there are only 26 measuring items, $26 \times 5 = 130$, which is far less than the number of effective samples. Thus, the questionnaires gained from the massive research satisfy the requirement of normal distribution.

Table 5-3 Descriptive Statistics Results of the Measurement Variables in Massive Research

Dimension	Measured variable	Minimal value	Maximum value	Mean value		Standard deviation	Variance	Skewness		Kurtosis	
				Statistics	Standard error			Statistics	Standard error	Statistics	Standard error
Tangibility	A1	1	7	4.92	0.041	1.375	1.891	-.511	.104	-.081	.207
	A2	1	7	5.42	0.039	1.357	1.842	-.322	.104	-.245	.207
	A3	1	7	3.28	0.057	1.334	1.779	-.528	.104	-.127	.207
	A4	1	7	4.95	0.045	1.326	1.759	-.287	.104	-.529	.207
	A5	1	7	4.86	0.047	1.332	1.774	-.506	.104	-.105	.207

	A6	1	7	4.11	0.057	1.408	1.982	-.576	.104	-.159	.207
Reliability	B1	1	7	4.42	0.055	1.307	1.707	-.217	.104	-.220	.207
	B2	1	7	4.37	0.058	1.310	1.717	-.085	.104	-.584	.207
	B3	1	7	4.91	0.051	1.291	1.668	-.371	.104	-.392	.207
	B4	1	7	4.95	0.046	1.251	1.564	-.492	.104	-.174	.207
	B5	1	7	4.99	0.046	1.223	1.496	-.441	.104	-.356	.207
Assurance	C1	2	7	4.77	0.050	1.285	1.652	-.253	.104	-.536	.207
	C2	1	7	4.75	0.049	1.326	1.758	-.537	.104	-.158	.207
	C3	1	7	4.78	0.045	1.289	1.661	-.326	.104	-.595	.207
	C4	2	7	4.74	0.047	1.267	1.606	-.268	.104	-.658	.207
	C5	1	7	5.42	0.045	1.360	1.849	-.392	.104	-.482	.207
	C6	1	7	4.90	0.048	1.313	1.725	-.241	.104	-.421	.207
Responsiveness	D1	1	7	4.91	0.050	1.563	2.441	-.634	.104	-.418	.207
	D2	1	7	4.69	0.050	1.539	2.370	-.562	.104	-.362	.207
	D3	1	7	4.82	0.051	1.379	1.901	-.121	.104	-.503	.207
	D4	1	7	4.52	0.049	1.309	1.713	-.115	.104	-.522	.207
	D5	1	7	4.67	0.048	1.428	2.040	-.257	.104	-.570	.207
Empathy	E1	1	7	5.10	0.048	1.322	1.748	-.299	.104	-.476	.207
	E2	1	7	4.30	0.050	1.308	1.710	-.110	.104	-.647	.207
	E3	1	7	4.47	0.051	1.288	1.658	-.168	.104	-.590	.207
	E4	1	7	4.56	0.059	1.343	1.804	-.080	.104	-.300	.207

The descriptive statistics extracted for the 26 measurement variables using SPSS 19.0. It can be observed that the skewness of the 26 measurement variables is between -0.634 and -0.08, which meets the prerequisite of normal distribution; further the kurtosis is between -0.658 and -0.081, again ensuring normal distribution. Therefore, it can be concluded that the probability distribution of all the sample data under each measurement variable approximately conforms to the normality assumption, so that the sample data obtained through the questionnaires can be used for confirmatory factor analysis and cross model validation.

5.5 Cross Validation

The preliminary test conducted on the multi-level evaluation model of the university library service quality under the new information environment theoretically proves that the model characterizes a good fit with the actual data. Though the third-order factor model is validated, it may only fit the pre-test data. The fit of a given data do not necessarily conform to other sample data. Thus, it is necessary to test the applicability of the proposed multi-level models and other sample data, so that another test and estimation of the interaction validity is essential. The principle procedures of the cross validation are basically the same as that of the preliminary test. The tested factor model

structure is also the same, though the data samples are different. Thus, this section conducts analysis and cross validation on the questionnaire data for validating the proposed third-order factor model through the procedures and methods of the preliminary test.

5.5.1 Test of two main dimensions

Similar to the preliminary test, the cross validation is firstly conducted for the two main dimensions to validate the first-order factor of the main dimension. The aim of this inspection stage is to validate whether the result quality and the process quality are regarded as the appropriate indicators of the overall service quality of the university library under the new information environment and to describe whether the overall service quality is able to gain the support of the research data through result quality and process quality.

Because the procedures and methods of the cross validation and the preliminary test are the same, the combined indicators of the model structure and the measurement items are also the same, thus resetting the test is not required. Therefore, it is suitable to directly use the sample data of the questionnaire research for cross validating the first-order factor model of the main dimension. It can be observed from the results of the confirmatory factor analysis that the loading values of each combined indicators are very high, and the covariance coefficient of the two main dimensions of result quality and process quality are also very high, with a value of 0.86, which proves the existence of a high-order factor between the two main dimensions. Furthermore, the fitting indexes of the first-order factor model for the whole main dimension are very good ($\chi^2 = 19.24$, $df = 8$, $\chi^2/df = 2.41$, RMSEA=0.05, GFI=0.99, AGFI=0.97, CFI=1.00, NNFI=1.00, RFI=0.99) (as shown in Table 5-4). It can be seen from Table 5-4 that all the fitting indexes are within the range of the recommended value. This proves that the first-order factor model of the main dimension has obtained better data support and conforms to the requirements of cross validation. Thus, this thesis concludes that the two main dimensions of result quality and process quality can evaluate the university library service quality under the new information environment.

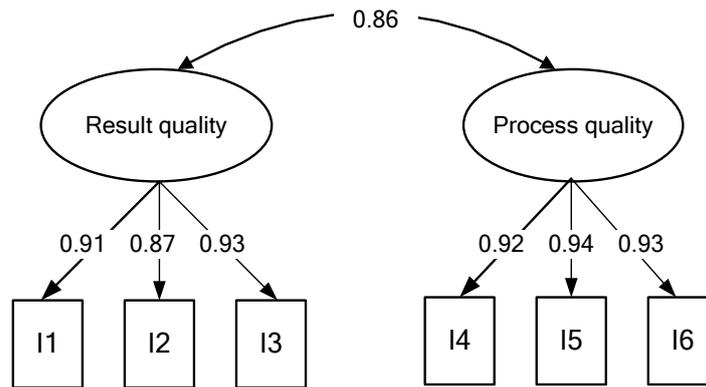


Figure 5-6 Cross Validation of the First-Order Factor Model of Main Dimension

Remark: I1=A1+A4+B1+B4; I2=A2+A5+B2; I3=A3+A6+B3+B5

I4=C1+C2+D1+E1+E2; I5= C3+C5+D2+D4+E3; I6=C4+C6+D3+D5+E4

5.5.2 Test service quality as a higher-order factor

Table 5-4 Overall Fitting Index of the Factor Model in Each Stage of Cross Validation

Cross validation (n=556)	X2	df	X2/df	RMSEA	GFI	AGFI	CFI	NNFI	RFI
Test for first-order factor model test of main dimension	19.24	8	2.41	0.050	0.99	0.97	1.00	1.00	0.99
Test service quality as higher-order factor	19.25	7	2.75	0.054	0.99	0.97	1.00	1.00	0.99
Test for first-order factor model of sub-dimension	71.98	25	2.88	0.058	0.97	0.94	0.99	0.99	0.99
Test for second-order factor model of sub-dimension	123.4 6	29	2.36	0.077	0.96	0.92	0.99	0.98	0.98
Range of recommended value	-	-	≤ 5.00	≤ 0.08	≥ 0.85	≥ 0.80	≥ 0.90	≥ 0.90	≥ 0.90

Similar to the preliminary test, the aim of inspection in this stage is to validate whether the entire service quality can be regarded as a high-order factor, namely whether users consider the entire service quality on the basis of the two main dimensions of result quality and process quality, whilst evaluating the university library service quality under the new information environment. The entire models are cross validated through confirmatory factor analysis, and the results show that the entire service quality, considered as the second order factor model of higher level factor, possesses good fitting index ($\chi^2 = 19.25$, $df = 7$, $\chi^2/df = 2.75$, RMSEA=0.054, GFI=0.99, AGFI=0.97, CFI=1.00,

NNFI=1.00, RFI=0.99) (as shown in Figure 5-4). This shows that the service quality considered as the high-order factor is cross validated, so that the second-order factor model of the main dimensions have gained strong support of the actual data.

In addition to the overall fitting index of the model, it also can be observed from Figure 5-7 that the path coefficients between the result quality/process quality and the high order factor are remarkable, with values of 0.89 and 0.98 respectively. This further ensures the validation of the theoretical assumptions H1 and H2 proposed earlier in this thesis. Thus, this thesis concludes the following. It is reasonable to consider service quality as the second order factor model of the main dimension for high order factor. University library service quality under the new information environment is composed of result quality and process quality, and users evaluate the entire service quality on the basis of result quality and process quality. The entire service quality explains the common variance between result quality and process quality.

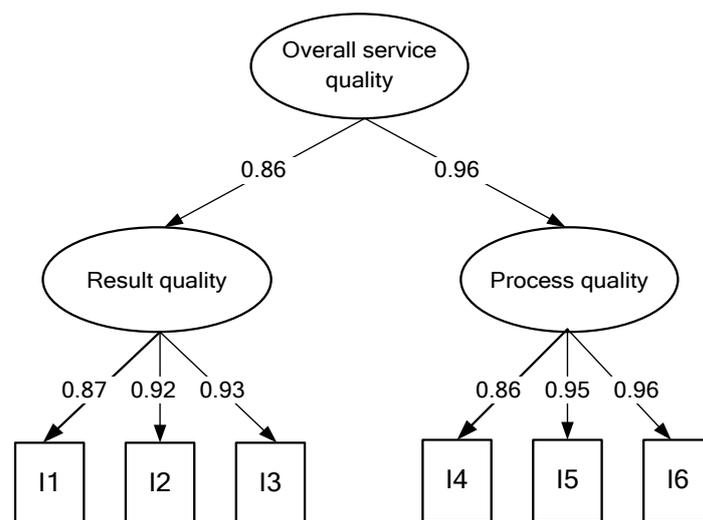


Figure 5-7 Cross Validation of Service Quality as Higher-Order Factor

Remark: $I1=A1+A4+B1+B4$; $I2=A2+A5+B2$; $I3=A3+A6+B3+B5$; $I4=C1+C2+D1+E1+E2$
 $I5=C3+C5+D2+D4+E3$; $I6=C4+C6+D3+D5+E4$

Test of five sub-dimensions:

The cross validation in the third stage is similar to the preliminary test. This test aims to validate whether the factor models of the five sub-dimensions are reasonable, namely whether result quality and process quality can be considered as the second-order factor of the five sub-dimensions. The cross validation in this stage can be divided into two parts: First is the cross validation of the first-order factor model of the five sub-dimensions; the combined indicators of the model structure and the measurement items are similar to that of the preliminary test; Second is the cross validation

of the second-order factor model of the five sub-dimensions, namely whether result quality and process quality can be considered as the second-order factor. The combination of indicators of the model structure and the measurement items are also similar to that of the preliminary test.

The first-order factor model of the sub-dimensions is conducted through confirmatory factor analysis. The results show that the first-order factor model of the sub-dimension characterize good model fitting effect ($\chi^2=71.98$, $df=25$, $\chi^2/df=2.88$, RMSEA=0.058, GFI=0.97, AGFI=0.94, CFI=0.99, NNFI=0.99, RFI=0.99) (as shown in Table 5-4), and all the fitting indexes are within the range of the recommended value. This proves that the first-order model has a good fitting and has been cross validated. It can be observed from Figure 5-8 that the loading values of the all combined indicators are high with a maximum value of 0.98 and a minimum value of 0.84. The covariance coefficients among the five sub-dimensions are also high. This infers the existence of high-order factor among the five sub-dimensions. Therefore, it is suitable to conduct cross validation on the second-order factor model of the sub-dimensions.

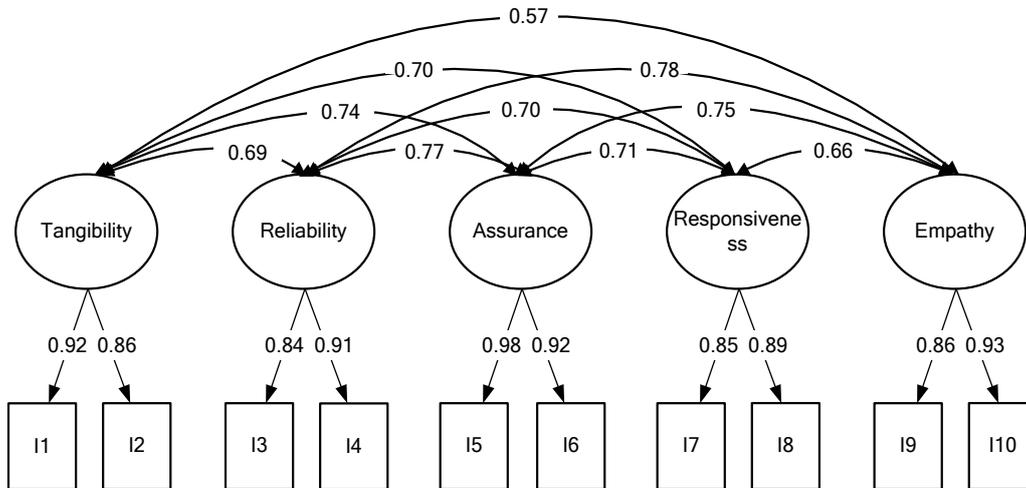


Figure 5-8 Cross Validation of the First-Order Factor of Sub-dimension

Remark: I1=A1+A3+A6; I2=A2+A4+A5; I3=B1+B3; I5=C1+C2+C4
 I6=C3+C5+C6; I7=D1+ D2+D4; I8=D3+ D5; I9=E1+E2; I10=E3+E4

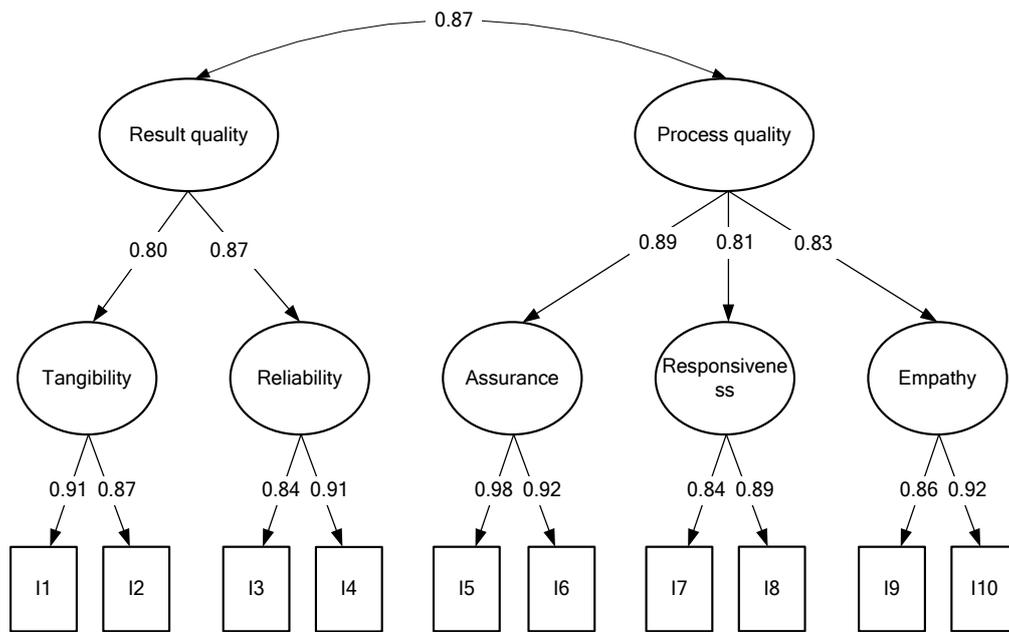


Figure 5-9 Cross Validation of the Second-Order Factor of Sub-dimension

Remark: I1=A1+A3+A6; I2=A2+A4+A5; I3=B1+B3; I5=C1+C2+C4

I6=C3+C5+C6; I7=D1+ D2+D4; I8=D3+ D5; I9=E1+E2; I10=E3+E4

Based on the cross validation of the first-order factor model of the sub-dimensions, this thesis conducts the cross validation of the second-order factor model of the sub-dimensions. Through confirmatory factor analysis, this research identifies that the second-order factor model of the sub-dimensions characterize good model fitting effect ($\chi^2=123.46$, $df=25$, $\chi^2/df=2.36$, RMSEA=0.077, GFI=0.96, AGFI=0.92, CFI=0.99, NNFI=0.98, RFI=0.98) (as shown in Table 5-4), and all the fitting indexes are within the range of the recommended value. This shows that the second-order model of the sub-dimensions has obtained strong support of actual data and has been cross validated.

