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ABSTRACT

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Abstract

Cutting-edge technologies such as artificial intelligence, big data, cloud computing and Internet of Things have injected new energy into the development of libraries. The smart device is the carrier of new technology, which makes abstract technology vivid to ordinary customers. The purchase of smart devices should help libraries to improve their service quality and work efficiency. Libraries have invested vast amounts of resources into the development and adoption of new technologies, but have not received prospective earnings. Many scholars in the library field have begun to pay attention to this issue, but the related research is still in a very early stage. According to the adaptive structuration theory, the factors that contribute to the success of information technology (IT) adoption fall into two broad categories: one is the degree to which the IT structure matches the current organizational structure, and the other is how well organizations and individuals adapt learning behaviors to IT. This study is focused on the latter category. Some researchers have recognized the importance of customers in the adoption of library smart devices (LSD), whereas some ignore library professionals as another group using LSD. The upgrading of library services and optimization of management depend on collaborative work between library professionals and LSD. However, few studies have focused on the adoption of smart devices by library professionals. This study interviewed five library professionals and one library smart device supplier to determine the development status of LSD in China. Then, a model of factors influencing LSD adoption was proposed on the basis of unified theory of acceptance and use of technology, adaptive structuration theory, and interview results. The results of this empirical study are partially consistent with previous work. These results support eight of the ten hypotheses. The two main factors that influence the adoption behavior of LSD include use intention and facilitating condition. The critical factors influencing use intention are performance expectation, social influence, and IT literacy. Surprisingly, the hypothesis of effort expectation to use intention is not supported. Moreover, IT literacy has been proved to have a significantly positive impact on effort and performance expectations.

Key words	Library professionals; Library smart device; Adaptive structuration theory; UTAUT; Structural equation model; Smart library

ACCEPTANCE OF SMART DEVICES IN LIBRARY FROM LIBRARY PROFESSIONALS' POINT OF VIEW

Master's Thesis
in Information Science System

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1 INTRODUCTION

1.1 Research background

The library field is facing unprecedented challenges in the Internet information explosion era, and libraries in many parts of the world are struggling to maintain their branches and knowledge service (Ramirez, 2018). The development of cutting-edge technologies such as: artificial intelligence (AI), knowledge graph, mobile context awareness, Internet of things (IoT), cloud computing, machine learning, augmented reality/virtual reality (AR/VR) and communication technology, provides plenty of opportunities and threats. Only by adapting them well to the library field can this threat be turned into a way out of the struggle. These technologies are abstract to ordinary people, but smart devices are vivid, which could help them take advantage of the technical benefits quickly and efficiently. The concept of libraries has dramatically evolved because of the advancement of new technologies and smart devices (Izuagbe et al., 2019). Technological advances continually give impetus to the development of libraries, which has changed from the traditional, digital and composite way to the smart way (Kowalczyk, 2015; Wang, 2018). The primary function of the libraries has switched from providing book collection to tailored customer services. The manual work previously has also been replaced by the cooperation between human force and smart devices. Information explosion is one of the features of the big-data era; old modes of knowledge storage, transmission, and collection are apparently no longer able to adapt to the large, diverse, and sharp growth of information. Applying smart devices is one of the most efficient ways to help libraries to fulfill their duties with a limited number of library professionals. The International Federation of Library Associations and Institutions (IFLA, 2019) emphasized that AI technology is one of the most important technologies for the future of libraries, and IoT can also help libraries achieve significant performance.

About 70% of projects on information technology (IT) end up failing, investments worth millions have been made develop and purchase library smart devices (LSD), but no prospective effects have been seen (Omotayo & Haliru, 2020). This fact implies that simply pursing technological innovation cannot guarantee that the libraries would benefit from the new technology. There are many other factors that might influence the success of adopting new technology in libraries. Any creative technology is considered a failure

if it is not accepted by users. Some scholars in the library community have begun to pay attention to solving this issue, but the research is still at a nascent stage.

Previous research on adaptive structuration theory (AST) generally identified "structuration" and "adaptive" as two main aspects of successfully adopting IT by the organization (Zha et al., 2017). This study believes that the factors influencing LSD adopting could also be divided into two aspects: (i) "structuration" refers to whether or not the technical structure of LSD fits well with the current social structure of libraries, and (ii) "adaptive" refers to whether or not users have enough ability and a positive environment to adapt to changes. This study tries to analyze LSD adoption issue from the "adaptive" idea. Users in libraries include library professionals and customers. Many empirical studies have focused on adaptive customer behavior, but few have considered the point of view of library professionals (Hardyanto et al., 2018; Izuagbe et al., 2019; Omotayo & Haliru, 2020; Orji et al., 2010; Tibenderana et al., 2010). Library professionals, who act as operators and maintainers of smart devices, have great impact on successful LSD adoption. The advancement of IT and popularization of smart devices drive many jobs to require computer-related work. Library professionals who can grasp the potential benefits of LSD need high-level IT literacy and domain knowledge, which is still in short supply, especially in developing countries (Izuagbe et al., 2019; Peter-Cookey & Janyam, 2017). Gaining insights into what factors influence their adoption behaviors and intentions could help them work with LSD in a more compatible manner, thus improving the overall service quality for customers. In addition, almost all previous research studies in the library field concentrated only on the adoption issues of a single technology. Therefore, the results they obtained were less comprehensive and representative, because people usually experience smart devices involving multiple technologies rather than one.

To bridge research gap and help libraries better deal with the adoption issue of smart devices, I proposed a model to evaluate the influencing factors of LSD adoption by library professionals on the basis of the unified theory of acceptance and use of technology (UTAUT), and a structural equation model (SEM) was applied to verify this model. In addition to the original six variables in UTAUT, the new model introduces "IT literacy" as a new independent variable that could affect performance and effort expectancy. One of AST's main ideas is that the adoption behavior and effect vary with individuals even if they experience the same technology. This study believes that IT literacy might be mainly responsible for these differences. The difference in IT literacy would further influence the performance and effort expectancy of library professionals to adopt LSD. This

study tries to describe the interrelationship of variables and determine the most significant determinant factors in the library context.

1.2   Research question

The research questions are as follows: What factors affect the LSD adoption intention and behavior of library professionals? Which are the most critical factors affecting them? Interviews and empirical research were conducted to answer these two research questions.

1.3   Research procedure

This thesis is divided into four parts. The first part includes the presentation of research questions and literature review. Section 1 summarizes the background of LSD and related academic papers. The impact of new technology changes the traditional working mode of libraries and the duty of library professionals. To better derive the benefits of new technologies for long-term development, libraries and library professionals must learn more about them. New technologies are usually abstract and hard to understand for both customers and library professionals. However, when they are turned into smart devices, it becomes easier for people to understand them. Many studies have concentrated on new technologies that customers could adopt, and few have gained insights into how new technologies change the work of library professionals. Therefore, this study investigates the use intention and behavior of LSD from the point of view of library professionals. In Section 2, the historical research direction of the library is briefly analyzed and summarized to prove that this research conforms to the current academic trend in the library field. Then, the concepts related to this study are carefully defined. In addition, this section discusses the importance of smart devices to library development, current development status of LSD, and key technologies of LSD. Finally, research about adoption behavior in libraries is discussed.

The second part involves conducting a small-scale qualitative interview. The aim is to further detect multiple issues concerning the current application of LSD, and then some feasible suggestions are proposed. Interview data can help gather sufficient information and opinions, which can provide practical support and be used as a reference for the variables in the proposed model.

In the third part, a quantitative questionnaire survey has been implemented. According to the interviews and AST, the model proposed in this study would try to be as consistent as possible with previous research and conclusions of the interviews. In addition, all variables and assumptions are defined and interpreted in this part, and a questionnaire has been designed. After pretesting by some library professionals, questionnaires were delivered massively to collect data on social media platforms. Then, cross-analysis and SEM were used to analyze and verify the data collected from these questionnaires. According to the results of empirical research, the proposed model was optimized and verified until the model reached an acceptable degree.

Finally, this study combined the results of the interviews and SEM to draw a conclusion. Limitations, contributions, and possible future research directions are discussed in the end.
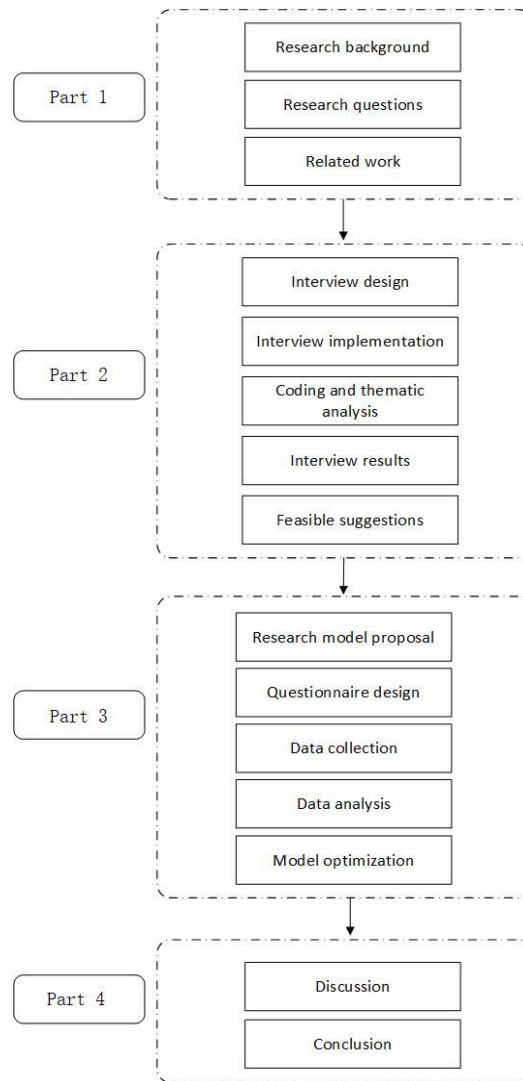

Figure 1. Research procedure design

2 LITERATURE REVIEW

2.1 Related work on IT adoption

The advancement of the IT industry has led to great development in the academic community of IT adoption. Since the 1970s, scholars have realized that IT could be seen as a critical resource to improve organizational performance via its adoption. Thus, a wide range of research studies on IT adoption in accordance with different perspectives and theories have been published over the past several decades. These studies could be divided into two schools: IT dualism and AST. They could also be categorized into individual and organizational perspectives. By analyzing previous work, this study believes studying the acceptance issue of LSD by referring to AST and individual perspectives is meaningful. The categories mentioned here are reviewed in the subsequent sections.