In addition, as shown in Figure 5-9, the path coefficients between result quality and the two sub-dimensions are very remarkable, with values of 0.80 and 0.87 respectively; the path coefficients between process quality and three sub-dimensions are also remarkable, with values of 0.89, 0.81 and 0.83 respectively. This implies that the five sub-dimensions characterize a good reflection of their respective main dimensions, and the theoretical assumption of H3, H4, H5, H6, and H7 proposed earlier has been cross validated. Thus, tangibility and reliability have positive effects on the service result quality, and assurance, responsiveness and empathy have positive effects on the service process quality. To this end, this thesis presents the following conclusions. Users evaluate the service result quality based on the two sub-dimensions of tangibility and reliability, and result

quality depicts the common variance between tangibility and reliability. Users evaluate the process quality based on the three sub-dimensions of assurance, responsiveness and empathy, and process quality depicts the common variance between assurance, responsiveness and empathy.

In summary, the multi-level evaluation model of university library service quality under the new information environment developed in this thesis has been successfully cross validated, so that the third-order factor model proposed is effective. The 7 theoretical assumptions postulated in this research have been validated, and the multi-level evaluation model has been supported by the actual data sample during the preliminary test and cross validation with universality and stability. The analysis has provided inferences to improve the service quality of university libraries under the new information environment.

5.6 Summary

This chapter postulated relevant theoretical assumptions and concept models of multi-level evaluation; then introduced the test methods and procedures of multi-level evaluation model for university library service quality under the new information environment, and further validated the multi-level evaluation model through preliminary test and cross validation. The results of the preliminary test and cross validation demonstrated that the 7 theoretical assumptions postulated in this research have been validated, and the structural evaluation model of the third-order factor of university library service quality under the new information environment developed in this thesis have been cross validated with strong support from the actual data sample. The structural evaluation model shows good applicability and validity, thereby providing effective inferences for enhancing the research in the context of university library service quality under new information environment.

Chapter 6: Research on Improvement Strategies of Library Service Quality of HEI

6.1 Analysis of Overall Library Service Quality of Higher Education Institution under the New Information Environment

In order to understand the concept of overall library service quality of the higher education institution under the new information environment, this study acts upon the sample data obtained from the large-scale questionnaire survey and quantifies the overall service quality in order to identifies the research gaps in the current scenarios of HEIs Since the measuring dimensions and their indicators may have different level of influences on the rating scale and models are unique in nature, it is essential to determine the weight of each measuring dimension and its indicator before measuring the overall service quality.

In order to evaluate the overall service quality accurately by obtaining objective and authentic inferences, it is important to assign each dimension and its indicator with appropriate scientific weighting. PZB [140] have prioritized the five respective dimensions of service quality by the way of directly relating the customer grant values to the five dimensions of SERVQUAL. But this method was objected by Cronin and Taylor, et al [20], since customer's evaluation might often include inaccuracies. Later, PZB (1994) have empirically proved that when the mean error rate of the customer grant value relative to the five dimensions of SERVQUAL reaches 22.5%, then this reflects that customers have not understood the significance of the five dimensions. Recent studies and evaluations conducted on the library service quality in China have revealed that users have no deeper understanding of the library service quality of the higher education institutions, particularly some of the measuring dimensions are yet to be demystified. Therefore, it is unsuitable to evaluate the importance of each dimension through a direct measurement of the user grant value. Besides, such a subjective manner of granting value is liable to the subjective influences of the users, thus lowering the credibility of the granted value.

To this end, this study adopts the sample data obtained from the large-scale questionnaire survey and evaluates the relative importance of the weights of each dimension and its respective indicators

up on the overall library service quality in higher education institutions under the new information environment, using regression analysis to fully reflect the intention of the users. By this way, this thesis obtains a more objective value to avoid the influence of the subjective judgments and recognition of the grant value by the users.

6.1.1 Evaluation the weight of each dimension

This study considers the library service quality of the higher education institution under the new information environment as the dependent variable, each dimension as the explaining variable, and conducts regression analysis on the survey data based on a stepwise multiple regression in order to obtain the regression coefficient of each dimensions in the library service quality of the higher education institution under the new information environment (shown in Table 6-1). Table 6-1 depicts the regression equation of the standard coefficients as the following.

Library service quality of higher education institution under the new information environment = $0.245 \times \text{tangibility} + 0.101 \times \text{reliability} + 0.193 \times \text{assurance} + 0.158 \times \text{responsiveness} + 0.154 \times \text{empathy}$.

The weight of each dimension is obtained by normalizing the standardized regression coefficient

$$w_i = w_i / \sum_{j=1}^5 w_j$$

Table 6-1 Stepwise Multiple Regression Analysis Result of Service Quality in Each Dimension

Dependent Variable	Explaining Variable	Unstandardized Coefficient		Standardized Coefficient	t	Significance
		Estimated	Standard	Beta		
		Value B	Error	Distribution		
Library Service Quality of Higher Education Institution under new information environment	(Constant)	1.479	.129		11.448	.000
	Tangibility	.043	.007	.245	6.566	.000
	Reliability	.018	.007	.101	2.703	.007
	Assurance	.027	.006	.193	4.472	.000
	Responsiveness	.030	.009	.158	3.458	.001
	Empathy	.033	.008	.154	4.003	.000

6.1.2 Evaluation of the weight of each indicator

By considering each dimension as the dependent variables, the indicator of each dimension as the explaining variable, this study obtains the standardized regression coefficient of each indicators corresponding to their dimensions using stepwise multiple regression. After being normalized, results of the weight of each indicator corresponding to their dimension is shown in Table 6-2. The weight of the overall library service quality of the higher education institution under the new information environment is obtained by multiplying the weight of each dimension with the weight of the corresponding indicator. By evaluating the weight of each dimension and its indicator, this thesis presents the user's perception and expectation on the library service quality of the higher education institution under the new information environment more accurately. Thereby offers useful inferences to the libraries of the higher education institution whilst identifying appropriate services to be improved for achieving rapid service quality improvement.

Table 6-2 Weight of each Dimension and its Indicator

Dimension	Indicator Variable	Standardized Regression Coefficient	Indicator-Dimension Weight	Dimension-Overall Weight	Indicator-Overall Weight	Indicator Weight Sequence
Tangibility	A1	0.203	0.142	0.288	0.041	19
	A2	0.193	0.135		0.039	17
	A3	0.285	0.200		0.058	26
	A4	0.225	0.158		0.045	21
	A5	0.236	0.166		0.048	23
	A6	0.283	0.199		0.057	25
Reliability	B1	0.280	0.216	0.119	0.026	4
	B2	0.297	0.229		0.027	5
	B3	0.256	0.197		0.023	3
	B4	0.231	0.178		0.021	1
	B5	0.234	0.180		0.021	2
Assurance	C1	0.188	0.162	0.227	0.037	10
	C2	0.194	0.167		0.038	13
	C3	0.197	0.170		0.039	15
	C4	0.201	0.173		0.039	18
	C5	0.193	0.166		0.038	12
	C6	0.187	0.161		0.037	9
Responsiveness	D1	0.266	0.210	0.185	0.039	16
	D2	0.262	0.207		0.038	14
	D3	0.243	0.192		0.036	8
	D4	0.254	0.201		0.037	11
	D5	0.240	0.190		0.035	7
Empathy	E1	0.291	0.246	0.181	0.044	20

E2	0.229	0.193	0.035	6
E3	0.305	0.258	0.047	22
E4	0.359	0.303	0.055	24

6.1.3 Evaluation of service quality scores

After obtaining the relative importance of the weights of each dimension and its indicator, this thesis measures the overall library service quality of some higher education institutions in East and Middle China, and computes the score of each dimension evaluated by the users whilst understanding the overall library service quality of the higher education institution under the new information environment. This evaluation is intended to postulate specific improvement measures whilst evaluating the overall service quality and the score of each dimension of the library of the higher education institution under the new information environment. The equation below is utilized to measure the overall library service quality of the higher education institution under the new information environment and the score of each dimension.

Equation of dimension score: $LSQ_i = \sum_{j=1}^{n_i} w_{ij} s_j$; equation of overall service quality score:

$$LSQ = \sum_{i=1}^5 w_i LSQ_i$$

In the equation, LSQ_i represents the score of the i th dimension of the library service quality of the higher education institution under the new information environment; w_{ij} represents the weight of the j th indicator in the i th dimension; s_j represents the score of the j th indicator; w_i represents the weight of the i th dimension in the overall service quality.

Mean perceived service quality, mean perceived adequacy gap and mean perceived superior gap of each indicator are computed by analysing the data obtained from the large-scale questionnaire survey, and then the score of each dimension and the overall service quality based on the above three mean values are computed using the aforementioned score equation to obtain the results shown in Table 6-3, Table 6-4 and Table 6-5, respectively.

Table 6-3 Score of Each Dimension and the Overall Score Based on Mean Perceived Service Quality

Dimension	Indicator	Mean Perceived Service Quality	Indicator-Dimension Weight	Dimension Score	Dimension-Overall Weight	Overall Service Quality Score
Tangibility	A1	4.92	0.142	4.493	0.288	4.671
	A2	5.42	0.135			
	A3	3.28	0.200			
	A4	4.95	0.158			
	A5	4.86	0.166			
	A6	4.11	0.199			
Reliability	B1	4.42	0.216	4.702	0.119	4.671
	B2	4.37	0.229			
	B3	4.91	0.197			
	B4	4.95	0.178			
	B5	4.99	0.180			
	B6	4.90	0.162			
Assurance	C1	4.90	0.162	4.747	0.227	4.671
	C2	4.91	0.167			
	C3	4.69	0.170			
	C4	4.82	0.173			
	C5	4.52	0.166			
	C6	4.67	0.161			
Responsiveness	D1	4.77	0.210	4.885	0.185	4.671
	D2	4.75	0.207			
	D3	4.78	0.192			
	D4	4.74	0.201			
	D5	5.42	0.190			
Empathy	E1	5.10	0.246	4.619	0.181	4.671
	E2	4.30	0.193			
	E3	4.47	0.258			
	E4	4.56	0.303			

Table 6-4 Score of Each Dimension and Overall Score Based on Mean Perceived Adequacy gap

Dimension	Indicator	Mean Perceived Adequacy gap	Indicator-Dimension Weight	Dimension Score	Dimension-Overall Weight	Overall Service Quality Score
Tangibility	A1	0.31	0.142	0.310	0.288	0.218

	A2	0.68	0.135		
	A3	-0.21	0.200		
	A4	0.49	0.158		
	A5	0.44	0.166		
	A6	0.33	0.199		
	B1	-0.02	0.216		
	B2	0.14	0.229		
Reliability	B3	0.13	0.197	0.120	0.119
	B4	0.11	0.178		
	B5	0.26	0.180		
	C1	0.19	0.162		
	C2	0.21	0.167		
Assurance	C3	0.10	0.170	0.152	0.227
	C4	0.12	0.173		
	C5	0.11	0.166		
	C6	0.19	0.161		
	D1	0.17	0.210		
	D2	0.20	0.207		
Responsiveness	D3	0.06	0.192	0.207	0.185
	D4	0.08	0.201		
	D5	0.54	0.190		
	E1	0.19	0.246		
Empathy	E2	0.11	0.193	0.228	0.181
	E3	0.07	0.258		
	E4	0.47	0.303		

It can be observed from these tables that the score of the perceived service quality for the five dimensions is 4.493, 4.702, 4.747, 4.885 and 4.619, respectively, and the overall score is 4.671; the score of the perceived adequacy gap for the five dimensions is 0.310, 0.120, 0.152, 0.207 and 0.228, respectively, and the overall score is 0.218; the score of the perceived superior gap for the five dimensions is -1.401, -1.632, -1.592, -1.487 and -1.623, respectively, and the overall score is -1.528.

From this analysis, the score of the mean service quality of the libraries of 16 higher education institutions involved in the survey is 4.671. Although it is still 1.528 time lower than the overall score expected by the users, it is 0.218 times higher than the minimum value accepted by the users, thereby falling within the acceptable range. However, the library of the higher education institution has to strengthen and improve the service quality to meet the user's expectation, thus better

satisfying the users and consolidating the user adhesiveness. Secondly, similar to the score of the overall service quality, the score of each dimension is only slightly better than the minimum acceptance level of the users, and still far below the ideal level expected by the users. The gap among user expectation in witnessed in three dimensions, namely, reliability, responsiveness and empathy. Since this gap is relatively higher, the library of the higher education institution should focus on improving these three dimensions, while the service quality in the other two dimensions could also be improved.

Table 6-5 Score of Each Dimension and Overall Score Based on Mean Perceived Superior Gap

Dimension	Indicator	Mean Perceived Superior Gap	Indicator-Dimension Weight	Dimension Score	Dimension-Overall Weight	Overall Service Quality Score
Tangibility	A1	-1.47	0.142	-1.401	0.288	
	A2	-1.02	0.135			
	A3	-1.77	0.200			
	A4	-1.28	0.158			
	A5	-1.42	0.166			
	A6	-1.32	0.199			
Reliability	B1	-1.83	0.216	-1.632	0.119	
	B2	-1.71	0.229			
	B3	-1.53	0.197			
	B4	-1.62	0.178			
	B5	-1.42	0.180			
Assurance	C1	-1.53	0.162	-1.592	0.227	-1.528
	C2	-1.47	0.167			
	C3	-1.65	0.170			
	C4	-1.61	0.173			
	C5	-1.68	0.166			
	C6	-1.62	0.161			
Responsiveness	D1	-1.59	0.210	-1.487	0.185	
	D2	-1.56	0.207			
	D3	-1.65	0.192			
	D4	-1.72	0.201			
	D5	-0.88	0.190			
Empathy	E1	-1.56	0.246	-1.623	0.181	
	E2	-1.77	0.193			

E3	-1.81	0.258
E4	-1.42	0.303

6.2 Analysis of Cost Function of Library Service Quality of Higher Education Institution

Cost function is the curve formed by the ordinal measurement made by the users with respect to the overall satisfaction or indicator satisfaction, reflecting the user's demand for the overall quality or a certain indicator (Grigoroudis & Siskos [54]). As shown in Figure 6-1, if the cost function resembles near straight line, then users are more satisfied and have given a higher evaluation, and such users are called as the neutral user; if the cost function depicts a concave curve, then users will never be really satisfied unless delivering the best quality to give a favorable evaluation, and such users are very demanding and are known as the demanding user; if the cost function appears resembles a convex curve, then users have given the favorable evaluation as their expectation are satisfied to a certain extent, and such users possess no other demands in the service aspects and are called as the non-demanding user. A more concave curve depicts demanding users and a more convex curve depicts non-demanding users.

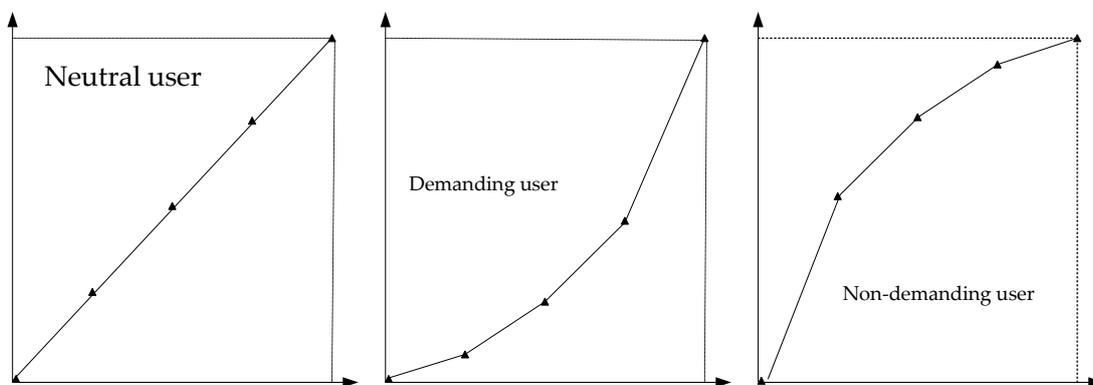


Figure 6-1 Cost Function of Different Demand Levels

This study categorizes the overall user satisfaction within the library service quality of the higher education institution under the new information environment into seven types, namely, “Very Unsatisfied”, “Unsatisfied”, “Relatively Unsatisfied”, “Ordinary”, “Relatively Satisfied”, “Satisfied” and “Very Satisfied” and sets them as control variables, further sets each dimension as the dependent variable and conducts the single factor analysis of variance to obtain the relationship between the score of each dimension and the score of the overall quality, as shown in Table 6-6. In

addition, this study draws the cost function for the five dimensions of the library service quality of the higher education institution under the new information environment according to Table 6-6, as shown from Figure 6-2 to Figure 6-6. It can be observed from Table 6-6 that samples with higher score for the overall satisfaction also characterize a higher score for each of the incurred dimension, indicating that each of the dimensions are highly consistent with the overall satisfaction, and the multi-level model constituted theoretically characterize favorable astringency and effectiveness.

Table 6-6 Check of Effectiveness of Each Dimension and Overall Satisfaction

Dimension	Overall Satisfaction						
	Very Unsatisfied	Unsatisfied	Relatively Unsatisfied	Ordinary	Quite Satisfied	Satisfied	Very Satisfied
Tangibility	1.500	2.850	3.339	3.832	4.460	5.062	5.719
Reliability	2.300	3.000	3.180	3.831	4.615	5.280	5.763
Assurance	1.333	2.233	2.867	3.734	4.688	5.355	5.825
Responsiveness	1.700	2.640	3.213	4.050	4.789	5.453	5.895
Empathy	1.500	2.175	3.075	3.621	4.510	5.207	5.605
Sample Quantity	2	10	30	116	161	205	32

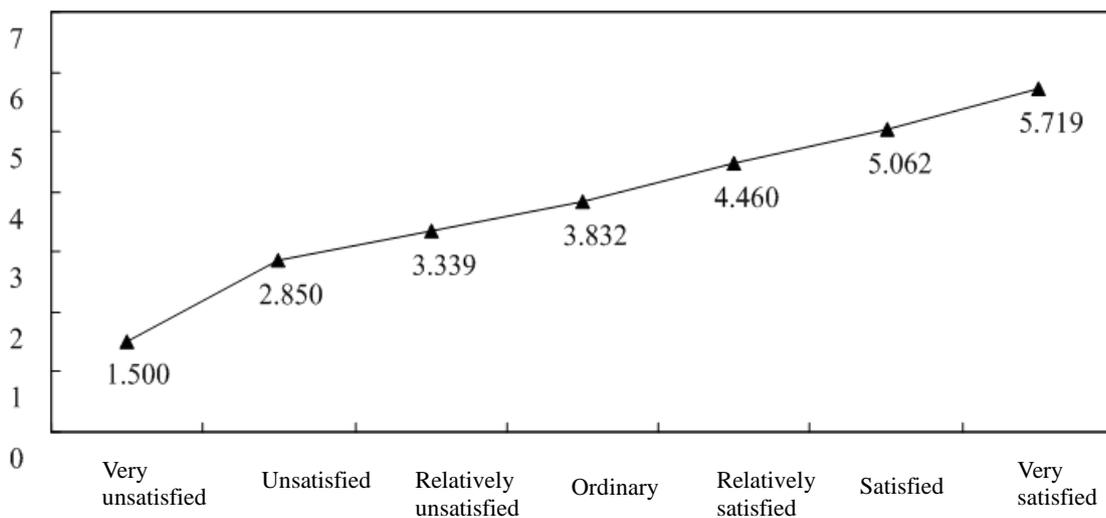


Figure 6-2 Cost Function of Tangibility

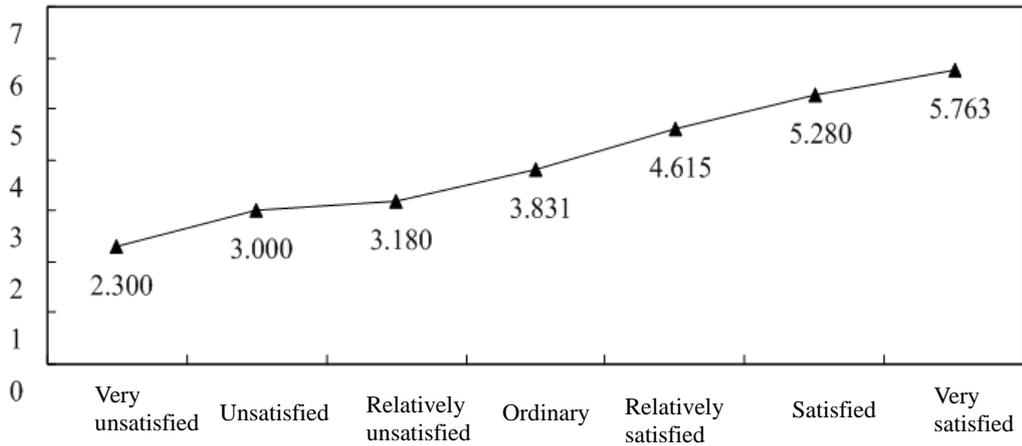


Figure 6-3 Cost Function of Reliability

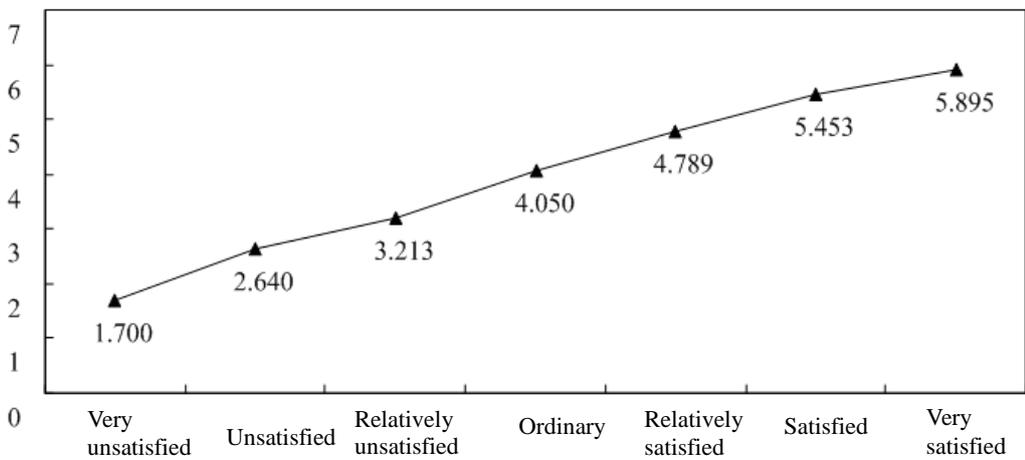


Figure 6-4 Cost Function of Assurance

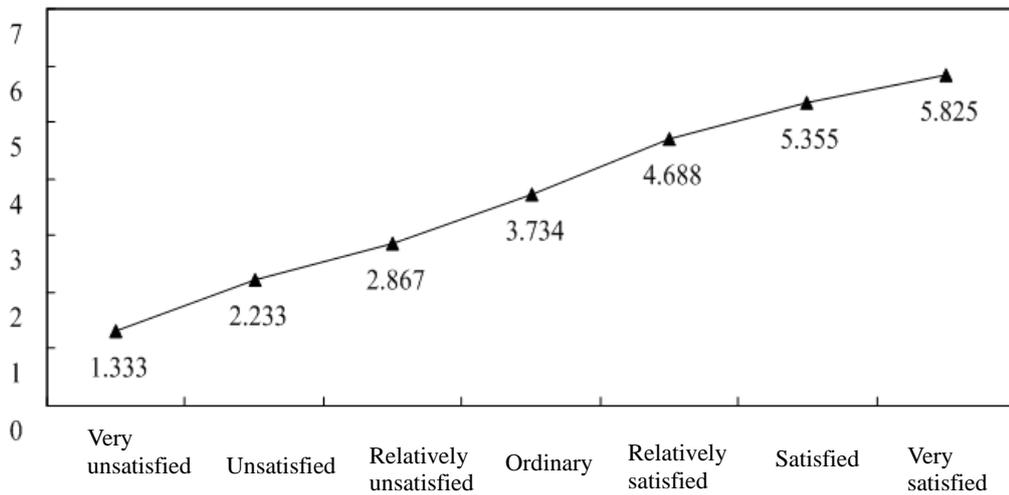


Figure 6-5 Cost Function of Responsiveness

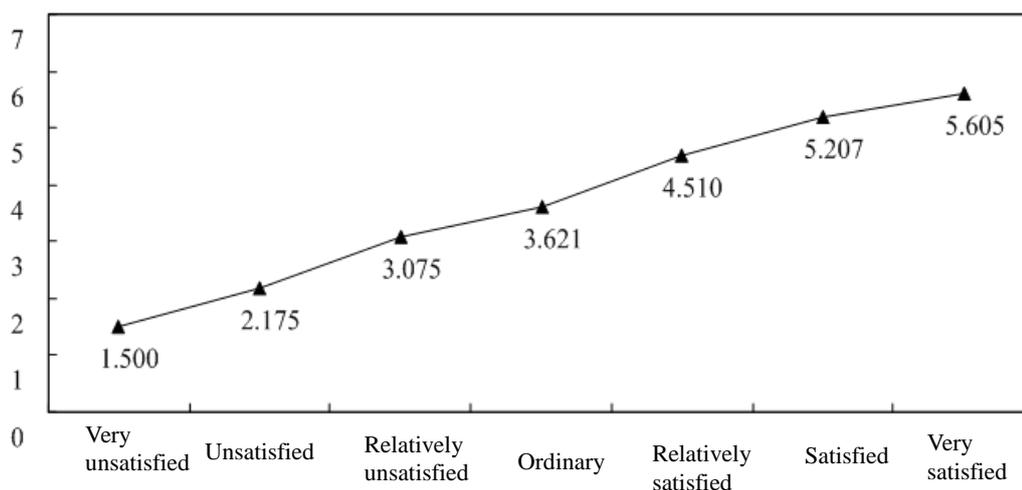


Figure 6-6 Cost Function of Empathy

It can be observed from these figures that the cost functions of the five dimensions basically resamples a near straight or slightly concave, indicating that the user's expectation in these five dimensions is highly satisfied, and users have given higher evaluations but still possess certain other demands. Among these cost functions, concave trend of the cost function of reliability is the most significant, indicating that users still demand improvements in the reliability of the service quality. Users demand more information resources from the, thus the library management personnel of the higher education institution should pay more attention to improve the reliability attribute of the service quality. The cost function of tangibility is nearly straight but a little convex, indicating that the library of the higher education institution is performing well in the aspects of physical and tangible network environment offered to the users, and users still do have a few demands. This result is quite consistent with the evaluation of the service quality of tangibility mentioned above. Cost functions of the assurance, responsiveness and empathy are nearly straight, indicating that users are completely satisfied in these three aspects. This infers us that users may have different levels of demands under different dimensions of service quality.

In addition to the cost function analysis of the five major dimensions, this study also conducts the cost function analysis of their corresponding 26 indicators, but not discussed in further detail. There are some notable drawbacks in the cost function since it evaluates the indicator and dimension from the perspectives of the user's demand, thus not evaluating each indicator more specifically. Therefore, the following sub-section presents a more specific analysis of the 26 indicators through action diagram methods.

6.3 Analysis of Action Diagrams of Library Service Quality of Higher Education Institution under the New Information Environment

Action diagrams are a series of decision diagrams generated with the combination of importance weight and mean of the user satisfaction. Since action diagrams reflect the importance of the evaluated object or the indicator, and the user satisfaction in order to determine the strategies of improvement in the service quality, it is also called as performance-importance maps or gap analysis. In the action diagram, x-coordinate usually represents the satisfaction performance and y-coordinate represents the importance weight, and the entire diagram is divided into four quadrants according to the satisfaction performance and importance weight, with each quadrant standing for an action or strategy (as shown in Figure 6-7).

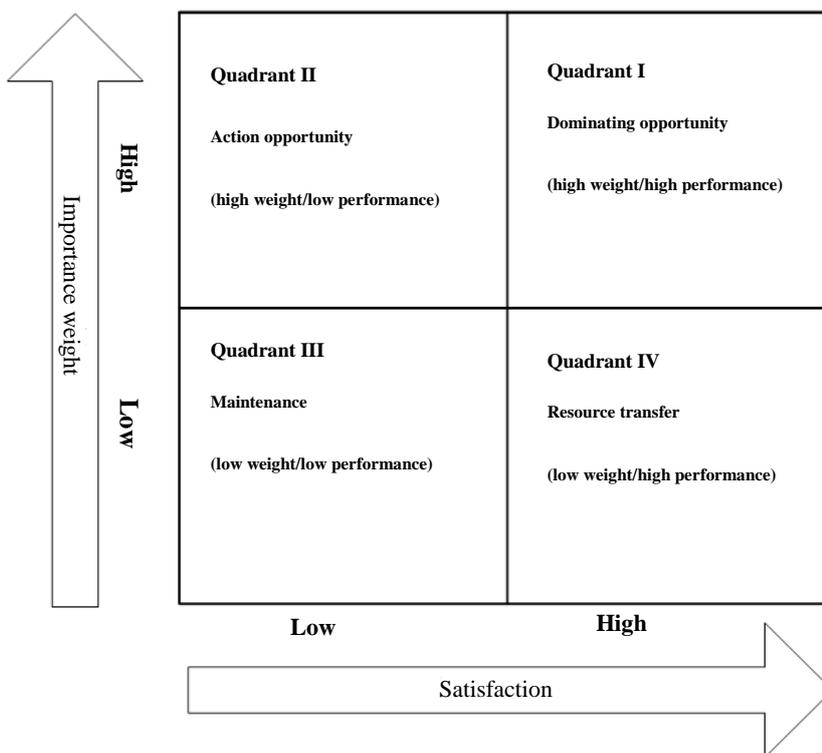


Figure 6-7 Four Quadrants of Action Diagrams

Quadrant I is the area of dominating opportunity, that is, the high-weight/high-performance area. Users intent for the service items in this area and are usually very satisfied. Such service items may constitute the competition advantage of the organization. Quadrant II is the area of action opportunity, that is, the high-weight/low-performance area. Service items in this area are quite important for the users, which might significantly influence the performance of the organization.

But the existing mean of the user satisfaction is quite low in this area, thus the organization should pay more attention to improve the user satisfaction. Quadrant III is the maintenance area, that is, the low-weight/low-performance area. Service items in this area are less important for the users and the mean of the user satisfaction is quite low, so that generally no specific action strategies are required towards the service items in this area. Quadrant IV is the resource transfer area, that is, the low-weight/high-performance area. Service items in this area are less important for the users, but the user's satisfaction is usually very high. A possible reason is that organizations invest excessive resources for such service items, that is, such items occupy excessive resources of the organization. As a result, organizations transfer resources in excess to improve other service items, so as to optimize the resource deployments of the organization as whole.

The four quadrants in the action diagrams can also be used to determine the priority of service items. Quadrant II on the upper left corner characterize the most prioritized level, so that organizations must focus on the service items in this area, since they are very important for users, whenever users are not quite satisfied with the current performance. Quadrant I on the upper right corner depicts the second most prioritized level, since service items in this area constitute the competitive advantages of the organization. These service items are also very important for the users and the user's expectation of satisfaction is quite high in this area. Thus, organizations should focus on necessary improvements in this area especially when there is an identified space for the improvement in the service items. Quadrant III on the lower left corner is the third most prioritized level, since the service items in this area might be of future importance for users, although they are less important at present. Organizations should pay attention to improve these items, when the current user satisfaction is identified to be very low. Quadrant IV on the lower right corner is the least prioritized level, since service items in this area are not important for users and the current user satisfaction is usually witnessed to be very satisfactory. Obviously, this sequence of priority is not always static. Different organizations may require different prioritized level of improvement strategies, depending on the potentiality of the organizations in improving relevant items.

Table 6-7 and Figure 6-8 shows Action Diagrams of Library Service Quality of Higher Education Institution under the New Information Environment ,X- coordinate means "Performance score of indicator" and "Y - coordinate means" Relative weight of indicator". Take "A3" for example, the Value Granted of "A3" is "26" under " Sequence by Weight of Indicator ", however, under"

Sequence by Mean Score of Indicator ",the Value Granted of "A3" is just "1"and the " Mean Score of Indicator " for "A3" is 4.56, therefore, the position of "A3" in the Action Diagrams is locates at the area of " Quadrant II" ,which means needs to be improved immediately.This study draws action diagrams of the library service quality of the higher education institution under new the information environment according to the survey data with the motivation of assisting higher education institutions whilst determining the service items which needs improvement, ultimately to elevate the perceived service quality for efficiently satisfying the user needs. Firstly, this study sorts the indicators of the library service quality of the higher education institution under the new information environment and grants values to each indicator, sets the indicators with the highest weight of “26”, and continues this process until the indicators with the lowest weight are granted with the value of “1”. Further, this study sequences and grants values to the mean service quality score of each indicator to finally obtain the descendingly sorted relative weights and mean score of each indicator, as shown in Figure 6-7. In the next step, this study considers the mean service quality score of each indicator (i.e. value in the sequence of mean score) as the transverse axle; a larger value of this transverse axle implies a higher perceived service quality and satisfaction performance among the users. Further, the relative importance of each indicator is considered (i.e. value in the sequence of indicator weight) as the longitudinal axle; a larger value of this longitudinal axle implies a higher relative importance of that corresponding indicator. Each step will generate a coordinate in the coordinate plane based on the sequence of relative weight and mean score, and such coordinates constitute the action diagram of the library service quality of the higher education institution under the new information environment. The diagram comprises 26 coordinates, representing the 26 indicators of the library service quality of the higher education institution under new the information environment. These 26 coordinates are scatter across the four different quadrants.