2.1.1 Rational decision school

Studies by early scholars on IT adoption usually viewed information technology and organization as two completely separate concepts. Their concerns included either the impact of IT on the organization (Joan, 1965; Perrow, 1972; Woodward, 1958) or the impact of organizational structure on the actual use of IT (Fulk et al., 1987; Kling, 1980; Salancik & Pfeffer, 1978; Walther, 1992). According to them, these two ideas are binary oppositions, so in determinism thinking similar to this, "rational decision" and "institutionalism" were born.

The rational decision school analyzes the process of IT adoption from the perspective of individual rational action, which is based on the hypothesis testing method of positivist philosophers. This school holds that organizational cognitive processes occur on the premise of rational decision-making. They are used to thinking from the perspective of individual rational behavior, which excludes the influence of environment on individuals and considers that organizational behavior is composed of the rational behavior of most individuals. IT contains a social structure that would definitively impose changes on organizations. The fundamental purpose of IT adoption by an organization or individual is to maximize benefits. If the adoption behavior does not achieve the expected results of performance improvement, IT adoption would be considered a failure. This school, which combines social psychology theories and cognitive processes, holds that technology is the determining factor in organizational change. This school has developed many

widely used theories and models, such as the technology acceptance model (TAM), task–technology fit, and theory of reasoned action. These theories generally believe that technology's characteristics psychologically affect one's use intention, and the intention to use is transformed into actual use behavior.

2.1.2 Institutionalist school

However, the institutionalist school hardly focuses on the individual's impact on organizational IT acceptance. It insists that IT adoption is not the reason for organizational change; rather, organizational change promotes IT adoption. IT plays only auxiliary roles in the result of organizational change. This school emphasizes that rational institutions guide the rational behaviors of individuals. An individual utilizes knowledge, resources, norms, and initiatives in a particular institution to construct the social structure of technology. This is in contrast to the rational decision school, which considers technology to be the center of all organizational changes. This school believes the institution is the only one center.

Both schools belong to "determinism" and the difference lies in their different cognition of the relationship between individual action and organizational structure. The rational decision school assumes that individual behavior can determine organizational structure, but institutionalism holds that institutions determine individual behavior. This dualism is also regarded as the duality of technology in the IT field. This duality exists simultaneously, which is explained as follows: On the one hand, IT is created by its creator according to its expected social structure. On the other hand, because the created IT implies the social structure that the creator intended, other individuals would be limited or promoted by such established norms and resources when adopting IT. Here, "norms" mean invisible institutions such as rules and customs, whereas "resources" refer to power resources and allocation resources.

Both schools ignore that IT adoption is a dynamic process; not one determines the other, but it is a cycle. A very important feature of IT is that it first constrains the organizational structure and environment in which it is applied, and then the social structure in IT is gradually changed in this application context. In other words, IT adoption and organizational structure are in an interactive relationship. The social structure of IT includes technical characteristics, usage rules, and related resources. DeSanctis and Poole (2014) proposed AST by referring to structuration theory in sociology (Giddens, 1984) to overcome the flaws of rational decision school and institutionalist school.

2.1.3 Adaptive structuration theory

By integrating the strengths of the two schools and the essence of structuration theory (Giddens, 1984), AST describes IT adoption as an interrelation of three variables: IT, organizational social structure, and interpersonal interaction. This dynamic description is based on two assumptions: (i) the behavior of the individual is both constrained and driven by IT and organizational structure, and (ii) the current organizational structure is the result of the long-term practice of previous individuals (Orlikowski, 1992).

According to the adaptative structuration theory, there is an interactive relationship between adoption and IT. IT contains a predetermined social structure; its creators incorporate social characteristics (such as hierarchy, organizational knowledge, and operational processes) into technology, forming unique attributes of the technology that constrain the actions of organizations and individuals (DeSanctis & Poole, 1994). At the same time, when individuals adopt technology, they can also decide how to utilize it and which characteristics of the technology to adopt (DeSanctis & Poole, 1994).

Structuration refers to the process by which social structure is constructed or reconstructed. Both the structure contained in IT and the internal structure of the organization undergo structural changes in the process of adapting to each other. Adaptive refers to the process by which organizations and individuals adapt to new IT in an appropriate way. After a period of fit between customers and IT characteristics, the new organizational structure and new IT structure appear, and the new structure is accepted by most members of the organization, thus forming a new system. This process is called "organizational change." According to the adaptive structuration theory, IT can improve the performance of organizations and individuals and help them complete tasks. However, the premise is that organizational structure can match the original IT structure, and individuals must have enough ability to reasonably use IT.

2.1.4 Related work on AST

Currently, research on AST can be divided into two categories (Zha et al., 2017). The first category is about the "structuration" idea. The general theme is to explore the key factors for successful IT project adoption. AST analyzes the adoption activities of IT in two ways: first, the birth of IT contains a specific social structure, and second, the social structure that actually occurs when IT is adopted. This kind of research generally finds that the "social structure embedded in technology" does not match the "organizational structure,"

which is the fundamental reason why IT projects fail to be adopted in a certain group of people or an organization. IT developers give IT a functional set and intention, which is also called the "social structure" of IT, according to the environment they experience and their expectations of the future. However, when IT is adopted, the social structure is usually different from the original social structure when IT was created. This difference creates communication barriers between IT creators and adopters, which results in mismatches.

Most of the research on the "structuration" idea is qualitative in nature, exploring the decisive factors that affect the failure of IT project implementation. Khuong et al. (2014) found that the reason for the mismatch between knowledge management software and needs of organizational members is that the creator's institutional environment is different from that of the adopter. Therefore, under different institutional pressures, the social structure of management software and the adopter's institutional environment have various forms. Luna-Reyes and Gil-Garcia (2014) believe that the organizational change of digital government can be analyzed from three aspects: (i) technology, (ii) organization, and (iii) institution. Different governments have different internal organizational structures and external environments, so even the same technology should be adopted differently according to their own actual situation. The success of applying the e-government system depends on whether or not the social structure of the government can adapt to the established structure of the system.

To improve the matching issue of IT and the organizational context, many scholars have presented effective solutions. Soh and Sia (2004) believed that when an organization adopts IT, the structural attributes should be given priority. If the organizational structure is formed by external authority, IT can apply the customization of technology to alleviate the mismatch problem. If it is adopted voluntarily by an organization, the mismatch can be eliminated by strengthening the organization's self-adaptation. Cao et al. (2013) advocated enhancing the interaction and communication between developers and enterprises and reducing misunderstandings between developers and investors through constant dynamic interaction.

The second category is the study of the "adaptive" idea, which focuses on how people actively choose IT to meet their expectations. Organizations and their members can choose to change how they work by modifying the organization's management process or rules or by changing the structure (functions and implications) of the technology. When facing different crowds, adoption methods are different even for the same IT. There is

plenty of research to explore factors influencing the adoption behavior of organizational members after the first IT adoption. Unlike the "structuration" idea, which focuses on macrolevel analysis, research on the "adaptive" idea focuses more on the motivation of organizational members to adopt IT at the microlevel. The research on this idea pays attention to individual rational decision-making. They combine social psychology and rational behavior theories with the adaptative structuration model and conduct a large number of quantitative empirical studies.

Ahuja and Thatcher (2005) found that work overloading and voluntary experimentation are the main motivations for organizational members to try new technological innovations. The impact of these two factors on IT adoption also varies with gender. Leonardi (2011) found that organizational members had a subjective initiative in IT adoption, and people would choose appropriate adoption methods according to the matching effect of their ability and performativity of IT. That is, organizational customs and technical functions are modified, reset, or enhanced during their adoption. Sun (2012) investigated the use of Microsoft Office and concluded that there are usually two ways for users to adapt to the changes that technology brings to their work: changing the set of technical functions and changing the implication of technology. The former refers to the features of the technology adopted by users who often try to utilize new features or find different alternatives. The latter refers to how technology can be utilized, and users may use its capabilities in new ways, not in the way the designer intended initially. In addition, Saeed and Abdinnour (2013) found that users generally have three modes after adopting self-service technology: (i) general use, (ii) special use, and (iii) extended use. User satisfaction, perceived usefulness, perceived ease of use, and voluntary will have significant differences in three stages. The differences in these variables can be used to determine the phase of IT adoption by an organization. Benlian (2015) showed that in the task-driven adoption environment, time has a significant impact on adoption. The increasing rate of use frequency and willingness of users to use IT functions tend to decrease over time. In the early days of adoption, users try their best to learn and use the functions of the technology. In the later phase, users are more familiar with the functions of the technology and can gradually find intersections between task requirements and IT functions. Therefore, they tend to use only a series of fixed functions to obtain benefits and maximize work efficiency.

The use behavior of customers can be divided into three phases: (i) exploratory behavior, (ii) innovative behavior, and (iii) extended use behavior. The exploratory behavior

is similar to the initial use behavior in Benlian's study. It is an exploratory learning behavior exhibited by users to understand the function of IT. The innovative behavior refers to people who find the uses of new technology after they master the basic functional set of IT and achieve their expectations. The extended use behavior includes the extension of the same technology function and extension of the same technology usage occasion. This behavior has gone beyond the function and spirit of the original IT. Typically, users are accustomed to using a few features of the technology without exploring the rest, which indicates a low level of usage. When users experience external incentives, such as leadership requirements or task overload, they explore more advanced usage patterns.

This research has been conducted on the basis of the adaptive idea. Library professionals have taken different adaptive actions to LSD because of the internal library structure and external environment. The fundamental purpose of these actions is to meet the requirements of organizational tasks and improve the performance of individuals and organizations. But for now, LSD adoption is still in a very early stage, and library professionals are still trying to explore the features of LSD. The analysis of the situation after the initial LSD adoption in the library, and insights into the factors that affect individuals' willingness and behavior to use LSD, would help libraries make more advanced adoption decisions.

2.2 Smart devices in libraries

2.2.1 Background of smart devices and library

Before introducing LSD, there is a need to discuss the development track for the modern library. In 1996, researchers put forward the application of computer information systems in daily library management activities, which implies that the smart library's idea probably originated from the digital library based on the computer system (Narayanan et al., 1996). In the following research about smart libraries, most scholars are concerned about what benefits a computer information system could bring to the library. With the establishment of their first alliance, smart libraries were first practiced in Canada in the year 2001. Finnish scholars proposed the concept of smart libraries at an academic conference in 2003 (Aittola et al., 2003). Chinese researchers published a paper in 2010 where the influence of IoT on the library was expounded, which is considered the first attention paid to smart libraries in the Chinese library context (Yan, 2010).

Scholars in the library community are highly sensitive to cutting-edge IT. Early research on smart libraries often employs words such as "e-library" and "digital library" to represent such libraries, which is mostly about building smart scenarios and introducing new technologies. Researchers focused more on how to take advantage of new technologies to improve the buildings and internal structures of libraries, which could be concluded as a "smart building" or "smart environment." For example, academics at the University of Queensland, Australia, explored the many positive changes that smart buildings and communities could bring to libraries (Raunik & Browning, 2003). Later, scholars gradually realized that smart libraries should pay attention to smart service and smart management in addition to stressing too much on new technology. Detlor and Arsenault (2002) believed that intelligent agent technology could be applied in information retrieval and consultation activities of digital libraries to improve the efficiency of customers and library professionals. Dent (2007) recommended that intelligent agent technology optimize the facilitating conditions of libraries, such as library professionals' training, IT literacy education, and consulting tasks. Other researchers referred to the application of intelligent communication technology in four fields, such as education and information, and presented the idea of its application in the library field. Meanwhile, they also investigated the views and application status of this technology in 20 libraries in Canada (Rubin et al., 2010).

With the continuous emergence of new technologies, it has become possible for the library community to provide a broader and deeper range of services to meet the needs of customers. At the same time, it is gradually getting rid of purely theoretical research and moving toward practical applications. For example, Chen et al. (2013) proposed a personalized customer service mode on the basis of context awareness technology for libraries. Dynamic behavior, static background, and real-time circumstance data of users could be collected as analysis materials to serve users with comfortable, safe, and accurate tailored services. Simović (2018) introduced the recommendation system by applying big data techniques to the library, which can help customers better understand and utilize the resources and functions in the library. Similarly, other research has also explored the benefits of data mining techniques in personalized customer services (Chang & Chen, 2006; Tsai & Chen, 2008).

It is not difficult to find something from the research over the past 20 years; they generally concentrated on ideas of smart management, smart environment, and smart service. Subsequently, another feature of smart libraries—smart people—was proposed. The

precondition and principles of smart management, smart environment, and smart service are all about matters concerning people. People and things are connected, people and knowledge are connected, people are connected, and people and the Internet are connected; all of these facts imply that the core principle is sustainable development for a people-oriented society. Scholars have also gradually realized that in the increasingly mature technological environment, the improvement of customer quality is another necessary element of constructing a smart library. Aharony (2013) expressed concerns about whether or not library professionals can accept new innovations and are ready to accept them and verified factors influencing library professionals' acceptance of mobile services through TAM. This research conformed to this trend and further explored the factors that influence the adoption and willingness of library professionals to adopt new devices. Yoon (2016) first applied TAM to investigate user acceptance of mobile library services in academic libraries.

2.2.2   Definition of smart devices

Researchers from different fields have not been able to come up with a unified definition for smart devices. For example, in the marketing field, the term "smart" stresses on the perspective of users (Klein & Kaefer, 2008). Then, on the basis of this premise, smart should mean users' demand-oriented devices that can meet their specific needs. This requires smart functions to avoid turning devices into cold machines, which depend only on machinery, but it can automatically find the needs of users and fulfill them according to their own ability. On the technical level, smart in the future should have the following features: self-adaptive, self-configuration, self-repair, self-protection, and self-optimization (Spangler et al., 2010).

It has been 10 years since the concept was first proposed, and the technology at that time was not advanced enough to fully implement these smart features. However, modern technologies such as IoT, cloud computing, AI, and AR/VR—which have been widely applied in various fields—could help achieve these smart features to a large extent (Qolomany et al., 2019). The new generation of devices absorbs multiple technologies, which more or less gives them such smart features. The three most critical technologies are IoT, data mining, and AI, which give intelligent capabilities to LSD.

IoT has been widely discussed and used by researchers in the library community. Pujar and Satyanarayana (2015) highlighted the significant impact that IoT would have on the library. Wójcik (2016) also stressed that IoT matches libraries very well and is

expected to be used in all aspects of library construction in the future. Cao et al. (2018) believed IoT devices—such as radio frequency identification devices, infrared sensors, global position system and scanners—can help improve the quality of library services, such as library professionals' training, customer consultants, and book tracking. An essential feature of IoT devices is their omnidirectional perception of people and objects (Massis, 2016). They can integrate and collect dynamic information of people and objects anytime and anywhere and then achieve automatic book positioning and other navigation functions. Yu et al. (2019) used the quickly response code technology to achieve automatic positioning, navigation, and book access of the library robot.

Data mining techniques can be applied to a variety of library devices, such as wearable devices, library robots, mobile handheld devices, and navigation devices. Through data mining techniques, libraries can find the potential correlational information of different users. For example, the University of Wollongong Library, Australia, found that students' library use was positively correlated with their academic performance (Cox & Jantti, 2012). Renaud et al. (2015) believed that data mining can be used to improve the accuracy of personal recommendation services. They proposed that data mining can help libraries establish links to different types of data, thus providing users with rich content. Jin (2015) proposed that the library chatbot's grammar could be automatically updated through communication between the robot and users.

AI, which is the core of many information systems and novel smart devices, is an inevitable trend of future library development (Krishnamoorthy & Rajeev, 2018; Russell & Norvig, 2016). With the help of AI, the library would further improve the quality of user service and working efficiency of the library (Becker et al., 2017). In 2012, the University of Nebraska–Lincoln, USA, mined the chat content of online users, enriched the question and answer database, and enabled users to obtain more targeted answers from their robot service (Allison, 2012). Jiang et al. (2016) designed library robots to achieve automatic book distribution and control. Tanaka et al. (2017) developed the guiding robot in the library, which can help users plan routes and chat in voice; they plan to add recognition technology soon. In the future, AI would be integrated with the library robot, which would expand the service scope of the library and reduce the burden on library professionals and customers to a great extent. It is foreseeable that the continuous progress of AI would promote the gradual evolution of library robots from a single function to true "library professionals" who can execute multiple responsibilities simultaneously.

The smart library includes three main features: (i) smart technology, (ii) smart service (user-centered personalized service), and (iii) smart people (both customers and library professionals) (Cao et al., 2018). Smart technology is the basis for achieving library intelligentization, smart service is the external manifestation of library intelligentization, and smart users are the ultimate beneficiaries of library intelligentization. Smart devices act as intermediaries, materializing new technologies and transforming them into smart services for the ultimate beneficiaries. Therefore, they play an integral part in the evolution of libraries.

2.3 Unified theory of acceptance and use of technology

Many factors affect the successful adoption of new technology or devices, and the adoption of the same technology varies with field, so evaluating the adoption of new technology in a specific domain must refer to its characteristics (Carlsson et al., 2006). Scholars have built many evaluation models on the acceptable behavior of customers to alleviate the mismatch of investments and benefits. TAM was the earliest method proposed and widely used, whereas the UTAUT model was recently considered to have better effects (Orji et al., 2010).

Davis et al. (1989) proposed TAM to evaluate IT adoption issues. In this model, perceived usefulness and ease of use are the significant variables that determine users' intention to adopt a new technology. Social, cultural, and political factors are moderator variables that have an impact on both perceived use and ease of use. Moreover, users' use intention—which would finally determine the actual use behavior—is determined by attitude, which is the dependent variable influenced by perceived use and ease of use. A Korean scholar, Yoon (2016) introduced the independent variable "interactivity" into TAM and found that the satisfaction of other users had the greatest impact on new users' intention to use technology. Hardyanto et al. (2018) assessed and verified that perceived ease of use would affect perceived usefulness, whereas perceived usefulness would affect users' attitude toward the library management system.