Table 6-7 Sequence and Value by Weight and Means Score of Indicators

Original Indicator Number	Sequence by Weight of Indicator			Sequence by Mean Score of Indicator		
	Indicator-Overall Weight	Indicator Number after Sequencing	Value Granted	Mean Score of Indicator	Indicator Number after Sequencing	Value Granted
A1	0.041	A3	26	4.92	A2	26
A2	0.039	A6	25	5.42	D5	25
A3	0.058	E4	24	3.28	E1	24

A4	0.045	A5	23	4.95	B5	23
A5	0.048	E3	22	4.86	A4	22
A6	0.057	A4	21	4.11	B4	21
B1	0.026	E1	20	4.42	A1	20
B2	0.027	A1	19	4.37	B3	19
B3	0.023	C4	18	4.91	C2	18
B4	0.021	A2	17	4.95	C1	17
B5	0.021	D1	16	4.99	A5	16
C1	0.037	C3	15	4.90	C4	15
C2	0.038	D2	14	4.91	D3	14
C3	0.039	C2	13	4.69	D1	13
C4	0.039	C5	12	4.82	D2	12
C5	0.038	D4	11	4.52	D4	11
C6	0.037	C1	10	4.67	C3	10
D1	0.039	C6	9	4.77	C6	9
D2	0.038	D3	8	4.75	E4	8
D3	0.036	D5	7	4.78	C5	7
D4	0.037	E2	6	4.74	E3	6
D5	0.035	B2	5	5.42	B1	5
E1	0.044	B1	4	5.10	B2	4
E2	0.035	B3	3	4.30	E2	3
E3	0.047	B5	2	4.47	A6	2
E4	0.055	B4	1	4.56	A3	1

Quadrant I represents the area of dominating opportunities (high-weight/high-performance) for the library service of the higher education institution. The relative importance and service quality scores of the indicators in this area are quite high, demonstrating the effectiveness of the library services in the higher education institution. Such scores are critical for the library services of the higher education institution to stay competitive. Indicators in this area include the following: “A1. Clean and comfort internal environment of the library”, “A2. Reasonable arrangement of internal facilities of the library”, “A4. Clear and easy-understanding navigation of the library’s website”, “A5. Beautiful interface of the library’s website”, “C2. Librarian always receives users politely”, “C4. Librarian is capable of answering questions from users”, “E1. Convenient and considerate service (e.g. rain gear, tea restaurant, etc.) is available for users” and “D1. Librarian deals with opinions and suggestions from users on time”. The library of the higher education institution should maintain all

such indicators and undertake development and consolidation measures to elevate the positive influences of such service items on the overall service quality of the library.

Quadrant II represents the area of action opportunity (high-weight/low-performance) for the library service of the higher education institution, that is, the areas requiring urgent improvements. Indicators in this area are quite important for users but the current perceived service quality score is still low. Thus, the library of the higher education institution should pay special attention in this area, since this area characterizes the first level of priority in the improvement strategies. Indicators in this area include: “A3. Library contains space provisions for team study and discussion”, “A6. User’s interface of mobile library is very attractive”, “D2. Librarian remedies the fault on time”, “C3. Librarian understands the user’s demand well”, “E3. Library provides customized online services to users” and “E4. Library provides training to users”. Since such indicators are quite important and significantly affect the service quality, it is obvious that such indicator may also affect the overall service quality adversely when being poor. But the current user satisfaction of such indicators is quite low in this area. Therefore, the higher education institution should undertake positive improvement strategies for such service items to improve the service quality, ultimately to elevate the overall library service quality of the higher education institution under the new information environment. Quadrant III depicts the maintenance area (low-weight/low-performance) of the library service of the higher education institution. Indicators in this area are less important for the users and the service quality score is quite low, thus an urgent actionable strategy is not usually required. Indicators in this area include: “B1. Service awareness of librarian is consistent with the description”, “B2. Service of the library is consistent with the description”, “D4. Website and resource downloading facilities of the library are smooth”, “C5. Consulting librarian of each discipline is proficient”, “C6. Librarian possesses knowledge in relation to the new information technology” and “E2. Library cares customized demands of users”. Although action strategies are required for such indicators, user satisfaction of such indicators is still low. Thus, the library of the higher education institution should subsequently observe such indicators, since some of these indicators might be of future importance for users. The library of the higher education institution should also consider improving such indicators to discover the opportunities for further enhancing the service quality.

Quadrant IV represents the resource transfer area (low-weight/high-performance) for the library

service of the higher education institution. Indicators in this area are less important for the users but the service quality score is relatively high, demonstrating that the library of the higher education institution characterize significant achievements in this aspect. Indicators in this area include: “B3. Users can retrieve their expected information and resources easily”, “B4. Electronic resources (e.g. database) of the library meets user demands”, “B5. Users can access the electronic resources anytime and anywhere (e.g. from their living area)”, “D3. Online librarian can answer the user questions on time”, “D5. Few errors exist in the website link of the library” and “C1. Librarian is friendly”. Such indicators of the library of the higher education institution are already good enough and the mean user’s satisfaction is quite high, so that there is no need of amendments in the near future. However, investments on such indicators can be decreased in the long term to transfer the service resources in excess to those service items requiring immediate improvements to elevate the overall service quality.

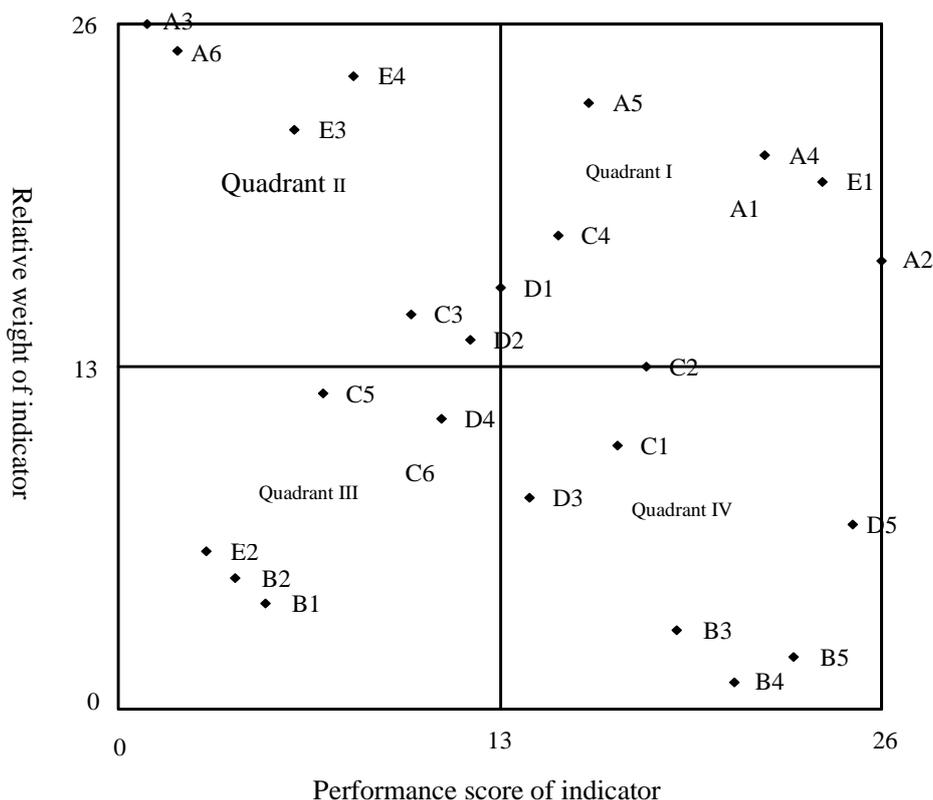


Figure 6-8 Action Diagrams of Library Service Quality of Higher Education Institution under the New Information Environment

6.4 Application Analysis of Model of Library Service of Higher Education Institution under the New Information Environment

6.4.1 Analysis of mutual effect between latent variables of multi-level evaluation model

The standardized path coefficient between the latent variables of each main dimension and their sub-dimensions is reflected from the interactive verification results of the second-order factor model of the sub-dimensions. The path coefficient is used to further analyse the direct effect, indirect effect and complete effect between latent variables in the developed model. The summation of the direct effect and indirect effect is the complete effect. Results are shown in Table 6-8.

Table 6-8 Statistics of Mutual Effect between Latent Variables of Structural Equation

		Result Quality	Process Quality
Tangibility	Direct Effect	0.80	0
	Indirect Effect	0	0.70
	Complete Effect	0.80	0.70
Reliability	Direct Effect	0.87	0
	Indirect Effect	0	0.76
	Complete Effect	0.87	0.76
Assurance	Direct Effect	0	0.89
	Indirect Effect	0.77	0
	Complete Effect	0.77	0.89
Responsiveness	Direct Effect	0	0.81
	Indirect Effect	0.70	0
	Complete Effect	0.70	0.81
Empathy	Direct Effect	0	0.83
	Indirect Effect	0.72	0
	Complete Effect	0.72	0.83

The following inferences are evident from Table 6-8.

- a) It is ideal to improve both the result quality and the process quality to strengthen the tangibility environment of the library of the higher education institution. An additional score of 1 in the

tangibility may elevate 0.80 score of the result quality directly and 0.70 score of the process quality indirectly. Tangibility construct is the foundation of the construction of the library service quality of the higher education institution, which is the front line medium of the library for the users, and is the basic precondition required to enhance the result quality and process quality, ultimately to elevate the overall library service quality of the higher education institution under the new information environment.

b) It is also very important for the improving the result quality to strengthen the reliability of the library service of the higher education institution. An additional score of 1 in reliability may elevate 0.87 score of the result quality. It also exerts a positive influence whilst improving the process quality, with each additional score of 1 in tangibility may elevate 0.76 score of the process quality indirectly.

c) It is important to elevate the process quality and result quality in order to improve service assurance. Each additional score of 1 in service assurance may elevate 0.89 score of the process quality directly and 0.77 score of the result quality indirectly. Therefore, service assurance is very crucial for enhancing the library service quality of the higher education institution.

d) Strengthening of the service responsiveness is also important for improving process quality. An additional score of 1 in responsiveness may elevate 0.81 score of the process quality directly. Responsiveness also exerts an indirect effect on result quality. An additional score of 1 in responsiveness may elevate 0.70 score of the result quality indirectly.

e) Strengthening the empathy is also significant for improving the process quality and result quality. An additional score of 1 in empathy may elevate 0.83 score of the process quality directly and 0.72 score of the result quality indirectly.

6.4.2 Analysis of relation between latent variables and measured items of multi-level evaluation model

The relation between structural variables and observable variables in the multi-level evaluation model of the library service quality of the higher education institution under the new information environment is a kind of reflection relation, indicating the extent of influence between structural variables and their corresponding observable variables. Analysis result of the scores and influence

coefficient presents the following inferences:

a) Relation between tangibility and its observable variables. “A3. Library contains space for team study and discussion” obtains the lowest score and its influence on the tangibility environment is relatively low, with a value of less than the lower limit of 0.5. The major reason is that few libraries of the higher education institution in China are presently providing such services, but it has been revealed in the interview that users have urgent demands for such services. In order to meet the user demands, the library of the higher education institution must focus on the construction in this aspect to enhance tangibility.

b) Relation between reliability and its observable variables. Except for “B5. Users may access the electronic resource anytime and anywhere (e.g. in the living area)”, which obtains a relatively higher score but only exerts medium influence on reliability. The score and influence on the reliability of almost all the indicators are positive, so that none of these items require urgent improvement.

c) Relation between assurance and its observable variables. “C3. Librarian understands the user demands well”, this obtains a relatively lower score but exerts the most significant influence on service assurance. Therefore, the library of the higher education institution must undertake effective measures to enhance the professional skills of the librarians, such that organizing specific competence training frequently for librarians can help enhancing their capability of tracking and handling the user demands.

d) Relation between responsiveness and its observable variables. “D4. Website and resource downloading facilities of the library are smooth”, this obtains a relatively lower score but exerts relatively a significant influence on service responsiveness. This indicates that the library of the higher education institution should strengthen the construction of their websites and network to accelerate retrieval and downloading pace of the electronic resources of the library, in order to improve the user perception of responsiveness of the network service.

6.5 Analysis of Improvement Strategies of Library Service Quality of Higher Education Institution under the New Information Environment

The new information environment is dynamically changing at a rapid pace. The multi-level

evaluation model proposed and verified in this thesis facilitates an effective tool for the libraries of higher education institution for the purpose of improving the service quality. In the future, the libraries of higher education institutions should undertake appropriate optimization strategies to strengthen the service quality, so as to improve the user’s perceived service quality.

6.5.1 Consolidation of management of user’s expectation

User’s expectation poses dual influences on the library services of the higher education institutions. On the one hand, management consolidation can help attracting users to utilize the library; on the other hand, it sets a minimum standard of expectation for the library service imperceptibly, this implies that the users’ expectation can be satisfied only when the actual library service exceeds the minimum standard.

Ojasalo [132] dynamically categorized the user expectations professional service into fuzzy expectation, explicit expectation and implicit expectation. Fuzzy expectation refers to the service problems, where users are not describing the improvements accurately but still expect the service providers to provide improvements. Explicit expectation refers to the expectation which already exists in the user’s mind before the user accepts the service, and it is further divided into practical expectation and unpractical expectation. Implicit expectation refers to the service elements which are recognised by the users as granted. Ojasalo described the dynamic relation among these three types of expectation, as shown in Figure 6-9:

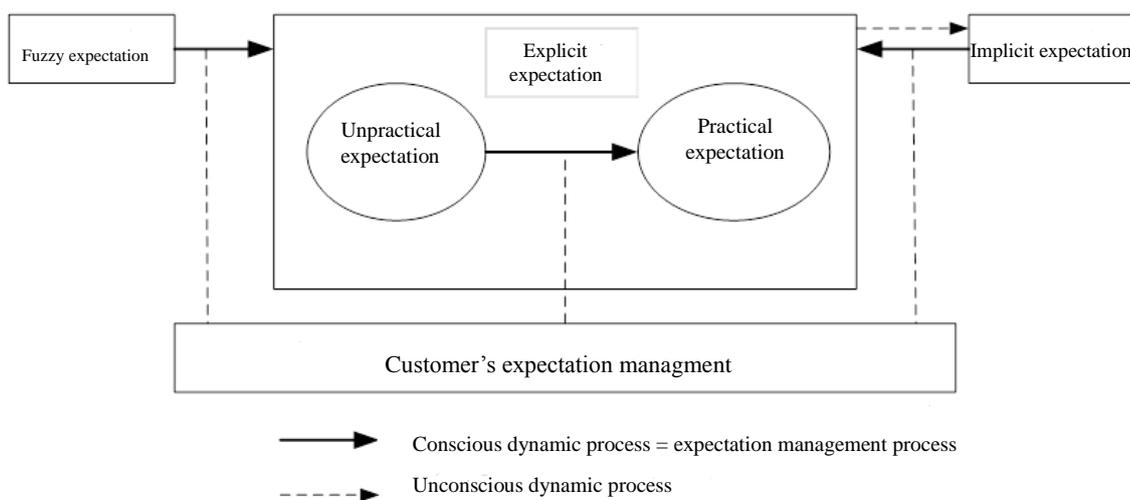


Figure 6-9 Dynamic Model of User’s Expectation

In Figure 6-9, the solid arrow represents the conscious dynamic process flow in which the service

provider manages the user expectations positively. The dotted arrow represents the unconscious dynamic process in which the service provider is usually unable to manage the expectation transformation. During the management process of the user expectation, the service provider should consider and discover both the fuzzy expectation and implicit expectations of users and should undertake effective management measures to transfer these expectations to explicit expectation. In the explicit expectation of users, users usually generate a kind of unpractical expectation, which is difficult to be satisfied but the service providers must pay sufficient attention to this and should undertake effective management measures to transfer the unpractical expectation to practical expectation as much as possible, so as to fulfill the user demands.