Venkatesh et al. (2003) enhanced TAM to become UTAUT. This model significantly improved the explanation capacity for use intention and has been widely used by many researchers. According to TAM, UTAUT came up with four independent variables: (i) performance expectancy, (ii) effort expectancy, (iii) social influence, and (iv) facilitating condition. There were four moderate variables: (i) age, (ii) gender, (iii) experience, and (iv) willingness to use. The rest of the two dependent variables are use intention and

actual behavior. The explanation degree of UTAUT is predicted to be about 75%, whereas TAM takes only 30%. Orji (2010) introduced nationality into the UTAUT model as an independent variable. She believed that customers in different countries have different reading behaviors and attitudes toward a new technology. Tibenderana et al. (2010) applied a service-oriented UTAUT model to evaluate IT services in libraries. Their results showed that "interconnectedness" and "social influence" greatly influence users' intention to use. Izuagbe et al. (2019) added IT skills as independent variables in TAM to evaluate the technology adoption behavior of library professionals. The results showed that when they lack IT operational capacity, library professionals' willingness to use decreases with an increase in perceived ease of use.

3   QUALITATIVE INTERVIEW RESEARCH

3.1   Interview implementation

Since there are few systematic researches on LSD, in order to investigate the status and existing problems of the adoption of LSD on library professionals' point of view, an interview was employed to investigate library professionals' general opinions about applying LSD and gaining insight into the current application status.

Table 1. Interviewees information

Number	1	2	3	4	5
Gender	Male	Female	Female	Female	Male
Working age	8	15	4	5	2
Department	IT	Customer consulting	Ancient books	Information source circulation	Developing and construction
Library	NanTong city Library	Central China normal university library	JiangXi provincial library	WuHan university library	XiangYang city library
Library type	Public	University library	Public library	University library	Public library

The interview has been carried out in three ways: mobile phone, face-to-face talk and online communication. There were 6 interviewees, including 5 library professionals from different libraries and 1 LSD supplier. The five library professionals are from: IT department of Nantong public library; customer consultation department of Central China normal university library; ancient books department of Jiangxi provincial library; resource circulation department of Wuhan university library; development and construction consultant of Xiangyang library. The reasons for selecting these five library professionals are very clear. On the one hand, some of them are from university libraries, and the others are from public libraries. On the other hand, they also share different responsibilities in the library which will increase the reliability of the interview and obtain broader opinions. The LSD supplier who is a sales director come from some LSD production company in Shanghai. He has rich experience in selling LSD. His answer will reflect the current situation of the application of library smart devices from another perspective. The detailed

interviewee information is shown in table 1. In order to protect the privacy of the interviewee, this study uses numbers and merely keeps their gender, working-age, department, library and library type.

The interview questions were divided into two parts. The first part is objective information collection, which mainly includes library professionals' necessary information, such as: what type of library you work for? What is your gender? How many years did you serve in the library? What are your departments and responsibilities? Do you think you have rich experience in using IT devices?

The second part is the subjective information collection, which mainly includes the library professional's understanding of LSD and their attitudes to LSD application. Such as: Can you talk about your knowledge of the current situation of smart device application in your library and your prospects? Do you think libraries should expand the use of smart devices in the future? Please feel free to talk about your views on the application of smart devices in libraries

Different interview questions were designed for library vendors. The questions mainly include: which libraries have you provided services and smart devices for? What are the most critical factors for a library when purchasing your LSD? What are the primary smart devices your company sells to libraries? There are six interviewees, including five library professionals from different libraries and one LSD supplier.

The data collected in the interview stage was transcribed and then coded manually. The purpose of the interview is to gain insight into some issues or general developing status in a particular field. There are no strict and fixed numbers to the number of employees as long as it is sufficient to reflect the common issues. The sample size of the interview was not very large, so I just manually coded it without any other computer software. The average interview time took 10 minutes and all answers were transcribed word by word. In order to make the collected data objective, this study does not judge which answer is worth transcribed, but transcribed all of their answers. The data collecting and coding has been done by 20th March 2020.

3.2   Current issue and feasible suggestion

The division of these three dimensions is consistent with the idea of adaptive structuration theory. Technology feature constrains the organizations and individuals who is going to apply it. The individual's adoption behavior is constrained by both the technology feature

and organizational structure, which is the result of the previous long-term practice of individuals. At the same time, individuals in the organization can decide whether to adopt the technology and which features of technology to adopt. Finally, the individual's long-term adoption behavior will change the technology features and organizational structure, then construct a new social structure.

Table 2. Framework of interview data analysis

Individual ability	Organizational atmosphere	Technology feature
IT literacy	Technology support	Techonology transfer
	Education and training	
	Funding	
	Attention from executive	

The interview results found some common problems in the current adoption of LSD. For example, library professionals' understanding and adoption behavior of LSD varies with their department, length of service, gender, and information literacy and so on. Besides, some other typical issues were found on each of the three layers.

On the individual layer, library professionals are generally optimistic about the prospects of LSD, believing that LSD will undoubtedly provide positive changes to their work in the future. But the primary issue is the benefits brought by LSD have not yet been evident, and the current situation is far from what library professionals expect. Some library professionals argue that their workload, working hours and quality of work have not been significantly improved. The workload of some library professionals has even increased. The interview transcription results indicate as below:

a: We use some smart robots in the library, such as automatic bookshelf robots. These robots are attractive to both library staff and customers which has immediately attracted much attention after deploy. However, the error rate of their work is very high, which requires us to check again their work, which does not reduce the workload.

b: My responsibility is to provide technical support, so whenever there is a malfunction, I will come and provide technical help as soon as possible. At present, our library applies quite a lot of LSD. But these devices often break down, and their quality is not very satisfactory, so I spend most of my working time helping library professionals in other departments fixing those broken devices. My job used to be as simple

as a small amount of IS/IT maintenance, but now my workload has been dramatically increased.

C: Our library has introduced smart navigation systems and intelligent question-and-answer robots. They are capable of talking, charge themselves, and finding a good way to serve the customer's needs. But, many customers report that they are not satisfied with the information they receive from these devices.

There are many reasons for this phenomenon, one of which is probably that library professionals have excessive expectations for LSD. And one of the reasons for the excessive expectation could be blamed on the lack of IT literacy, which will change according to their gender, working age, major, department and so on. The higher the IT literacy of the library professionals, the more reasonable their expectations will be. Therefore, IT literacy is regarded as the primary variable affecting the performance expectations and effort expectations of library professionals, which has been tested valid in the empirical part.

On the organizational layer, almost all of the interviewees claimed that their own libraries lack investment on LSD. Although the library funds are relatively vast and adequate, it is still not enough to afford many high-quality LSD, which usually leads the library to execute the secondary choice. With the profound development of the modern library, the cost will increasingly rise (Bahr, 2000). When considering the necessity to invest in upgrading the technology continuously, enough funding will undoubtedly be critical (Lyman, 1996). This problem also leads some library professionals to complain the LSD now failed to meet their expectations.

d: We lack enough money to purchase and maintain LSD because they are usually expensive while we have to spend more funding on other business projects. LSD bought on a shoestring budget are not very reliable.

Another common problem is the concern of top leaders. Top leaders need to have a deeper understanding and substantive attention to LSD, rather than a superficial perception. Decision-makers need to realize that the importance of LSD for upgrading the service quality and make sustainable strategies to cope with the changes caused by new technology. Only by acutely understanding the performance and recognize the possible issues in the application process, can they better adapt to this irreversible trend. If the leadership always pays superficial attention to LSD, it will cause library professionals and customers to become frustrated with LSD and eventually refuse to use them. Many methods could

be applied to increase this aspect, such as improve incentives, encouraging staff training and raising investment. Since library professionals' IT literacy varies, it is one of the effective ways to carry out personalized staff training activities to help them make good use of LSD in their work. Besides, the communications between ordinary library professionals and technicians also need to be taken seriously by the leadership, which not only needs to ensure enough technicians to help average library professionals maintain the equipment, but also needs to enhance typical library professionals' general knowledge of the operation mechanism of LSD through productive training activities.

e: I hope that as smart devices will become widely used, someone can teach us how to adapt to working with them quickly.

f: My teaching strategy is to teach people how to fish rather than give them the fish, which means I hope that library professionals can figure out the operation mechanism of smart devices instead of merely learning the use of a particular device. Therefore, they can then have the ability to learn by themselves when facing other new devices, and my teaching strategy has been well received.

g: The library leaders lack a deep understanding of technology and follow the trend, so they hardly know how LSD can be used in the library, which would lead to bad decisions for their subordinates.

h: The work conflict between technicians and ordinary library professionals is persistent because library professionals have limited knowledge of the technology, they hope technicians can repair the equipment as soon as possible, but the number of technicians is limited. It takes time to find a balance between them.

On the technical layer, technology transfer, which means the immaturity of LSD technologies, is the main issue. The new technology in library field is basically borrowed from other areas, which causes that the technology does not fit the actual task requirements of the library well. The technology transfer issue will arise as well in the initial phase of IT's introduction in many other fields, and it would alleviate the technology evolving and more in-depth understanding of customer needs. Therefore, one solution is to involve users frequently in the production and design process of LSD and continuously absorb the feedback and suggestions from customers (Hussain, 2020). This agile IT development strategy is required to enhance the communication and evaluation between

users, designers, and vendors (Black, 2001). Also, improving library professionals' IT literacy and helping them express their needs clearly to LSD suppliers is critical. Due to the difference between library professionals' professional and IT knowledge, they generally lack the necessary professional description to help manufacturers better understand their actual needs. This ambiguity of expression will create a gap between suppliers and library professionals, and slow the development of personalization and customization of LSD. And this needs the library to carry out the staff training work effective.

i: LSD is a new field and the development of this field is lagging behind the development of the general business field; the library field borrows the technology from them." Many of the library needs' functions differ from other scenarios, so the technology needs to be further improved to be more consistent with the library context.

g: I realized the needs of library professionals are unclear to us during the design and production stages. Thus, we want to communicate more with library professionals and involve them in these stages to ensure our products could better achieve their actual requirements.

4   RESEARCH MODEL AND HYPOTHESES

4.1   Research model

Based the basis of UTAUT and AST, this study proposes an adoption model suitable for the library field. The four independent variables in the original model in UTAUT are reduced to three: IT literacy, facilitating condition, and social influence. Taking the idea of "adaptive" from classical structuration adaptive theory, which believes the social structure inherent in technology constrains the organizations and individuals who choose to use it. And the individual's adoption behavior is limited by both of the social structures of technology and the organizational structure, which comes from previous long-term practice of individuals. Even in the face of the same technology, different individuals will have different adoption behavior, and the reason may be closely related to their job tasks and the individual's information technology literacy.

Meanwhile, the individuals in the organization can decide whether to adopt the technology and which features to adopt. The individual's long-term adoption behavior will change the both of the social structure of technology and organizational structure, then constitute a new social structure. On this basis, this study believes that one of the main reasons for the differences in the adoption behavior and results of LSD is their information technology literacy. Through literature review of AST, it was found that library professionals' performance expectancy and effort expectancy for library smart devices are highly correlated with their IT literacy, so the two variables are classified as the dependent variables of IT literacy. Compared with the original UTAUT model, this study adds the positive influence of facilitating conditions on performance expectancy. Besides, it was also believed that IT literacy not only maintains a positive impact on the use intention through the two mediating variables (performance expectation and effort expectation) but also directly influences the use of intention.
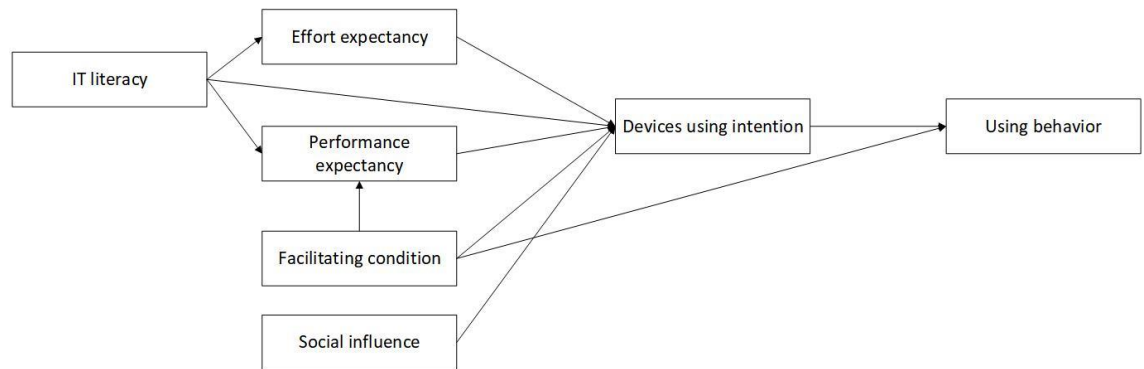
Figure 2. Initial proposed model

4.2   Measurement items and variables definition

4.2.1   Variables definition

Facilitating condition:

Facilitating condition (FC) mainly refers to the technical support from the organization, technology itself, and other sources, so users can learn how to control the technology quickly and easily (Venkatesh et al., 2003; Williams et al., 2015). Zhouet al. (2010) believe that users should have the necessary financial knowledge and mobile phone operation skills to adopt the mobile banking system or hardly control the whole using process. The mobile banking system should also provide enough instruction for users to get used to this system. I.-C. Chang et al. (2007) believe that the technical support of the information system and the operational knowledge users required will positively affect actual adoption of IS and eliminate potential obstacles that users may face, such as the inability of users to fully understand the interaction process with the system. They also define FC as the degree that a doctor believes their hospital will provide them enough support to adopt a new IT or system. Zhou et al. (2010) believe that FC includes the necessary personal knowledge and organizational support to use new IT. User has to obtain adequate knowledge about the IT and the field where this IT is applied, and the organizational support has to be provided in time when user has trouble.

In the context of this study, most of library professionals come from related majors such as library management instead of information technology or other IT-related majors, which means they may have knowledge barriers on the use of new LSD. The library needs these library professionals to skillfully apply these purchased smart devices to their work, so the library professionals need external help to adapt to these new LSD. The support could be divided into two parts: one is support from LSD themselves, the second is

support from the organization. For the newly purchased LSD, the device suppliers must provide understandable instructions for the library professionals to get familiar with the new devices' properties and operation procedures. This instruction would help appliers to gain more knowledge about the idea and functions the designers try to spread to them. The instructions cannot be too technical to make the library professionals have great difficulty in understanding it. The help from the organization mainly refers to that the library IT department actively carry out related training work, which will help the library professionals to adapt to the collaborative work with LSD as soon as possible.

Performance expectancy:

Performance expectation (PE) is developed from perceived usefulness (PU), scholars usually defined it as user's belief that a system or technology will help them achieve the desired goals, especially getting better work performance than when the task was done manually (Venkatesh et al., 2003). Magsamen-Conrad et al. (2015) believe that performance expectancy shows generational differences in different age groups in the context of tablet adoption. And they define performance expectancy as to what extent individuals believe using IT could benefit to their work.

In this study, library professionals' PE for LSD mainly refer to whether the devices can help them reduce their workload and achieve better work quality. For example, the application of a navigation robot in the library can help the library professionals in consulting departments better serve the customers. The original purpose of purchasing this robot was that robots could replace library professionals and provide faster, comprehensive and detailed answers to customers' consults. But in fact, if the robots are constantly malfunctioning, or the process of interacting with users is complicated, so it might lead to customers feeling unhappy or not getting the answers they want, and users may then complain about the robots and blame the library. The pressure and workload on the library professionals in related departments (such as consulting and technical departments) is indirectly increased. Therefore, the performance expectancy of library professionals for LSD mainly includes reducing workload and improving work performance.

Effort expectancy:

Effort expectancy (EE) was developed from perceived ease of use (PEU) and the complexity of innovation diffusion theory (Venkatesh et al., 2003). This variable refers to in which degree the user perceives difficulty in learning to use an IT technology or a system.

Effort expectancy is one of the most important variables influencing the user's IT acceptance (Cimperman et al., 2016). They also confirmed that EE would affect use intention of older people's acceptance of indoor remote healthcare service.

In this study, EE of library professionals mainly refers to their self-perceived difficulty in learning or operating LSD in routine work. If library staff cost much time and energy to acquire or operate new LSD, it will bring great pressure to their work and affect their willingness to use. Even though the device may bring them some performance benefits in the future, they probably would not show much willingness to adopt it if they feel they cannot control it, or the learning process takes much time. In addition, after they learn how to use the device if the operation process is complicated and requires a lot of energy, they will also reconsider whether to continue to apply this device.

IT literacy:

The definition of IT literacy (ITL) came from social cognitive theory. It is defined as an individual's self-assessment, capability and knowledge storage before trying to achieve a specific goal (Bandura, 1977). IT literacy, also seen as IT skills (Brown & Parr, 2018; Kaarakainen et al., 2017; Kaarakainen et al., 2018), e-skills (Izuagbe et al., 2019) and IT self-efficacy (Aesaert & van Braak, 2014; Rohatgi et al., 2016), appeared in many researches. It includes the ability or experience one has when learning a new technology and refers to whether they are confident enough to it. Some researchers have verified that ITL are positively related with PEU and PU in TAM (Bandura, 2010; Chau, 2001; GovindAarajan & Krishnan, 2019; Kulviwat et al., 2014). The PEU and PU are very similar to performance expectations (PE) and effort expectations (EE) used in this study, so it could be inferred there might be a positive influence between ITL and PE and EE.

In this research, ITL mainly refers to whether library staff actively seek to use LSD. Actively using LSD not only means that library professionals are interested in them, but also means that they are confident to handle them. ITL can be measured from multiple dimensions. This study mainly evaluates this variable based on users' previous experience in using IT and whether they often volunteer to use other IT devices in their daily life. The richer the experience of using smart devices in life or work, the higher ITL users will get, and the more effort expectation uses will have.

Social influence:

Social influence (SI) stressed the positive impact of environment on adoption process of IT (Venkatesh et al., 2003). Relatives, colleagues, friends, superiors, or other people that

users care about may potentially change the user's perception of new technology, and prompting use's adoption intention or behavior.

In this study, SI is defined as: people or environment which is important to library staff will affect their intention to use smart devices. If a new LSD is not familiar to the library professionals or public, they will doubt the performance of this device, thus reducing its use intention.

Devices using intention:

Using intention (UI) refers to the fact that users would use or show a willingness to a technology or information system in the future (Venkatesh et al., 2003). In this study, the willingness to use devices mainly refers to that library staff would use smart devices in their work, or they think they will be happy to work with smart devices in the library, or they believe smart devices in the library will have positive support to their work.