In order to consistently elevate the user perceived service quality under the new information environment, library of the higher education institution should manage the user expectations based on the following strategies. The first strategy is to manage the service commitment. Actually, libraries of the higher education institution often publicize services to the local users through defined channels and offer additional service commitments to attract users. Such offers drive users to use the library services by the way of creating imaginative illustrations of the library services among the user minds. However, this also includes a risk that the library may not satisfy the user expectations since some users might expect too much from the library. If the expectation is not satisfied, then such users will be disappointed with the library service, thereby degrading both the perceived quality and satisfaction, and such users may refuse the library service again. Thus, library of the higher education institution should pay much attention to the management of user expectation not only to satisfy the service expectation for consistently attracting users, but also to guarantee the realization of the promised service commitments. This helps the service providers to provide users with excellent service, and to accomplish user satisfactions, which benefits establishing a stable service relationship with the users.

The second strategy is making the expectation explicit. It can be observed from the theory of fuzzy expectation and implicit expectation that users may be unable to express their expectation clearly under certain circumstances, and such fuzzy expectations may still affect the user's perceived quality of the library service. User's awareness of the service quality may increase particularly when they have much higher expectation of the service quality. If the expected service is not actually provided, then user may be unsatisfied with the library and the perceived service quality

will decrease. Therefore, library of the higher education institution should consider appropriate scientific and effective marketing and communication methods to identify and manage the expected fuzzy and implicit services of the users and try to make such expectation explicit as much as possible. Besides, libraries should be able to identify the unpractical expectation of the users and should clarify the service commitments to reduce such unpractical expectation and should assist users whilst transforming the unpractical expectations to practical expectations, so as to finally achieve the goal of exceeding the user expectation.

The third strategy is managing the diversified expectation. Individual differences may also affect the user expectations and different users usually possess different expectations of the library services. From the perspectives of their extent of user expectation, some users may expect most up-to-date services of new books while some users may not care about this aspect; from the perspectives of the clearness of expectation, some users are able to express their expectation clearly for the library to understand their requirements, while some users only possess the expectation but are unable to express their expectations clearly; from the perspectives of the satisfaction of expectation, some users will be satisfied when the expectation is fulfilled appropriately, while some users will never be satisfied until their expectation is completely fulfilled. In this circumstance, library of the higher education institution should manage the diversity of the user expectations by categorizing and position the users to undertake corresponding management strategies based on their customized expression of expectations. The libraries should meet the minimum expectation of the users and should outreach the ideal expectation as much as possible; then the libraries should also try to accomplish the practical expectation of the users while reducing the unpractical expectations of the users as much as possible; and finally, the libraries should adopt diversified management methods for specific users to fulfill their customized expectation.

The final strategy is exceeding the user expectations. It is very difficult for the libraries to exceed the user expectations because most users possess relatively higher level of expectation of the library services, thus the library of all the higher education institutions should adopt this objective as a mandate. There is certain risk in exceeding the user expectations, in such a way that when user expectations are completely fulfilled, users may expect more in the future. When such an expectation goes beyond the capability and competence of the libraries, it will be even harder for the universities to satisfy such users. This kind of circulating paradox provides both opportunity and

challenge for the service providers. Libraries of the higher education institution should effectively limit this extent while grasping the opportunity to fulfill the user expectations as much as possible, and should also prevent the users from generating excessively higher level of expectation for future services. This will be a difficult problem for the libraries of the higher education institution for a long term in the future.

6.5.2 Consolidation of management of user's demand

Users demand for information from the libraries of the higher education institution under the new information environment has experienced an important change in the recent years. Demands for free acquisition of information, space of information acquisition, time of information acquisition, tool of information acquisition and content of information acquisition are all changing significantly, as detailed in Chapter 3. Such changes in the user demands are bound to affect the user's judgment of the perceived service quality, which helps to scientifically manage the user demands from the library of the higher education institution under the new information environment.

Firstly, the library should predict and identify the user demands. Predicting the user demands is the most prioritized task in the user demand management. The library should understand and analyse the actual demands and their characteristics through a scientific prediction method and contrast them against the service capabilities of the library, such as the skill of the librarian, the collection of books and the digital service facilities, in order to evaluate the library can satisfy the user demands. If not, libraries should establish the service improvement plans to strengthen their service capability in order to meet the user demand. For instance, during the exam period, demands for the study hall in the library will rise abruptly leaving almost all the seats occupied, so that libraries should undertake relevant measures to eliminate the seat occupancy. If their current capability exceeds the user demands, then libraries should undertake measures to attract the users to dynamically elevate the user demands, to match their demands with the service capabilities of the library. For example, libraries should introduce electronic touch-screen reading devices for the users for delivering up-to-date information. But it is obvious that most of the user demands in this aspect is quite low since they do not understand or are not used to such reading behaviours. Thus, the libraries should focus on popularizing and demonstrating the convenience of new services to raise the user demands.

Secondly, libraries should understand and classify the user demands. Predicting the user demands is the first step of management and the librarians should also understand the user demands once predicting them. Based on the measurement of the library service quality of the higher education institution under the new information environment using the multi-level evaluation model, the demand for the overall quality can be understood by the cost function. User demands should be treated by categorizing users, based on their demands, as neutral user, demanding user and non-demanding user. A higher level of satisfaction among neutral users reflect their higher evaluation in their demands. Demanding users are quite strict, so that the service quality should be strengthened to raise their satisfaction. Such a strict standard reflects that such users are more concerned with the indicators or the service properties to a certain extent, therefore libraries should pay enough attention to this aspect. Non-demanding users often give a favorable evaluation even when their demands are satisfied partly, this reflects that such users are not quite concerned with the property or indicator, thus libraries may save their investments in this aspect. The level of investment can be determined by the shape of the curve. In a word, library management personnel of the higher education institution should understand the demand of these three types of users comprehensively to establish their service quality elevation strategy and should try to extract the most effective return with least investment, thereby achieving the most effective utilization of the resources.

Finally, libraries should always try to meet the user demands. Based on the prediction, identification, understanding and classification of the user demands, libraries of the higher education institution should try to meet the user demands. It has been identified from the user interviews that the user demands for customized services from the library of the higher education institution are on the high. User demands will become more customized and diversified under the new information environment, thus libraries of the higher education institution should pay attention to the personal demands of users on time and should respond to such customized demands positively to provide their corresponding customized services.

6.5.3 Consolidation of management of user experience

The service fashion, service function, service mode and librarian of the library have experienced an important change under the new information environment. Utilization and sharing of the collection

of library resources have increased dramatically, and more importantly, the information demand, information behaviour and information capability of the users have also changed dynamically. Therefore, libraries of the higher education institution should pay more attention to the user experiences under the new information environment than in the traditional environment. The user experience of the libraries of the higher education institution is challenged by various factors and is gradually becoming a new problem for the library management of the higher education institution. It is obvious that mostly user values are generated from the elaborately designed user experiences such that with a one-time poor experience, users might migrate to other library services. Libraries of the higher education institution should provide favorable user experiences to win the recognition of the library services of the higher education institution by the user. Thus, it is very important to manage the user experiences, which measures the subjective and authentic opinions of user on the library service of the higher education institution. Such measurements can be used to obtain the user's desired user experiences in order to manage the user experiences positively, thus meeting the expectation and demands from the users.

Development and progress of new information technologies enable a rapid acquisition and excavation of data and further give rise to the user experience management method. Management of the user experience means acquiring the user's data using advanced database and other information technologies to analyse the behaviour and habits of the users, accumulate and share user knowledge, provide the users with the customized product or service, develop and manage the relationship with the users and cultivate the long-term loyalty of the users to balance the trade-off between the maximized user's value and the maximized enterprise's value. The core connotation of user experience management is to maximize both the organization's value and the user's value. The balance between such two kinds of maximization depends on the relationship value between the users and the enterprise, as well as the user experience, which also requires the support from new information technologies. Libraries should survey and analyse the characteristic demands from the perspectives of users to meet their customized and diversified demands. The rapid development of information technologies and mobile technologies under new the information environment facilitates the libraries of the higher education institution with excavating analysis of user data in order to accumulate and understand user's knowledge, develop and provide customized services according to the characteristic and demand of the users, ultimately to improve the service quality for

realizing the relationship value between the users and the enterprises.

Secondly, the libraries should consider the experience of each individual users whilst providing services and should track and monitor the user experiences using information technologies to acquire the information about user experiences during the interactive event. This helps enhancing the quality of service and experiences to constantly improve the user experiences. Through the management of user experience and real-time interactive events in the library service of the higher education institution, the library of the higher education institution can acquire the detailed and accurate real-time information to better understand the demands and reaction of the mobile readers, and to discover problems and weaknesses in the service on time for developing more customized and favorable services for the readers. The libraries should review the actual experience of each user for their respective services to assure high-quality user experiences, and to adopt relevant remedies upon receiving complaints from users.

Finally, the management of the user experience by the libraries of the higher education institution under the new information environment should elevate the experience intensity between the library and users. Elevation of the experience intensity is favorable for extending the duration of experience, thus maintaining the long-term satisfaction and royalty of the users towards the library. In other words, effective management of the user experience should consistently improve the factors influencing the user experience and exceeding the user expectation to create the best user experience in order to enhance the satisfaction and royalty of the users.

6.6 Summary

This Chapter firstly presented an analysis of the overall library service quality of HEI under the new information environment. Then, it further demonstrated the analysis of the cost function, action diagrams and application analysis of the developed model under the new information environment. At last, this chapter postulated relevant improvement strategies for the library service quality of higher education institution under the new information environment.

Chapter 7: Conclusion, Prospect and Future Work

7.1 Research Conclusion

Libraries in Chinese universities mostly pay more attention to the collection, processing and storage of literature resources, but the research and practice of library services and the service quality evaluation are still undermined. University library is the centre of cultural transmission, the treasure of knowledge and an important pillar of building the knowledge-based harmonious society. Service quality directly influences success of this mission of the university libraries. University library are facing more dynamic challenges under the new information environment, and the service quality is certainly an essential element that evaluates the capacities of the university libraries in resolving the issues of the new information era. In response to this issue, the objectives of this thesis are realized as follows: A literature review on existing research works on digital libraries and service quality of digital library has been conducted, and the technical advantages and potential problems of such works have been investigated; The influence of the emerging IT technologies has been investigated to identify the key characteristics of the services being offered by HEI digital libraries: A new service quality evaluation model based on the SERVQUAL model for HEI digital libraries has been designed based on the above investigation: The SERVQUAL-based service quality evaluation model for HEI digital and mobile libraries has been verified. The service quality improvement strategies to improve the university library service quality has been postulated from multiple perspectives.

This research mainly draws the following conclusions:

A. University library service quality under the new information environment is limited by a subjective evaluation achieved through a comparative evaluation of the difference between the user expectations of service results and service process, and the actual perception performance. The two important elements or properties of service quality include result quality and process quality. Result quality depicts the actual service result which is obtained by users from their interaction with the services of university library in the new information environment, namely the service outputs of university library service perceived by users. The process quality defines show the university library services are delivered to the users, which reflects the perception service quality generated among

the users during the process of their contact and communication with the university library service staffs and the service systems, namely the quality of university library services during delivery.

B. The revised SERVQUAL developed in this PhD has been proved to have good applicability in the context of university library service quality evaluation under the new information environment through literature research, focus group interviews and expert in-depth interview. The classic service quality evaluation scales should be appropriately amended when used in the new information environment and in new industries, according to the characteristics and requirements of the new information environment.

C. User's evaluations of the main dimensions of the university library service quality are achieved mainly based on the evaluation of the five sub-dimensions; and the overall service quality is evaluated based on the main dimensions. That is to say that the user's perception process of university library service quality under the new information environment characterize multiple levels, namely that the service quality is evaluated in three different levels including sub-dimension level, main dimension level and integral level. Integral level is the top level, where the total service quality of the university library under the new information environment is decided by the main dimensions. Main dimension level is the middle layer evaluating the result quality and the process quality, based on the sub-dimensions. Sub-dimension level is the bottom layer which evaluates tangibility, reliability, assurance, responsiveness and empathy.

D. University library service quality under the new information environment is a high-order construct characterizing a multi-dimensional reflection. Model fitting indexes of the preliminary test and cross validation demonstrates the significance of the developed model, illustrating that the third-order reflection measurement model of service quality has good structural effectiveness and robustness. The main dimension contains result quality and process quality. The result quality is decided by effectiveness and reliability, and the process quality is decided by assurance, responsiveness and empathy. In the service quality level model proposed by Brady [9], the measuring items for each main dimension and the overall service quality have been defined, where the main dimensions are regarded as the antecedents of service quality (by considering service quality model as a structural model rather than a measuring model). However, most of researchers think that service quality is the potential and common factor of the main dimension (Dabholkar [44]; Brady [9]). In fact, service quality has been defined as an attitude of users in the previous literatures,

and attitude is a reflected construct and has reached a broad consensus in academia. Therefore, this research also regarded mobile library service quality is a reflected construct. In comparison with the traditional service quality model, the proposed multi-dimensional multi-level structural model can preferably explain the complexities of customer perceived service quality effectively.

E. The present scenarios and issues of Chinese university library service quality have been analysed concretely through measurement point analysis, value function analysis, action charts analysis and latent variable interaction effect analysis etc. Overall, the service quality in Chinese university libraries is still low under the new information environment. Although it is not worse than the minimum tolerance limits of users, gaps are still evident between the present scenarios and the expected service quality level of users. The indicators with higher weighting but lower performance in the service quality need significant improvement.

7.2 Research Prospect and Future Work

This thesis includes certain limitations in a few aspects. Therefore, the following research prospects and future work are postulated.

A. With the rapid development and dynamic changes in information technology and network environments, especially with the emergence of big data era, the characteristics and connotations of new information are changing continuously, which will certainly exert continuous influences on the service mode and service quality of university libraries. Due to limited time scale, the characteristics of the new information environment such as digitization, universality, interaction and individuality, are not excavated and embodied to the complete extent in the research process of this thesis. This is regarded as one particular limitations of this thesis, deeply investigating such characteristics is one of the future research directions of this research.

B. This research focused only on the evaluation of Chinese university library service quality, and the scenarios of public libraries under the new information environment have not been given importance. Extending the research objects to conduct a comprehensive research on the public libraries, in order to build a universal service quality evaluation model with relevant measurement scales covering both the university libraries and public libraries is another future research direction of this thesis.

C. The analysis samples of this research mainly come from the university libraries in Eastern China. The economy of these regions is relatively developed, and the characteristics of the new information environment are more advanced. Therefore, the results of this research cannot represent the scenarios of the whole country. Another future research direction would be extending the geographical region for conducting relevant surveys to postulate suggestions for the libraries in the entire China.

D. The research belongs to cross-sectional study, and the research period is fixed in time. Thus, this thesis has limitations whilst forecasting development trends of Chinese university library service quality under the new information environment. Time series based longitudinal studies can provide more diversified set of samples under different time periods. This thesis has another future aim of acquiring the development data of university library service quality under the new information environment and preferably to predict and control the elements of service quality.

E. This research has developed and verified the evaluation scale and model, but testing the practical applicability of the developed models is not included. Acquiring accurate service quality improvement counter-measures through comprehensive evaluations of local university library service quality under the new information environment based on the proposed multi-level model is another future research direction. Future research will also investigate other quantitative evaluation methods to comprehensively evaluate the university library service quality under the new information environment with the aid of the models validated in this thesis. Comparative case studies of different university library service quality can not only enrich the evaluation methods of university library service quality under new information environments, but also can extract more practical and effective service quality improvement measures.

Appendix

Questionnaires of University Library Service Quality under the New Information Environment

Dear friends:

We are conducting a research for university library service quality under the new information environment. It aims to understand and evaluate the university library service quality under the new information environment and to provide improvement suggestions for the university library service quality. We hope you will carefully fill in the questionnaire, to which we express Chinese heartfelt gratitude.

The survey is only used for research. We guarantee that the personal information of respondents will be strictly kept confidential. Please feel free to fill out.

General Information

Gender: Male Female

Education: Undergraduate Master Doctor

Discipline background: Literary, History and Philosophy Science Engineering Medicine
 Law Economics Management other

How often do you use the library? Four times a week or more 2~3 times a week Once a week or less

Note

(Please score for each indicator. 1 is the lowest score, and 7 is the highest score)

Actual feeling value: actual experience value for each indicator when you use the library.

Acceptable value: the minimum acceptable standard for each indicator. It is unacceptable in case of being lower than the standard.