4.2.2 Measurement items

All of the variables used in this thesis are noted with more than one source. The measurement items are not created by myself but modified from the source. To make sure the measurement items could reflect the facts that I want, I also refer to the interview answers. The details are shown in table 3.

4.3 Hypotheses

H1: IT literacy positively affects the library professional's performance expectation of LSD.

H2: IT literacy positively affects the library professional's effort expectation of LSD.

H3: Performance expectation positively affects the library professional's LSD use intention.

H4: Effort expectation positively affects the library professional's LSD use intention.

H5: Facilitating condition positively affects the library professional's LSD use behavior.

H6: Social influence positively affects the library professional's LSD use intention.

H7: Librarian's use intention of LSD positively affects the use behavior.

H8: IT literacy positively influences the library professional's LSD use intention.

H9: Facilitating condition positively influences library professional's performance expectation.

H10: Facilitating condition positively affects the library professional's LSD use intention.

Table 3. Measurement items and source for variables

Variables	Measurement items	Source
Facilitating Condition （FC）	FC 1: There are technicians to help me adapt to use the LSD in our library. FC 2: The technicians always solve problems in time when something goes wrong when we are using LSD. FC 3: Our library always collects our feedback and improves the flaws of the LSD.	(Venkatesh et al., 2003) (Balaban et al., 2013)
Performance Expectation （PE）	PE 1: LSD is useful to my work PE 2: LSD improves my working quality PE 3: LSD improve my working efficiency.	(Venkatesh et al., 2003) (Zhou et al., 2010)
Effort Expectation (EE)	EE 1: Using LSD in my work skillfully is easy for me. EE 2: LSD could help me to get my work done easily. EE 3: Learning how to use LSD is not difficult for me. EE 4: My interaction with LSD is understandable and concise.	(Venkatesh et al., 2003) (Zhou et al., 2010)
Social Influence (SI)	SI 1：People who are important to me think I should use LSD. SI 2: People that could affect my action suggest me to apply LSD. SI 3: The reputation of LSD will affect my use intention.	(Venkatesh et al., 2003) (Zhou et al., 2010)
Use intention (UI)	UI 1：I like to work with LSD. UI 2: Working with LSD makes my work more interesting. UI 3: Using LSD is helpful to my job. UI 4: I wish I could use LSD in my job.	(Venkatesh et al., 2003)
IT Literacy （ITL）	ITL 1: I am confident and will actively seek to use LSD. ITL 2: I have rich experience in using smart devices (systems) in my daily life. ITL 3: I have a strong interest in using new smart devices.	(Bandura, 1977) (Duo-gang & Jun-hua, 2016)
Use Behavior (UB)	UB 1: I always use LSD in my work. UB 2: I will use and cooperate with the LSD in my work. UB 3: I will recommend library professionals, superiors and customers to use the LSD.	(Davis, 1989) (Venkatesh et al., 2003)

5   EMPIRICAL RESULT

5.1   Data collection and demographic distribution

This study applies a random sampling method, and all library professionals in China have an equal opportunity to answer this questionnaire. The questionnaire was mainly distributed through the online social media groups like WeChat and QQ. A total of 152 questionnaires were collected; 142 were valid, which accounts for 93.4%. There are two criteria to judge the validity of the questionnaire: whether the filling time is too short and whether all of their answers are the same. Any questionnaire involving these two points is deemed invalid.

All the respondents came from libraries in 28 provinces across China, and Hubei, Jiangxi and Jiangsu were the major provinces (21.83%, 11.27% and 10.56% respectively). There are 49 male participant and 93 females got involved in the final data sample. The respondents were asked to fill in their library departments, and a total of 15 departments were mentioned. The most frequently mentioned department were customer services (37.2%), information resource construction (33.8%), resource circulation (27.46%), and information technology (30%). Quite many library professionals have worked in or are working in various departments.

The distribution of working years of library professionals is less than five years (22.54%), 6-10 years (18.31%), 11-15 years (19.72%), and more than 16 years (39.44%). According to the statistical analysis results, 80.77% of library professionals with 6-10 years of working experience believe they can easily use LSD in their work, and this figure ranks the first among the four groups. The second group is less than five years which accounts for 78.13%, the third group with 11-15 years takes up 71.43%, and the last group with more than 16 years represents 66.07%.

Of the 142, 55 (38.73%) reported they often use LSD at work, 51 (35.92%) said they sometimes use them, 34 (23.94%) reported they rarely use them, and only 2 (1.41%) reported they never used LSD. Furthermore, 42.86% of male respondents said they often use LSD at work, while females only account for 32.26%. And there are still 2.15% of female respondents said they had never worked with LSD, compared with 0 for men.

Similarly, men are also more confident in their understanding of LSD. 28.57% of male respondents think they know very much about LSD, while 63.27% think they know roughly. However, the figures for female library professionals were 15.05% and 74.19%,

respectively. In general, 19.72% of library professionals think they know very much about LSD, 70.42% of respondents think they know roughly, 9.86% think they know very little, and no one thinks they know nothing about LSD.

As for the survey on motivation, 81.69% of respondents believe using LSD could improve their work quality and efficiency so that they can perform their duties better. 69.72% of library professionals believe that LSD can reduce their workload, and 58.45% believe that adopting LSD can help libraries become attractive and attract more customers to visit the library. Interestingly, some library professionals (21.12%) also felt they are forced to use LSD. Besides, 77.46% of respondents believed that customers' wishes, the organization's requirements, and the reputation of LSD would also motivate them to use LSD in their work.

The statistics of LSD show that the smart borrowing and returning device is the most frequently used device among all LSD, 91.55% of the respondents claim their library have vastly applied it. The second one is intelligent inquiry device accounting for 84.5%, and the third is the smart security device which takes up 80.98%. 17.60% library professionals mentioned the application of intelligent robots, whose functions mainly include intelligent question-and-answer and comprehensive inquiry services for interacting with customers, as well as bookshelf arrangement and book inventory checking functions for interacting with library professionals. There are other kinds of LSD mentioned in the survey, such as: the smart card machine, smart lighting control system, smart air conditioning control system, smart anti-fire equipment, smart music system, smart printer, wearable devices, AR/VR devices, customer navigation equipment, smart bookshelf, electronic reading pad, smart sterilization equipment.

5.2   Reliability and validity

5.2.1   Cronbach α test

There are seven variables in this study, 19 observational variables are needed to be tested for reliability and validity. Observational variables generally refer to the measurement problem of corresponding variables. Reliability and validity test are common methods to test the reliability and accuracy of data in quantitative research, especially the questionnaire of user attitude scale. The general index of reliability is the Cronbach α. The higher the index is, the higher the reliability of the data collected. If the index is higher than 0.8, then the reliability of the data is very high; if it is less than 0.6, the reliability of the data

cannot be accepted. The Cronbach α of each variable should be calculated separately to determine whether the obtained data corresponding to each variable is reliable. The corresponding coefficient of each variable in this study is all higher than 0.8, indicating that all data are highly reliable. As shown in the table 4, the Cronbach α of each variable in this study is higher than 0.8, indicating that all data is highly reliable.

Table 4. Reliability and validity

Variables	Cronbach*α*	Composite Reliability	Average variance extracted	Numbers of questions
Facilitating Condition	0.857	0.858	0.669	3
Performance Expectation	0.935	0.937	0.833	3
Effort Expectation	0.939	0.939	0.794	4
IT Literacy	0.821	0.821	0.606	3
Social Influence	0.871	0.873	0.776	2
Using Intention	0.914	0.915	0.844	2
Using Behavior	0.801	0.799	0.665	2
Total/Average value	0.878	0.877	0.741	19

5.2.2 Construct validity and CFA verifying

Many values could be used to measure validity. In this study, AVE and CR values were used to test the degree of aggregation of collected data. Pearson correlation and AVE square root values were then used to test the discrimination degree of each factor. Firstly, KMO and Bartlett tests were conducted on the overall data to determine whether the data had good validity. When KMO >0.8 and Bartlett < 0.05, it is proved that the data has high validity and could be used for factor analysis. This test results show that the overall KMO of the collected data is 0.9 and Bartlett is 0.00, which falls into the acceptable range.

Table 5. Correlations between variables

	UB	UI	SI	ITL	FC	PE	EE
UB	0.815						
UI	0.693	0.919					
SI	0.644	0.719	0.881				
ITL	0.688	0.696	0.631	**0.778**			
FC	0.565	0.449	0.538	0.451	0.818		
PE	0.543	**0.732**	0.597	0.516	0.569	0.913	
EE	0.617	0.571	0.517	0.696	0.470	0.445	0.891

Next, confirmatory factor analysis (CFA) is applied to analyze the degree of aggregation and differentiation of data. As can be seen from the calculation results in table 4, AVE and CR of all variables are greater than 0.5 and 0.7, indicating that the convergence validity of data is extremely high. According to the test results of Pearson and AVE square root test, it can be seen in table 5 that the minimum AVE square root of the factor (the diagonal value of the matrix) is 0.778, which is greater than the maximum value of the

correlation coefficient (the rest value) is 0.732, indicating that the measurement questions in this questionnaire have a high degree of differentiation.

5.3   Amos results demonstration

5.3.1   Test of observational variables

The purpose of the test of the observational variable is to check whether questions corresponding to each latent variable in the questionnaire are reasonable and have the value of scientific analysis. This thesis uses standard factor loading to do this task. When standard factor loading was greater than 0.4, it could be considered that the observational variables could accurately describe the corresponding latent variables.