Expected value: the desired service level you want the library to meet for each indicator

Research content

1. The library is clean and comfortable

Acceptable value							Expected value							Actual feeling value						
1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7

2. The layout of facilities within the library is reasonable

Acceptable value							Expected value							Actual feeling value						
1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7

3. The library has space appropriate for group study and discussion

Acceptable value							Expected value							Actual feeling value						
1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7

4. The library navigation website is clear and easy to understand

Acceptable value							Expected value							Actual feeling value						
1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7

5. The library interface is very beautiful

Acceptable value							Expected value							Actual feeling value						
1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7

6. The user interface of mobile library is fascinating

Acceptable value							Expected value							Actual feeling value						
1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7

7. The librarian's service consciousness is the same as described

Acceptable value	Expected value	Actual feeling value
1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7

8. The services provided by the library are the same as those described

Acceptable value	Expected value	Actual feeling value
1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7

9. Users can easily retrieve the information they need

Acceptable value	Expected value	Actual feeling value
1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7

10. The electronic resources (such as database) of library can meet users' requirements

Acceptable value	Expected value	Actual feeling value
1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7

11. Users can access electronic resources in any place (e.g., living quarter) at any time

Acceptable value	Expected value	Actual feeling value
1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7

12. Librarians' services are friendly

Acceptable value	Expected value	Actual feeling value
1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7

13. Librarians are always polite to users

Acceptable value	Expected value	Actual feeling value
1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7

14. Librarians understand users' needs

Acceptable value	Expected value	Actual feeling value
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- 1 2 3 4 5 6 7 1 2 3 4 5 6 7 1 2 3 4 5 6 7
15. Librarians have the skills to solve users' problems
- | Acceptable value | Expected value | Actual feeling value |
|------------------|----------------|----------------------|
| 1 2 3 4 5 6 7 | 1 2 3 4 5 6 7 | 1 2 3 4 5 6 7 |
16. Subject consultants have the professional knowledge that is trusted by users
- | Acceptable value | Expected value | Actual feeling value |
|------------------|----------------|----------------------|
| 1 2 3 4 5 6 7 | 1 2 3 4 5 6 7 | 1 2 3 4 5 6 7 |
17. Librarians have the knowledge related to new information technology
- | Acceptable value | Expected value | Actual feeling value |
|------------------|----------------|----------------------|
| 1 2 3 4 5 6 7 | 1 2 3 4 5 6 7 | 1 2 3 4 5 6 7 |
18. Librarians can deal with the users' opinions and suggestions timely
- | Acceptable value | Expected value | Actual feeling value |
|------------------|----------------|----------------------|
| 1 2 3 4 5 6 7 | 1 2 3 4 5 6 7 | 1 2 3 4 5 6 7 |
19. Librarians can remedy the service errors in time
- | Acceptable value | Expected value | Actual feeling value |
|------------------|----------------|----------------------|
| 1 2 3 4 5 6 7 | 1 2 3 4 5 6 7 | 1 2 3 4 5 6 7 |
20. Online consultants can solve problems in time
- | Acceptable value | Expected value | Actual feeling value |
|------------------|----------------|----------------------|
| 1 2 3 4 5 6 7 | 1 2 3 4 5 6 7 | 1 2 3 4 5 6 7 |
21. Library websites and resources can be downloaded rapidly
- | Acceptable value | Expected value | Actual feeling value |
|------------------|----------------|----------------------|
| 1 2 3 4 5 6 7 | 1 2 3 4 5 6 7 | 1 2 3 4 5 6 7 |
22. The error rate of library web page link is low

Acceptable value

Expected value

Actual feeling value

1 2 3 4 5 6 7

1 2 3 4 5 6 7

1 2 3 4 5 6 7

23. The library provides users with convenient and thoughtful services (such as rain gear, tea restaurant, etc.)

Acceptable value

Expected value

Actual feeling value

1 2 3 4 5 6 7

1 2 3 4 5 6 7

1 2 3 4 5 6 7

24. The library focuses on the personalized needs of the users

Acceptable value

Expected value

Actual feeling value

1 2 3 4 5 6 7

1 2 3 4 5 6 7

1 2 3 4 5 6 7

25. The library provides customized online services for users

Acceptable value

Expected value

Actual feeling value

1 2 3 4 5 6 7

1 2 3 4 5 6 7

1 2 3 4 5 6 7

26. The library conducts training activities for the users (lectures, etc.)

Acceptable value

Expected value

Actual feeling value

1 2 3 4 5 6 7

1 2 3 4 5 6 7

1 2 3 4 5 6 7

What do you think of the overall service quality level of library: 1 2 3 4 5 6 7

What opinions and suggestions do you have for improving the quality of library service?

References

- [1] Andaleeb, S.S. and Simmonds, P.L. (1998) Explaining user satisfaction with academic libraries: strategic implications, *College & Research Libraries*, 59(2), pp. 156-167
- [2] Awan, M.U. and Mahmood, K. (2013), 'Development of a service quality model for academic libraries', *Quality & Quantity*, 47(2), pp. 1093-1103
- [3] Andaleeb, S.S. and Simmonds, P.L. (1999) Explaining user satisfaction with academic libraries: strategic implications, *College & Research Libraries*, 9(2), 16-17
- [4] Anderson, J.C. and David, W.G. Structural Equation Modeling in Practice: a review and recommended two-step approach, *Psychology Bulletin*, 103(3), pp. 411-423
- [5] Akter[5], S., D'Ambra, J. and Ray, P. (2013) 'Development and validation of an instrument to measure user perceived service quality of mHealth', *Information & Management*, 50(4), pp. 181-195
- [6] BRUCETHOMPSON, C. (2001) 'Psychometric properties of scores from the web-based LibQUAL+ study of perceptions of library service quality', *library trends*, 49(4), pp. 585-604
- [7] Brillantine, F.M. Using Surveys to Improve Service to Students: A Comparison of LibQual+ and Survey Monkey, *Catholic University of America, Law Library Lights*, 50(1), pp. 5-9
- [8] Brekke, E. and Rounds, L. (1997) User Surveys in ARL Libraries' [A]// In: SPEC Kit 205. Washington DC: Association of Research Libraries, pp. 7
- [9] Brady, M.K. and Cronin, Jr J.J. (2001) 'Some new thoughts on conceptualizing perceived service quality: a hierarchical approach', *Journal of marketing*, 65(3), pp. 34-49
- [10] Bitner, M.J., Booms, B. and Tetreault, M. (1990) 'The service encounter: Diagnosing favorable and unfavorable incidents', *Journal of Marketing*, 54(1), pp. 71-84
- [11] Balog, A. (2011) 'Testing a multidimensional and hierarchical quality assessment model for digital libraries', *Studies in Informatics and Control*, 20(3), pp. 233-246
- [12] Babakus, E. and Boller, G.W. (1992) 'An Empirical Assessment of the SERVQUAL Scale', *Journal of Business Research*, 24(3), pp. 253-268
- [13] Bouman, M. and Van der Wiele, T. (1992) 'Measuring Service Quality in the Car Service Industry: Building and Testing an Instrument', *International Journal of Service Industry Management*, 3(4), pp. 4-16
- [14] Bai, L.N., Lu, P. and Qiao, A.L., et al. (2014) 'Library Service Quality Evaluation Research Based on the LibQUAL+TM - Taking Harbin Engineering University Library as an Example', *Library Journal*, (09), pp. 60-65
- [15] Bao, P. and Zhou, L. (2010) 'ClimateQUALTM: A New System of Library Service Quality Evaluation', *Journal of Academic Libraries*, (5), pp. 96-100
- [16] Calvert, P.J. (2001) 'International Variations in Measuring Customer Expectations', *Library Trends*, 49(4), pp. 732-757
- [17] Churchill, G. and Suprenant, C. (1982) 'An investigation into determinants of customer satisfaction', *Journal of Marketing Research*, 19(4), pp. 491-504
- [18] Cabrerizo, F.J., López-Gijón, J., Ruiz, A.A., et al. (2010) 'A model based on fuzzy linguistic information to evaluate the quality of digital libraries', *International Journal of Information Technology & Decision Making*, 9(03), pp. 455-472

- [19] Cook, C. and Heath, F.M. (2001) Users perceptions of library service quality: a LibQUAL+ qualitative study, *Library Trends*, 49(4), pp 548-584
- [20] Cronin, Jr J.J. and Taylor, S.A. (1992) Measuring service quality: a reexamination and extension, *The Journal of Marketing*, 56(3), pp. 55-68
- [21] Carman, J.M. (1990) Consumer Perceptions of Service Quality: An Assessment of the SERVQUAL Dimension, *Journal of Retailing*, 66(1), pp. 33-55
- [22] Coleman, V., Xiao, Y., Bair, L. and Chollett, B. (1997) Toward a TQM Paradigm: Using SERVQUAL to Measure Library Service Quality, *College & Research Libraries*, 58(3), pp. 237-251.
- [23] Cook, C., Heath F. and Thompson B. (2003) 'LibQUAL+™ from the UK perspective', *Proceedings of the 5th Northumbria International Conference on Performance Measurement in Libraries and Information Services*, Durham, UK.
- [24] Coleman, V., Xiao, Y., Bair, L. and Chollett, B. (1997) Toward a TQM Paradigm: Using SERVQUAL to Measure Library Service Quality', *College & Research Libraries*, 15(4), pp. 114-118
- [25] Cook, C. and Thompson, B. (2000) 'Reliability and validity of SERVQUAL scores used to evaluate perceptions of library service quality', *Journal of Academic Librarianship*, 26(4), pp. 248-258
- [26] Calvert, P.J. (2001) 'International variations in measuring customer expectations', *Library trends*, 49(4), pp. 732-757
- [27] Cook, C. and Thompson, B. (2002) 'Reliability and validity of SERVQUAL scores used to evaluate perceptions of library service quality, *Journal of Academic Librarianship*, 22(3), pp. 22-25
- [28] Carman, J.M. (1990), 'Consumer perceptions of service quality: An assessment of the SERVQUAL dimensions', *Journal of retailing*, 2(1), pp. 3-5
- [29] Churchill, Jr G.A. (1979) 'A paradigm for developing better measures of marketing constructs', *Journal of Marketing Research*, 16(2), pp. 6-7
- [30] Coleman, V., Xiao, Y.D., Bair, L., et al. (1999) Toward a TQM paradigm: Using SERVQUAL to measure library service quality, *College & Research Libraries*, 26(3), pp. 27-29
- [31] Cao, S. (2008) 'Quality Evaluation of Library Services based on LibQUAL+™ - The Survey and Thinking of Services Quality of Jiaxing Vocational and Technical College Library', *Library Development*, (11), pp. 73-76
- [32] Chai, Y. (2005) 'Effect of Cultural Value Orientation on Evaluation of Service Quality in Service Industry - Taking the Hospital Industry of Tianjin for a Case, *Journal of Tianjin University of Commerce*, 25(2), pp. 27-32
- [33] Chai, Y., Wei, F.X. (2006) 'An Empirical Study of Cultural Factor's Influence of on Customers' Evaluation of Service Quality', *Journal of Nanjing Normal University (Social Science)*, (3), pp. 62-67
- [34] Chen, L., Li, L., Qin, Z. (2008) 'Association Rule's Application to Improve Service Quality of Library', *Journal of Information*, 27(2), pp. 145-146, 150
- [35] Chen, X.P., Xu, S.Y. and Fan, J.L. (2012) 'Empirical Methods in Organization and Management Research (2nd Edition)', *Peking University Press, Beijing*, pp. 192-193
- [36] Chen, Z.Q. and Cheng, J.J. (2014) 'Digital Library Service Quality Gap Causes and Strategies', *Library Theory and Practice*, (5), pp. 10-13
- [37] Chu, J.L. (1999) 'A Review of Library Evaluation Theories in Western Countries', *Journal of Library Science in China*, 25(3), pp. 53-60

- [38] Chu, J.L. (1998) 'Using SERVQUAL to Measure Library Service Quality', *Journal of Academic Libraries*, 16(5), pp. 43-44
- [39] Chu, J.L. (2008) 'User Research and Service Innovation Oriented to New Information Environment', *Journal of Library Science in China*, (3), pp. 68-70
- [40] DeCandido, G.A. (1997) 'After the User Survey, What then? Issues and innovations in transforming libraries', In: SPEC Kit 226. Washington DC: Association of Research Libraries, pp. 15
- [41] Dyke, V.T.P., Kappelman, L.A. and Prybutok, V.R. (1997) 'Measuring Information Systems Service Quality: Concerns on the Use of the SERVQUAL Questionnaire', *MIS Quarterly*, 21(2), pp. 195-208
- [42] Donthu, N. and Yoo, B. (1998) 'Cultural Influences on Service Quality Expectations', *Journal of Service Research*, 1(2), pp. 178-186
- [43] Dabholkar, P.A., Shepherd, C.D. and Thorpe, D. I. (2000) 'A comprehensive framework for service quality: an investigation of critical conceptual and measurement issues through a longitudinal study', *Journal of Retailing*, 76(2), pp. 139-173
- [44] Dabholkar, P.A., Thorpe, D.I. and Rentz, J.O. (1996) 'A measure of service quality for retail stores: scale development and validation', *Journal of the Academy of Marketing Science*, 24(1), pp. 3-16
- [45] Diao, Y. (2013) 'Research on Optimization of Service Quality Evaluation System of University Library - Based on Kano Model and Service Quality Gap Model', *Research on Library Science*, (8), pp. 22-26
- [46] Frost, F.A. and Kumar, M. (2000) 'INTSERVQUAL—an internal adaptation of the GAP model in a large service organisation', *Journal of Services Marketing*, 14(5), pp. 358-377
- [47] Finn, D.W. and Lamb, C.W. (1991) 'An Evaluation of the SERVQUAL Scales in a Retail Setting', *Advances in Customer Research*, 18(1), pp. 483-490
- [48] Furrer, O., Liu, B.S. and Sudharshan, D. (2000) 'The Relationships between Culture and Service Quality Perceptions: Basis for Cross-Cultural Market Segmentation and Resource Allocation', *Journal of Service Research*, 2(4), pp. 355-371
- [49] Fornell, C. and Larcker, D. (1981) 'Evaluating Structure Equations Models with Unobservable Variables and Measurement Error', *Journal of Marketing Research*, 18(2), pp. 39-50
- [50] Fornell, C. and Larcker, D.F. (1983) 'Evaluating structural equation models with unobservable variables and measurement error', *Journal of Marketing Research*, 8(2), pp. 3-5
- [51] Fan, X.C. (1999) 'Service Quality Management: Interaction Process and Interaction Quality', *Nankai Business Review*, (1), pp. 8-12, 23
- [52] Fang, X.S. (2008) 'Evaluation of Library Performance', Zhejiang University Press, Hangzhou, p. 14
- [53] Griffin, A. and Hauser, J.R. (1993) 'The Voice of the Customer', *Marketing Science*, 12(1), pp. 1-27
- [54] Grigoroudis, E. and Siskos, Y. (2002) 'Preference Disaggregation for Measuring and Analysing Customer Satisfaction: The MUSA Method', *European Journal of Operational Research*, 143(1), pp. 148-170
- [55] Gonçalves, M.A., Moreira, B.L., Fox, E.A., et al. (2007) '“What is a good digital library?”—A quality model for digital libraries', *Information processing & management*, 43(5), pp. 1416-1437
- [56] Ghobadian, A., Speller, S. and Jones, M. (1994) 'Service quality: concepts and models', *International Journal of Quality & Reliability Management*, 11(9), pp. 43-66