Table 6. Standard factor loading

Latent variable	Observable variable	Standard Factor loading
IT literacy	ITL 1	0.840
	ITL 2	0.783
	ITL 3	0.797
Effort expectation	EE 1	0.893
	EE 2	0.895
	EE 3	0.953
	EE 4	0.829
Social influence	SI 1	0.886
	SI 2	0.874
Performance expectation	PE 1	0.878
	PE 2	0.956
	PE 3	0.904
Facilitating condition	FC 1	0.807
	FC 2	0.818
	FC 3	0.833
Using intention	UI 1	0.911
	UI 2	0.925
Using behavior	UB 1	0.769
	UB 2	0.871

The fitting degree of the initial model constructed in this study is not ideal, so it has been modified many times. The optimization process includes the modification, merging, and deletion of the original questionnaire measurement questions. Questions with low standard factor loading are deleted, with higher relevance are merged and with fewer distinctions are grouped into other factors. As shown in table 6, the results illustrate that standard factor loading indexes about all measurement problems used for model analysis

are much higher than 0.4, so it can be inferred that the selected observational variables can reflect the information collected by the corresponding variables a high degree.

5.3.2 Modified model fit index

There are many indexes to measure the fit of the structural equation model. Because of the deviation of measurement questions, the subjective divergence of people's opinions, and the limited sample size, the model sometimes cannot meet all the optimal criteria at the same time. In addition to the optimal criterion, there is also an acceptable criterion, which means that the model is not perfect, but it's still acceptable. Referring to table 7, it could be seen that five indexes are good and two indexes are acceptable, so the overall adaptability of the modified model can be accepted, and the model constructed in this study is valid and has acceptable validity. Therefore, the hypothesis verification part of the structural equation model could be carried out in the next step.

Table 7. Model fit

Index	Calculated value	Criterion		Fit evaluation
		Optimality criterion	Accepted Criterion	
χ^2	229.265	/		/
df	121	/		/
χ^2/df	1.895	<3		GOOD
RMR	0.046	<0.05		GOOD
CFI	0.950	>0.9	[0.7,0.9]	GOOD
NFI	0.900	>0.9	[0.7,0.9]	GOOD
AGFI	0.796	>0.9	[0.7,0.9]	ACCEPTED
GFI	0.856	>0.99	[0.7,0.9]	ACCEPTED
NNFI	0.909	>0.9	[0.7,0.9]	GOOD

5.3.3 Hypotheses test results

Table 8 demonstrates that the Amos results do not support 2 of the ten proposed hypotheses. Besides, the initial model does not assume that H9: FC has a positive affection with PE, nor does it assume that H8: ITL has a positive influence on UI. After calculating the results of initial model, it is found that there are strong modification indices (MI) values in the path coefficients of these two pairs of variables. If the correlation was modified and added, the fit of the model could be greatly increased. At the same time, both of the two hypotheses could be theoretically explained reasonably. Therefore, the three hypotheses are added to form a new modified model.

The CR index in table 8, also known as the t-value test, is often used to evaluate whether there is a strong correlation between variables. And the P-value is closely related

to CR (t), which increases with the increase of the absolute value of t. The higher the absolute value of CR (t), the smaller p-value.

When $|CR(t)| \geq 3.29$, then p ***<0.001, it indicates that there is an extremely significant relationship between these variables. In this study, H1, H2, H3, H7, and H9 are presented with such characteristics. When $|CR(t)|$ is between 2.58 and 3.29, P**<0.01 indicates a relatively significant relationship between these groups of variables, like H5, H6, and H8 in this study. When $|CR(t)|$ is between 1.96 and 2.58, P*<0.05, it could be inferred that variables maintain a significant relationship. When $|CR(t)| \leq 1.96$, the P[ns] > 0.05, it refers to there is no evidence that could be found to support the hypothesis, like H4 and H10 in the chart above.

Table 8. Empirical result demonstration

Hypothesis	Relationship	CR（t）	Path coefficient	Test
H1	ITL→PE	4.071	0.380***	SUPPORT
H2	ITL→EE	9.312	0.788***	SUPPORT
H3	PE→UI	4.711	0.383***	SUPPORT
H4	EE→UI	0.902	0.093[ns]	NOT SUPPORT
H5	FC→UB	2.846	0.250**	SUPPORT
H6	SI→UI	3.201	0.354**	SUPPORT
H7	UI→UB	7.038	0.723***	SUPPORT
H8	ITL→UI	2.850	0.445**	SUPPORT
H9	FC→PE	4.384	0.415***	SUPPORT
H10	FC→UI	-1.202	-0.252[ns]	NOT SUPPORT
NOTE:*** indicates P＜0.001, ** indicates P＜0.01, ns indicates: no significance				

According to the path coefficient graph in figure 3, the proposed hypotheses verification can be summarized and visualized. The empirical results well supported the influencing factors model constructed in this study. Consistent with previous UTAUT studies, the empirical results prove that the most direct and significant factor affecting library professionals' adoption behavior of LSD is their use intention. When library professionals have a strong willingness and motivation to use, their use behavior will also increase significantly. Besides, facilitating condition is another factor that influences the use behavior, although not as important as the use intention. Facilitating condition typically includes technical support, employee training, funding, and leadership attention.
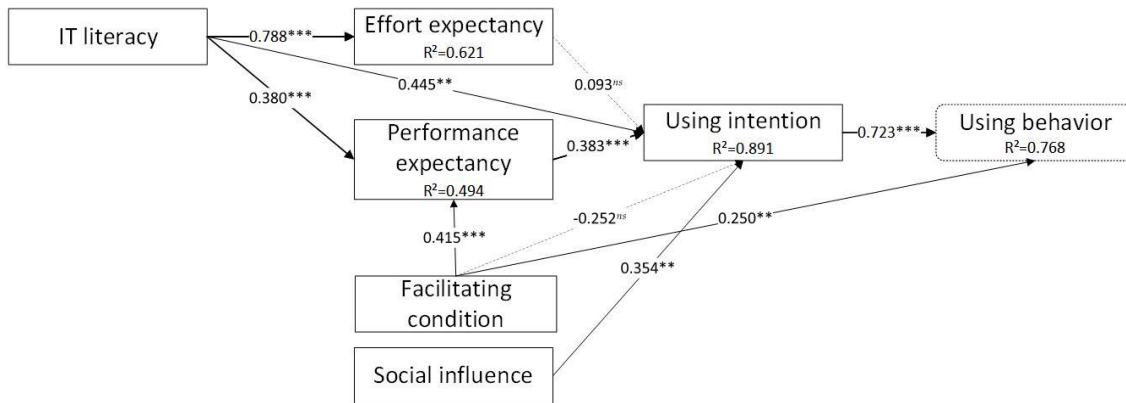
Figure 3. Modified model

At the beginning of this study, we hypothesized that the facilitating condition positively affects use intention rather than use behavior. However, empirical results reject the positive influence of FC to UI ($\beta=-0.252$, $t=-1.202$, $p=0.09>0.05$), but support FC have a significant impact on UB ($\beta=0.250$, $t=2.846$, $p<0.05$). On the other word, in this case, the FC does not affect library professional's UI but directly change their UB. The library professionals are undergoing more pressure from new technology, which has been discussed many times in previous studies like technology invades into personal life, technology is too complicated to handle, and they fear that it will replace human force. Thus, they have many worries in the process of adopting LSD. But they must learn to control LSD due to the work needs and overall trends. The FC has also been proved to maintain a positive influence on PE ($\beta=0.415$, $t=4.384$, $p<0.001$). Whether their IT literacy is high or low, facilitating conditions will always help library professionals better understand and utilize LSD to improve their performance. For example, timely and effective technical support can help library professionals solve problems and repair faults quickly, staff training can help them deepen their understanding and knowledge of LSD, and more reasonable investment will improve the device quality. The attentions of senior management will comprehensively improve the adoption result of LSD and improve the job satisfaction.

Through literature review and interviews, it was found that IT literacy positively affected library professionals' use intention, which was also supported by our empirical result ($\beta=0.445$, $t=2.850$, $p<0.05$). Library professionals with higher ITL have a deeper understanding of LSD. They generally have more experience in using many kinds of smart devices in life than others, and they will actively seek to interact with LSD in their work. That is the reason why their UI is relatively higher. On the contrary, those library professionals with low ITL will be afraid of facing too many smart devices in their work

and life, which might interfere with their own life, so they have a lower willingness to use them. In addition, ITL has been shown to significantly affect PE (β=0.380, t=4.071, p<0.001) and EE (β=0.788, t=2.846, 9.312, p<0.001). A higher level of ITL leads to less time and effort library professionals spend on learning to use LSD and operating them in the daily work. In this condition, the library professionals are inclined to believe they can make good use of smart devices at work and get better benefits, such as improving work quality and efficiency, reducing workload, and so on.

Surprisingly, the hypothesis of effort expectancy positively affects the use intention is not supported by the empirical result (β=0.093, t=0.902, p =0.367>0.05), and the results only proved that H1 performance expectation has a positive and significant impact on the UI (β= 0.380, t=4.711, p<0.001). The reason is probably that library professionals pay more attention to the improvement of their work efficiency and quality when they want to apply LSD, which is the critical point to influence their UI. They will not give up to use LSD because of the difficulty of the learning process. No matter how much time and energy they spend on the learning process, they want to keep up with the trend of applying LSD, and they want to gain insight into how these devices could change their work. This explains why the EE have no impact on UI in our model. Library professionals generally believe that smart devices will bring positive changes to their work, but it is still in a very early phase, which requires library, library professionals, and suppliers to work harder to make advancement.