- [57] Garvin, D.A. (1983) 'Quality on the line', *Harvard business review*, 61(5), pp. 65-75
- [58] Grönroos, C. (1984) 'A service quality model and its marketing implications', *European Journal of marketing*, 18(4), pp. 36-44.
- [59] Grönroos, C. (1982) 'An applied service marketing theory', *European Journal of Marketing*, 16(7), pp. 30-41.
- [60] Guo, R.F. (2013) 'Study on Mobile Information Service Quality of University Library Based on LibQual+TM', *New Century Library*, (6), pp. 25-27
- [61] Hossain, M.J. (2014) 'A study of the causes of user dissatisfaction in academic libraries: a case of university students in a developing country', *Journal of Library Administration*, 54(6), pp. 462-482
- [62] Hossain, M.J. and Ahmed, S.M.Z. (2014) 'An investigation of service expectations: Developing and validating an alternative scale for service quality assessment in academic libraries', *International Information & Library Review*, 46(1-2), pp. 21-30
- [63] Herson, P. and Altman, E. (1996) 'Service Quality in Academic Libraries', Norwood, NJ: Ablex
- [64] Hebert, F. (1994) 'Service Quality: AN Unobtrusive Investigation of Interlibrary Loan in Large Public Libraries in Canada', *Library and Information Science Research*, 16(1), pp.3-21
- [65] Humphries, A.W. and Naisawald, G.V. (1991) 'Developing a Quality Assurance Program For Online Services', *Bulletin of the Medical Library Association*, 79(3), pp.263-270
- [66] Hebert, F. (1993) 'The Quality of Interlibrary Borrowing Service in Large Urban Public Libraries in Canada', Unpublished Doctoral Dissertation, University of Toronto, Library and Information Science
- [67] Herson, P., Nitecki, D.A. and Altman, E. (1999) 'Service Quality and Customer Satisfaction: An Assessment and Future Directions', *The Journal of Academic Librarianship*, 25(1), pp.9-17
- [68] Haynes, S.N., Richard, D. and Kubany, E.S. (1995) 'Content validity in psychological assessment: A functional approach to concepts and methods', *Psychological assessment*, 7(3), pp. 238-247
- [69] Hébert, F. (1994) 'The Quality of Interlibrary Borrowing Services in Large Urban Public Libraries in Canada', Toronto: University of Toronto
- [70] Herson, P. and Altman, E. (1998) 'Assessing service quality: satisfying the expectations of library customers', Chicago: American Library Association, pp. 101-116
- [71] Herson, P. and Calvert, P.J. (1996) 'Methods for measuring service quality in university libraries in new zealand', *The Journal of Academic Librarianship*, 22(5), pp.387-391
- [72] Hsu, M.K., Cummings, R.G. and Wang S.W. (2014) 'Business students' perception of university library service quality and satisfaction', *Contemporary Issues in Education Research*, 7(2), pp. 137-144
- [73] Hossain, M.J. and Ahmed, S.M.Z. (2014) 'Developing a service performance assessment system to improve service quality of academic libraries', *Business Information Review*, 30(4), pp. 210-221
- [74] Han, J.L. and Dong, J. (2006) 'Customer Perceived Service Quality Evaluation and Management', Nankai University Press, Tianjin
- [75] Han, Y., Yang, X.Q. and Li, J. (2007) 'Impact factors of Library Service Quality: Weight Measurement and Fuzzy Evaluation', *Journal of Library Science in China*, 33(5), pp. 79-82
- [76] Hao, G.R. (2010) 'Study on Multi-level Fuzzy Integrative Evaluation Based on Entropy Weight and AHP's Combined Weight Coefficient on Library Service Quality Evaluation', *Modern Information*, 30(2), pp. 133-136, 141
- [77] He, Y. (2006) 'Study on Management of Library Service Quality - Application of Perceptual

- Blueprinting Model in Library', *Journal of Southwest University for Nationalities*, 27(5), pp. 242-244
- [78] Hong, Z.S., Su, Q. and Huo, J.Z. (2012) 'Study on the Research of Service Quality Management', *Management Review*, 24(7), pp. 152-163
- [79] Hou, J.T., Wen, Z.L. and Cheng, Z.J. (2004) 'Structural Equation Model and Its Applications', Educational Science Press
- [80] Hu, R.T. (2010) 'Construction of Information Library Quality Evaluation System', *Journal of Library Science*, 32(12), pp. 21-22, 33
- [81] Hu, X.M. and Jia, Z. (2012) 'Evaluation Method Study of Library Service Quality based on Significant Difference Test', *Library and Information Service*, 56(1), pp. 78-81
- [82] Huang, S. (2012) 'Research on Service Quality Evaluation of University Library based on Kano Model and LibQUAL Model', *Research on Library & Information Work of Shanghai Colleges & Universities*, 22(3), pp. 49-55
- [83] Jayasundara, C., Ngulube, P. and Minishi-Majanja, M.K. (2009) 'A theoretical model to predict customer satisfaction in relation to service quality in selected university libraries in Sri Lanka', *South African Journal of Libraries and Information Science*, 75(2), pp. 179-194
- [84] Jain, S.K. and Gupta, G. (2004) 'Measuring Service Quality: SERVQUAL vs. SERVPERF Scales', *Vikalpa: The Journal for Decision Makers*, 29(2), pp. 25-37
- [85] Jin, G.D. (2002) 'Discussion on Implementation of Evaluation of Library Service Quality', *Journal of Academic Libraries*, 20(3), pp. 49-54
- [86] Kyrillidou, M., Olshen, T., Heath, F., et al. (2003) 'Cross-cultural implementation of LibQUAL+™: the French language experience', *Proceedings of the 5th Northumbria International Conference on Performance Measurement in Libraries and Information Services*, Durham, UK.
- [87] Kyrillidou, M. and Persson, A.C. (2006) 'The new library user in Sweden: A LibQUAL+™ study at Lund University', *Performance Measurement and Metrics*, 7(1), pp. 45-53
- [88] Kaiser, H.F. (1974) 'An index of factorial simplicity', *Psychometrika*, 39(1), pp. 31-36
- [89] Kaiser, H.F. (1960) 'The Application of Electronic Computers to Factor Analysis', *Educational and Psychological Measurement*, 20(1), pp. 141-151
- [90] Killick, S., van Weerden, A and van Weerden, F. (2014) 'Using LibQUAL+® to identify commonalities in customer satisfaction: the secret to success?', *Performance Measurement and Metrics*, 15(1/2), pp. 23-31
- [91] Kan, D.T. (2014) 'Study on Mobile Information Service Quality Evaluation', *Modern Information*, (7), pp. 56-59
- [92] Kong, F.C. and Cao, Y.X. (2010) 'Library Service Quality Evaluation Based on Fuzzy Multi-index and TOPSIS Method', *Information Science*, (3), pp. 416-419
- [93] Lu, Y., Zhang, L. and Wang, B. (2009) 'A multidimensional and hierarchical model of mobile service quality', *Electronic Commerce Research and Applications*, 8(5), pp. 228-240
- [94] Ladhari, R. and Morales, M. (2008) 'Perceived service quality, perceived value and recommendation: a study among Canadian public library users', *Library Management*, 29(4/5), pp. 352-366
- [95] Lehtinen, U. and Lehtinen, J.R. (1982) 'Service quality: a study of quality dimensions', *Service Management Institute*
- [96] Lewis, R.C. and Booms, B.H. (1983) 'The marketing aspects of service quality', *Emerging perspectives on services marketing*, 65(4), pp. 99-107
- [97] Lewis, B.R. (1989) 'Quality in the service sector: a review', *International Journal of Bank*

Marketing, 7(5), pp. 4-12

- [98] Lancaster, F.W. and Joncich, M.J. (1979) 'Measurement and evaluation of library services', Information Resources
- [99] Line, M.B. (1990) 'The concept of library goodness: user and library perception of quality and value', London: The Library Association
- [100] Li, F.L. and Li, N. (2008) 'The Evaluation of Electronic Service Quality and Its Application to Digital Library', Library and Information Service, 52 (9), pp. 44-46
- [101] Li, J. and Han, Y. (2009) 'Study on Service Quality Control of Digital Library Based on QoS', Library and Information Service, 53(11), pp. 47-50
- [102] Li, M.J. (2011) 'The Study on the Factors Influencing Mobile Reading Service Quality Based on Kano's Model', Sci-Tech Information Development & Economy, 21(6), pp. 124-128
- [103] Lian, Q. and Cao, Z.M. (2005) 'Dynamic Fuzzy Comprehensive Evaluation of Library Service Quality', Journal of Information, 24(12), pp. 36-38
- [104] Liang, J. (2012) 'Construction and Empirical Test about Digital Library Service Evaluation Model Oriented to Users' Interaction', Library and Information Service, 56(7), pp. 72-78
- [105] Lin, Q. (2013) A Tool for Developing Service Quality in Public Library: Mystery Shopping, Library Research, 44(2), pp. 39-41
- [106] Ling, Y.F. and Zhou, L.L. (2014) 'Research on Secret Shopping Program for Service Quality Evaluation of the Library of North Carolina State University', Research on Library Science, (7), pp. 97-101
- [107] Liu, G.M. (2009) 'Library Service Quality Evaluation Model Based on Fuzzy Nearness', Science & Technology Information, (10), pp. 144-145
- [108] Liu, J.Y. (2008) 'An Indigenous Study on High-order Factors Model of Library Service Quality and Its Application', Library and Information Service, 52(1), pp. 93-96
- [109] Liu, K.D., Pang, Y.J. and Hao, J.M. (2008) 'A New Method of Synthesis Evaluation of Library Service Quality', Journal of Information, 27(8), pp. 133-135
- [110] Liu, X.B. (2008) 'Evaluation of University Library Service Quality Evaluation Model Based on ANP Algorithm', Journal of Library and Information Sciences in Agriculture, (9), pp. 155-157
- [111] Liu, Y.L. (2011) 'Investigation and Analysis of Library Service Quality Satisfaction Based on LibQUAL+TM - Taking the Library of Ludong University as an Example', Ludong University Journal (Philosophy and Social Sciences Edition), (6), pp. 84-87
- [112] Liu, Y.Y. (2006) 'Network-based Tools for Library Service Quality Evaluation - LIBQUAL, DIGIQUAL and MINES', Library and Information Service, 50 (9), pp. 124-126
- [113] Lu, X.P. (2012) 'A Talk on the Principles and Ways to Improve the Service Quality of Public Library', Library, (4), pp. 115-117
- [114] Luo, M. (2005) 'Library Service Quality Model and Its Application', Journal of Library Science in China, 31(2), pp. 20-24
- [115] Luo, X.M. and Yu, G.F. (2014) 'Two-tuple Linguistic-based University Library Service Quality Evaluation', Information Research, (7), pp. 131-133
- [116] Malik, S.A. and Malik, S.A. (2015) SERVQUAL to measure perceptions and expectations of library users: a case study of a public university library of Pakistan, International Journal Management in Education, 9(3), pp. 303-322
- [117] Mattila, A.S. (1999) 'The Role of Culture in the Service Evaluation Process', Journal of Service Research, 1(3), pp.250-261
- [118] Malhotra, N.K., Ulgado, F.M., Agarwal, J. and Baalbaki I.B. (1994) 'International Service Marketing: A Comparative Evaluation of the Dimensions of Service Quality between

- Developed and Developing Countries', *International Marketing Review*, 11(2), pp.5-15
- [119] Majid, S., Anwar, M.A. and Eisenschitz, T.S. (2001) 'User perceptions of library effectiveness in Malaysian agricultural libraries', *Library Review*, 50(4), pp. 176-186
- [120] Martensen, A. and Grønholdt, L. (2003) 'Improving library users' perceived quality, satisfaction and loyalty: an integrated measurement and management system', *The Journal of Academic Librarianship*, 29(3), pp. 140-147
- [121] Mirzai, N.H. and Aboutalebi, N. (2014) 'Examining the effects of services quality gap based on the customer loyalty and satisfaction through SERVQUAL method (Saadat Poya Teb Company as a case study)', *International Journal of Academic Research in Accounting, Finance and Management Sciences*, 4(1), pp. 228-234
- [122] Marshall, J.G. (2007) Measuring the value and impact of health library and information services: past reflections, future possibilities, *Health Information & Libraries Journal*, 24(s1), 17
- [123] Ma F., Li, Y.B., Cao, Y.Y., et al. (2013) 'Research on Service Quality of University Digital y Based on SEM Model', *Library Theory and Practice*, (7), pp. 78-81
- [124] Nitecki, D.A. and Herson, P. (2000) 'Measuring service quality at Yale University's libraries', *The Journal of Academic Librarianship*, 26(4), pp. 259-273
- [125] Nitecki, D.A. and Franklin, B. (1999) 'Perspectives on: New Measures for Research Libraries', *The Journal of Academic Librarianship*, 25(6), pp.484-487
- [126] Nitecki, D.A. (1995) 'An Assessment of the Applicability of SERVQUAL Dimensions as A Customer-based Criteria for Evaluation Quality of services in an academic library', Maryland: University of Maryland
- [127] Nitecki, D.A. (1998) 'Assessment of Service Quality in Academic Libraries: Focus on the Applicability of the SERVQUAL', In: *Proceedings of the Second Northumbria International Conference on Performance Measurement in Libraries and Information Services*, England: University of Northumbria, pp. 181-196
- [128] Nagata, H., Satoh, Y., Gerrard, S. and Kytomaki, P. (2004) 'The Dimensions that Construct the Evaluation of Service Quality in Academic Libraries', *Performance Measurement and Metrics*, 5(2), pp.53-65
- [129] Nitecki, D.A. and Herson, P. (2000) 'Measuring service quality at Yale University's libraries', *The Journal of Academic Librarianship*, 26(4), pp. 259-273
- [130] Nagata, H., Satoh, Y., Gerrard, S. and Kytomaki, P. (2005) 'The Dimensions that Construct the Evaluation of Service Quality in Academic Libraries', *Performance Measurement and Metrics*, 2(1), pp.23-27
- [131] Oliver, R.L. (1980) 'A cognitive model of the antecedents and consequences of satisfaction decisions', *Journal of marketing research*, 17(4), pp. 460-469
- [132] Ojasalo, J. (1999) 'Quality dynamics in professional services', Helsinki: Swedish School of Economics and Business Administration
- [133] Orr, R.H. (1973) Measuring the goodness of library services: a general framework for considering quantitative measures, *Journal of documentation*, 29(3), pp. 315-332
- [134] O'Neill, M., Wright, C and Fitz, F. (2001) Quality evaluation in on-line service environments: an application of the importance-performance measurement technique', *Managing Service Quality*, 11(6), pp. 402-417
- [135] Parasuraman, A., Zeithaml, V.A. and Berry, L.L. (1988) Servqual: A multiple-item scale for measuring consumer perceptions of service quality, *Journal of retailing*, 64(1), pp. 12-40
- [136] Parasuraman, A., Zeithaml, V.A. and Berry, L.L. (1985) 'A conceptual model of service quality and its implications for future research', *Journal of marketing*, 49(4), pp. 41-50

- [137] Parasuraman, A., Zeithaml, V.A. and Malhotra, A. (2005) 'ES-QUAL a multiple-item scale for assessing electronic service quality', *Journal of service research*, 7(3), pp. 213-233
- [138] Pritchard, S.M. (1996) 'Determining quality in academic libraries', *Library trends*, 44(3), pp. 572-594
- [139] Powpaka, S. (1996) The Role of Outcome Quality as a Determinant of Overall Service Quality in Different Categories of Service Industries: An Empirical Investigation, *Journal of Service Marketing*, 10(2), pp.5-25
- [140] Parasuraman, A., Berry, L.L. and Zeithaml, V.A. (1991) 'Refinement and reassessment of the SERVQUAL scale', *Journal of Retailing*, 67(4), pp.420-450
- [141] Parasuraman, A., Zeithaml, V.A. and Berry, L.L. (1996) Alternative scales for measuring service quality: a comparative assessment based on psychometric and diagnostic criteria, *Journal of retailing*, 70(3), pp. 201-230.
- [142] Pritchard, S.M. (1998) 'Determining Quality in Academic Library', *Library Trends*, 41(3), pp.54-59
- [143] Quinn, B. (1997) 'Adapting Service Quality Concepts to Academic Libraries', *Journal of Academic Librarianship*, 23(5), pp.359-369
- [144] Qi, X.H. (2013) 'Study on Library E-service Quality Evaluation', *Information Theory and Practice*, 36(7), pp. 58-62
- [145] Qi, X.H. (2013) 'Study on Library Service Quality Evaluation and Elements', *Information Theory and Practice*, 36(5), pp. 83-87
- [146] Qi, X.H. (2014) 'Construction of Library E-service Quality Evaluation Scale', *Information Theory and Practice*, 37(11), pp. 98-103
- [147] Qi, X.H. and He, W. (2013) 'An Empirical Analysis on Influencing Factors of Library E-service Quality', *Journal of the National Library of China*, 22(3), pp. 16-23
- [148] Qi, X.H. and Yang, J.J. (2009) 'Construction of Library E-service Quality Evaluation Index System', *Information Theory and Practice*, (12), pp. 80-83
- [149] Qiao, H. and Wang, Y. (2009) 'Digital Library System and Service Quality Evaluation', *Journal of Information*, 28(12), pp. 196-199
- [150] Qin, X.Y. (2005) 'Evaluation on Library Information Service Quality in Digital Environment', *Library Journal*, 24(8), pp. 30-32, 47
- [151] Qiu, H.Z. and Lin, B.F. (2008) 'Principles and Applications of Structural Equation Model', China Light Industry Press
- [152] Richard, M. D. and Allaway, A.W. (1993) 'Service Quality Attributes and Choice Behaviour', *Journal of Service Marketing*, 7(1), pp.59-68
- [153] Roszkowski, M.J., Baky, J.S. and Jones, D.B. (2005) 'So which score on the LibQUAL+™ tells me if library users are satisfied?', *Library & information science research*, 27(4), pp. 424-439
- [154] Rust, R.T. and Oliver, R.W. (1994) 'Service quality: New directions in theory and practice', California: Sage Publications
- [155] Rehman, S.U., Kyrillidou, M. and Hameed, I. (2014) Reliability and validity of a modified LibQUAL+® survey in Pakistan: An Urdu language experience, *Malaysian Journal of Library & Information Science*, 19(2), pp. 83-102
- [156] Ren, X., Zhang, Y.L. and Jin, Z.R. (2002) 'A New Model for Library Service Quality Evaluation - From SERVQUAL to LibQUAL+', *Journal of Information*, 21(7), pp. 47-48
- [157] Satoh, Y. and Nagata, H. (2003) 'The assessment of library service quality: principally on the issues for based on SERVQUAL to library services', *Journal of Japan Society of Library and Information Science*, 49(1), pp. 1-14

- [158] Seth, N., Deshmukh, S.G. and Vrat, P.A. (2006) 'Conceptual model for quality of service in the supply chain', *International Journal of Physical Distribution & Logistics Management*, 36(7), pp. 547-575
- [159] Sheikh, A. (2014) Quality of CIIT Library Services and Users' Satisfaction: A Survey of Students, Faculty and Staff Members, *Libri*, 64(1), pp. 49-60
- [160] Smith, G.A., Tryon, H.D. and Snyder, L.B. (2015) 'Developing an academic library assessment plan: a case study', *Performance Measurement and Metrics*, 16(1), pp. 48-61
- [161] Shi, X., Holahan, P.J. and Jurkat, M.P. (2004) Satisfaction formation processes in library users: understanding multiSource effects, *The Journal of Academic Librarianship*, 30(2), pp. 122-131
- [162] Stamatopoulos, A. and Mackoy, R. (1998) 'Effects of Library Instruction on University Students' Satisfaction with the Library: A Longitudinal study', *College & Research Libraries*, 59(4), pp.323-334
- [163] Shi, G.H. and Xu, N. (2014) 'The Construction and Application Research of Public Library Service Evaluation Model - Based on the Perspective of Insync Surveys', *Journal of Information*, (3), pp. 182-186
- [164] Shi, G.H., Yu, W. and Wang, Z.M. (2010) 'Construction of Library Service Quality Assessment Model Based on SERVQUAL', *Library Theory and Practice*, (7), pp. 1-6
- [165] Shi, G.H., Yue, J.J., Chen, J.X. (2010) 'Chinese Library Service Quality Evaluation Scale Construction and Its Empirical Study', *Journal of Library Science in China*, 36(4), pp. 37-46
- [166] Shi, G.H., Yue, J.J., Liu, Q.G. and Wei, Z.Q. (2009) 'Study on Applicability of SERVQUAL Model in Service Quality Evaluation of Chinese Libraries - Based on Kano Theory', *Library and Information Service*, 53(23), pp. 49-52
- [167] Shi, G.H., Zeng, L. and Chen, J.X. (2010) 'Analysis of the Difference of Library Models for Service Quality Based on Quadrant Analysis Methods - Application of SERVQUAL and LIBQUAL+TM in Chinese Libraries', *Library Construction*, (5), pp. 43-46
- [168] Song, X.M. (2013) 'Establishment of An Improved Model for Library Service Quality Measurement Based on SERVQUAL Model', *Library Work in Colleges and Universities*, 33(4), pp. 52-55
- [169] Sui, C.J. (2004) 'Quality Evaluation of Digital Collection', *Journal of Library Science in China*, 30(4), pp. 43-46
- [170] Sun, J. and Su, H. (2005) 'A User's Perception Model for Assessing Service Quality - Evaluation of Library Service Quality based on User's Perception', *Library and Information Service*, 49(11), pp. 105-109
- [171] Sun, M., Yan, J.X. and Peng, Y. (2012) 'Weights for Service Quality Evaluation in University Libraries Based on Triangular Fuzzy Number Method', *Library and Information Service*, 56(17), pp. 89-92
- [172] Suo, C.J. (2007) 'Evaluation and Performance Analysis of Digital Collection', *Beijing Library Press*, Beijing, p. 134
- [173] Suo, C.J. and Duan, Y.S. (2008) 'Measures for Optimization of Quality of Digital Collection Services', *Journal of Library Science in China*, 34(1), pp. 43-46
- [174] Tajer, P. (2014) 'Using LibQual+® As a qualitative method: taking one iranian academic library as an example', *Qualitative & Quantitative Methods in Libraries*, (1), pp. 173-181
- [175] Thompson, B., Kyrillidou, M. and Cook, C. (2007) User library service expectations in health science vs. other settings: a LibQUAL+® Study, *Health Information & Libraries Journal*, 24(s1), pp. 38-45
- [176] Tan, F.B. and Chou, J.P.C. (2008) 'The relationship between mobile service quality, perceived

technology compatibility, and users' perceived playfulness in the context of mobile information and entertainment services', *International Journal of Human-Computer Interaction*, 24(7): 649-671

- [177] Uzun, A. (2002) Library and information science research in developing countries and Eastern European countries: A brief bibliometric perspective, *The International Information & Library Review*, 34(1), pp. 21-33
- [178] Vidgen, R. and Barnes, S. (2002) 'An integrative approach to the assessment of e-commerce quality', *Journal of Electronic Commerce Research*, 3(3), pp. 114-127
- [179] Velnamby, T. and Sivesan, S. (2014) 'Factor analysis of service quality in University Libraries in Sri Lanka—an application of Servqual Model', *Industrial Engineering Letters*, 3(5), pp. 40-49
- [180] Van Dyke, T.P., Kappelman, L.A. and Prybutok, V.R. (1997) Measuring information systems service quality: concerns on the use of the SERVQUAL questionnaire, *MIS Quarterly*, 21(2), pp. 195-208
- [181] Van House, N.A., Weil, B. and McClure, C.R. (1990) 'Measuring academic library performance', Chicago: ALA
- [182] Vinagre, M.H., Pinto, L.G. and Ochoa, P. (2011) Revisiting digital libraries quality: a multiple-item scale approach, *Performance Measurement and Metrics*, 12(3), pp. 214-236
- [183] Whitehall, T. (1992) 'Quality in Library and Information Service: A Review', *Library Management*, 13(5), pp.23-35
- [184] Weiner, S.A. (2005) Library quality and impact: is there a relationship between new measures and traditional measures?', *The Journal of academic librarianship*, 31(5), pp. 432-437
- [185] Wisniewski, M. and Donnelly, M. (1996) 'Measuring service Quality in the Public Sector: The Potential for SERVQUAL', *Total Quality Management*, 7(4), pp.357-365
- [186] Wolfenbarger, M. and Gilly, M.C. (2003) eTailQ: dimensionalizing, measuring and predicting etail quality, *Journal of retailing*, 79(3), pp. 183-198
- [187] Winsted, K.F. (1988) 'The Service Experience in Two Cultures: A Behavioural Perspective', *Journal of Retailing*, 73(3), pp.337-360
- [188] Wang, I.M. and Shieh, C.J. (2006) 'The relationship between service quality and customer satisfaction: the example of CJCUC library', *Journal of Information and Optimization Sciences*, 27(1), pp. 193-209
- [189] Wang, C.X. (1999) 'Study on Focus of Quality Management of Hotel Services', *Nankai Business Review*, (4), pp. 62-64
- [190] Wang, C.X. and Cai, H.R. (1996) 'Service Marketing and Service Quality Management', Sun Yat-sen University Press, Guangzhou, pp. 2-9
- [191] Wang, L.J. (2013) 'Study on Service Quality Evaluation of Mobile Library in Colleges and Universities Based on LibQualTM', Nanjing University
- [192] Wang, P., Wang, Y., Luo, J., et al. (2012) 'Application of Critical Incident Technique and Principal Component Analysis in Service Quality Evaluation of University Library', *Information Theory and Practice*, 35(12), pp. 79-85
- [193] Wang, P., Yan, T.S., Tang, M.L., et al. (2008) 'Research on Intelligent Evaluation Method for Academic Library Service Quality Based on Users', *Library*, (3), pp. 80-81, 87
- [194] Wang, R.X. (2011) 'Study on the Way of Service Quality in Library Based on QFD', *Library and Information Service*, 55(5), pp. 23-27
- [195] Wang, X.L. (2010) 'Application of Attribute Mathematical Model to the Comprehensive Evaluation of Library Service Quality', *Journal of Information*, 29(7), pp. 129-132
- [196] Wei, F.X. (2005) 'Service Quality Evaluation and Management', Posts & Telecom Press,

Beijing

- [197] Wei, F.X. and Han, J.L. (2003) 'An Empirical Study on the Cultural Difference Impact on Customer Perceived Service Quality', *Nankai Business Review*, 6(3), pp. 77-80
- [198] Wen, S.M. (2013) 'On the Evaluation of the Analysis of the Service Quality of Mobile Library', *Journal of the Library Science Society of Sichuan*, (5), pp. 30-32
- [199] Wu, D.M., et al. (2006) 'Approach and Analysis of Service Quality Evaluation in Libraries under Web Environment - Practice and Thoughts on the User Satisfaction Survey in Tsinghua University Library', *Journal of Academic Libraries*, (1), pp. 49-52
- [200] Wu, D.M., Shao, M. and Zhang, X.L. (2012) 'Empirical Research of Service Quality Measurement Indicators in Research Libraries', *Journal of Academic Libraries*, (5), pp. 82-89
- [201] Wu, D.M. (2013) 'Empirical Research of Service Quality Measurement Indicators in Research Libraries', *Journal of Academic Libraries*, (11), pp. 77
- [202] Wu, J.H., Chen, Y.Y. and Zhou, L. (2012) 'Personalized Information Services Research Tendency in Ubiquitous Information Environment', *Library and Information Service*, (15), pp. 31-36
- [203] Wu, M.L. (2010) 'Questionnaire Statistical Analysis Practice - Operation and Application of SPSS', Chongqing University Press, Chongqing, pp. 159-160
- [204] Xia, Q.L. and Shi, G.H. (2014) 'Analysis on Factors Influencing Library Mobile Information Service Quality Based on AHP-Fuzzy Comprehensive Evaluation Method', *Journal of Information*, 32(8), pp. 860-871
- [205] Xia, Q.L., Shi, G.H. and Zhang, X.H. (2015) 'Mobile Library Service Quality: Concept, Structure and Measurement', *Document, Information & Knowledge*, (1), pp. 55-63
- [206] Xiao, X.T. and Wang, D.D. (2010) 'Trends on User's Information Environment, Information Behaviour and Information Needs', *Library Theory and Practice*, (1), pp. 40-43
- [207] Xu, L., Wang, L. and Zhou, C.J. (2001) 'Towards Total Quality Management - Using SERVQUAL to Measure Library Service Quality', *Library and Information Service*, (5), pp. 76-79
- [208] Yap, D., Gable, G.G. and Chan, T. (2007) 'Towards Global Service Quality Dimensions: an Exploration of Commonality in Service Quality Measurement across Industries', 18th Australasian Conference on Information System, Toowoomba, pp. 907-915
- [209] Yan, L. (2014) 'Study on Library Mobile Service Quality Based on Fuzzy Comprehensive Evaluation', *Library Theory and Practice*, (3), pp. 87-89
- [210] Yang, Y.H., Wang, Y.G. and Zhong, X.D. (2002) 'Customer Relationship Management: Concept, Drivers and Growth Dimensions', *Nankai Business Review*, 5(2), pp. 48-52
- [211] Yu, L.Z., Gu, S. and Zhao, Z. (2005) SERVQUAL and Quality Assessment of Library Services: A Review of Research in the Past Decade, *Journal of Academic Libraries*, 23(1), pp. 51-57
- [212] Yu, L.Z., Wang, Y.Z. and Hong, Q.L. (2005) 'SERVALAL and the Service Quality Assessment in Chinese Academic Libraries - A Quantitative Study on the Utility of SERVQUAL Instrument', *Library and Information Service*, 49(6), pp. 90-94
- [213] Yue, J.J., Shi, G.H. and Chen, J.X. (2010) 'The Research of Multi-dimensional and Multi-level Structure for Library Service Quality', *Library*, (4), pp. 36-40
- [214] Zeithaml, V.A., Berry, L.L. and Parasuraman, A. (1996) 'The Behavioural Consequences of Service Quality', *Journal of Marketing*, 60(2), pp.31-46
- [215] Zeithaml, V.A., Berry, L.L. and Parasuraman, A. (1993) 'The nature and determinants of customer expectations of service', *Journal of the academy of Marketing Science*, 21(1), pp. 1-12

- [216] Zeithaml, V.A., Parasuraman, A. and Berry, L.L. (1985) 'Problems and strategies in services marketing', *International Journal of research in marketing*, 49(2), pp. 33-46
- [217] Zeithaml, V.A., Berry, L.L. and Parasuraman, A. (1993) 'The nature and determinants of customer expectations of service', *Journal of the academy of Marketing Science*, 6(3), pp. 2-7
- [218] Zhang, Y. (2010) 'Developing a holistic model for digital library evaluation', *Journal of the American Society for Information Science and Technology*, 61(1), pp. 88-110
- [219] [Zeng, L.Y. (2006) 'Application of the Testing Tool SERVQUAL in the Service Quality Analysis of University Library', *Sci-Tech Information Development & Economy*, 16(23), pp. 66-68
- [220] Zhang, C.J. (2011) 'An Empirical Study on Service Quality of Public Libraries in Different Regions of China', *Library Journal*, 30(9), pp. 16-20
- [221] Zhang, W.X. (2012) 'Construction Method of Library Service Quality Evaluation Index - Focused Interview', *Information Theory and Practice*, 35(1), pp. 91-95
- [222] Zhang, M.J. (2013) 'Analysis on the Difference in Service Quality Evaluation of University Library - Investigation and Thoughts on Reader Satisfaction of the Library of Ningxia Medical University', *Library Theory and Practice*, (3), pp. 81-84
- [223] Zhang, Q.H. (2003) 'Service Quality of Digital Library', *Library and Information Service*, (5), pp. 105-107
- [224] Zhang, X., Yang, Z.P., Zhou, N.L., et al. (2005) 'Quality Control and Evaluation System for Collaborative Digital Reference Services of Chinese National Science Digital Libraries', *New Technology of Library and Information Service*, (11), pp. 30-33
- [225] Zhang, X.Q. (2013) 'Study on Strategy for Improving Mobile Library Service Quality under the New Situation', *View on Publishing*, (2), pp. 67-69
- [226] Zhang, L (2009) 'Software Technical Support Services Quality Evaluation Study', *China Soft Science*, 23(3), pp. 115-125
- [227] Zhang, Y.J. (2007) 'Study on Information Service Quality Evaluation Model of Digital Library', *Modern Information*, 27(5), pp. 118-120
- [228] Zhang, Y.Q. (2012) 'Service Marking Culture Construction of Academic Libraries in the New Information Environment', *Library and Information Service*, 56(11), pp. 55-59, 70
- [229] Zhao, Y. (2013) 'Study on Mobile Library Information Service Quality Control System', *Library and Information Service*, 57(18), pp. 61-66
- [230] Zhao, Y. (2014) 'Construction of Digital Library Mobile Service Quality Evaluation Model based on Multi-dimensional and Multi-level Method', *Information Theory and Practice*, 37(4), pp. 86-91
- [231] Zhao, Z.B. and Tu, R.T. (2009) 'Empirical Study of the Dual-dimensionality of Measuring Product Attributes', *Chinese Journal of Management*, 6(1), pp. 70-77
- [232] Zheng, B., Zhao, Z.Y. and Liao, B.Z. (2012) 'The Evaluation of Library Service Quality Based on Gray Relational Analysis - Take Guangdong Ocean University Library as an Example', *Information Science*, (9), pp. 1345-1347
- [233] Zheng, P. and Zhang, B.Y. (2008) 'Comprehensive Evaluation of Library Service Quality Based on Set Pair Analysis', *Journal of Information*, 27(1), pp. 145-148
- [234] Zhou, Y.L., Wang, Y.H., Wei, W.X., et al. (2014) 'Study on Evaluation of University Library Service Quality Based on LibQUAL+TM - Taking the Library of Hebei University of Technology as an Example', *Library Work and Study*, (2), pp. 109-112
- [235] Zhu, H.T. and Liu, Y. (2007) 'Study on the Evaluation of the Digital Library Information Service Quality Based on the Analytic Hierarchy Process', *Information Science*, 25(5), pp.

720-724

- [236] Zhu, Q. (2010) 'Embrace New ITs with an Open Mind - IT Applications in Libraries in 2009', *Journal of Library Science in China*, 36(3), pp. 77-78
- [237] Zhu, T.H. (2013) 'Empirical Study on Service Quality Evaluation of Library in Colleges & Universities - Based on Quality Function Deployment and Grey Relational Analysis', *Information Studies: Theory & Application*, (10), pp. 77-80
- [238] Zhuang, S.J., Zhu, H. and Chi, X.L. (2012) 'Information Quality Education for College Students in Ubiquitous Knowledge Environment', Intellectual Property Publishing House, Beijing, pp. 2-9