In our study, social influence mainly refers to the influence of others on library professionals' willingness to adopt LSD, which includes leaders' requirements, customers' hopes, peer recommendation, and media publicity. Literature review shows that SI has been proved to have a positive impact on UI in many other research fields. The results of this study follow previous studies, which confirmed the hypothesis 6 (β=0.354, t=3.201, p<0.05): library professionals will show greater UI when encouraged by someone who can influence their behavior or someone important to them.

It can be concluded from the final hypothesis model that ITL significantly affects the PE and EE. PE further significantly affects library professionals' UI to LSD. The most critical factor influencing library professionals' UI is PE, followed by SI, and ITL. The most important factor influencing library professionals' UB of LSD is their UI, and the second factor is the facilitating condition in the proposed model. In addition to ITL, the FC also has a significant impact on PE.

6 CONCLUSION AND DISCUSSION

The interview analysis results and the interpretation of the empirical analysis will be discussed in detail and comprehensively in this chapter. This chapter is divided into four parts. The first part will combine the findings of previous work, the findings of the interviews, and the empirical results to further explain the three research questions proposed in this research. The second part will discuss the theoretical and practical contributions made in this thesis. In the third part, the limitations will be pointed out, and the important reasons will be explained. The fourth part, according to the contribution and research limitations, the possible future research topic of LSD is prospected and suggested, and more issues to be solved in this field are put up with.

6.1 Findings

The research questions are what factors affect the adoption of LSD from the library professional's point of view? How these factors related to each other? The results of this thesis answer the research questions above. IT literacy, facilitating condition, performance expectation, effort expectation, social influence, and use intention are significant factors affecting library professionals' LSD use behavior. Their correlation is explained in the empirical result part.

As there is little research on library smart devices from the perspective of library professionals in the current academic field, this study firstly employed a qualitative interview study that provides some practical findings and feasible suggestions. On the individual's literacy layers, library professionals are generally optimistic about the prospects of LSD, believing that LSD will certainly provide more positive changes to their work in the future. But the primary issue is that the current benefits is hard to be proved, and the current situation is far from what library professionals expect. Some library professionals even argue that their workload, working hours and quality of work have not been significantly improved. There are many reasons for this phenomenon, one of which is probably that library professionals have too high expectations of LSD. And one of the reasons for the excessive expectation is likely to come from the lack of IT literacy. ITL varies with their gender, working time, majors, department and previous experience. ITL will lead them to spend less energy on adopting LSD. And the higher the ITL of the library professionals, the deeper the understanding of the LSD, the more reasonable their expectations will be. Reasonable expectations would help to narrow the psychological gap for library

professionals. Therefore, ITL is regarded as the primary variable affecting the PE and EE of library professionals which has been tested valid in the follow-up empirical part of this study.

In the organizational atmosphere part, we found that senior leaders' attention, technical support, staff training, and funding are important influencing factors to the adoption of LSD from librarian's point of view. These are all part of the facilitating condition in our research model, which is also closely related to the idea of organizational social structure in the AST. The social structure of an organization includes both allocative and authoritative resources. In this context, allocative resources refer to funding, technical support and staff training, while authoritative resources refer to the attention of senior leaders and other encouragement mechanism. Although the funding of the library seems relatively adequate, it is still not enough to afford to purchase a large number of high-quality LSD, which usually leads library to execute the secondary choice. But currently, there is a big difference in both product and service quality between the best products and the second best in the field of LSD. This problem is also one of the reasons why professionals complain the LSD now failed to meet their expectations. Another common problem is the concern of top leaders. Top leaders need to have a deeper understanding and substantive attention to LSD, rather than a superficial perception. Only by acutely understanding the performance of smart devices and be aware of the possible problems in the application process, can they better adapt to this irreversible trend. If the leadership always pays superficial attention to LSD, it will cause library professionals and customers to become frustrated with the effect of smart devices and eventually refuse to use them. Many methods could be applied to increase this aspect, such as improving incentive mechanism, encouraging staff training and raising investment. Due to the fact that library professionals' ITL varies, carrying out personalized staff training activities is one of the effective ways to improve the application results of LSD.

The main problem at the technological feature layer called technology transfer, which means the immaturity of LSD technologies. The technology in the library field is borrowed from other fields instead of native technology, which causes that the technology does not well match the actual task requirements of the library. The technology transfer issue will arise as well in the early stages of introducing new technology in many other fields, and it will be gradually improved with the technology evolving and the company's better understanding of customer needs. Therefore, one solution is applying agile developing strategy to frequently involve users in the production and design second of LSD

and continually absorb feedback from them. Also, improving library professionals' ITL and helping them express their needs clearly to LSD suppliers is also one of the critical steps. This needs the library to carry out the staff training effectively.

Next, this study tries to apply UTAUT and AST into the LSD adoption on the basis of the interview results, and explore the main factors influencing library professionals' UB and UI. This study takes the idea of "adaptive" from classical AST, which believes the social structure inherent in technology constrains the organizations and individuals who choose to use it. And the individual's adoption behavior is constrained by both of the social structures of technology and the current organizational structure which comes from previous long-term practices of individuals. Even facing the same technology, different individuals will have different adoption behavior, and the reason may be closely related to their job tasks and the individual's ITL. Meanwhile, the individuals in the organization can decide whether to adopt the technology and which features to adopt. The individual's long-term adoption behavior will change the social structure of technology and organizational structure and constitute a new social structure.

On the discussion above, this study believes that one of the main reasons for the differences in the behavior and result of early library professionals' adoption of LSD is their ITL. Then, the literatures related to ITL were reviewed, these include IT skills (Brown & Parr, 2018; Kaarakainen et al., 2017; Kaarakainen et al., 2018), e-skills (Izuagbe et al., 2019) and IT self-efficacy (Aesaert & van Braak, 2014; Rohatgi et al., 2016). According to this, this study introduced the ITL of library professionals into the traditional UTAUT model as a new independent variable. ITL not only includes the ability or experience one has when learning new technology but also refers to whether they are confident enough to use IT. Our research model assumes that library professionals' ITL directly affects their use intentions and their performance expectations and effort expectations. This assumption comes from previous research on TAM, which has shown that users' IT self-efficacy and e-skills positively impact perceived usefulness and perceived ease of use TAM (Bandura, 2010; Chau, 2001; GovindAarajan & Krishnan, 2019; Kulviwat et al., 2014).

Empirical results support eight of the ten hypotheses, and the fits indexes of the revised model are within the acceptable range. The empirical results show that the UI has the most significant influence on the UB ($\beta=0.723$, $t=7.083$, $P<0.001$), highly consistent with the original UTAUT. Library professionals' ITL significantly impacts their UI ($\beta=0.445$, $t=2.850$, $p<0.001$). Although it is slightly lower than the impact of PE ($\beta=0.383$,

t=4.711, P<0.001) on UI, the empirical also shows that another variable has a significant impact on PE is IT literacy (β=0.380, t=4.071, P<0.001). In addition, ITL is also probed to significantly impact EE (β=0.788, t=9.312, P<0.001). This fully demonstrates the importance of library professionals' ITL to the adoption behavior and intention. In addition, SI also has a positive impact on library professionals' UI of LSD (β=0.354, t=3.201, P<0.05). Besides, FC has a relatively SI on the UB (β=0.250, t=2.846, P<0.05) and very significant impact on PE (β=0.415, t=4.384, P<0.001).

6.2   Contributions

6.2.1   Theoretical contributions

This study is an application of the UTAUT and AST in the field of smart library. The library community is sensitive to the application and adoption of new technology in the library context. After exploring smart service mode, smart management mode, and smart environment, it is necessary to switch our focus to study smart library professionals.

6.2.2   Practical contributions

I: Several issues and suggestions are identified in this study, which could be used to reference libraries when trying to apply LSD. This study sheds light on generating solutions toward some issues so that organizations can put forward targeted movements to improve management.

II: Library professionals can learn attitudes about each other towards new LSD through this research and then make practical self-motivation plans.

6.3   Limitations

Firstly, as a quantitative study, this thesis verified the hypothesis and model through data analysis of 142 questionnaires. It is generally believed that the number of questionnaires collected should be at least 5 times more than the number of questions set, and at it is better to surpass 10 times. The number of questions in this study is 19, and the number of questionnaires collected was more than five times, but less tahn10 times. This is mainly because the resources we can obtain are limited, and we have done as much as we can.

Secondly, the samples in this study were collected from Chinese library professionals, but the adoption of LSD is a trend in the library worldwide. The sample data would be objective if surveys could include library professionals from countries other than China.

Thirdly, more influential factors and complex relationship between them should be put up with and verified.

Besides, library professionals who were able to fill the questionnaire on social media usually have IT experience and some degree of IT literacy. This issue might lead our results relatively optimistic than reality. However, when considering the current context of prevailing of mobile phone, our results still maintain values somehow.

Finally, library professionals can still be divided into many categories, such as gender, seniority, department and region. Although these variables are briefly discussed in the cross-statistics sections, it does not cover much about this in empirical part.

6.4　Future works

According to the contributions and limitations mentioned above, the following aspects are suggested for further study in the future. The first one is to explore the differences in the LSD use intention of different groups of library professionals. Second, this study's focus is based on the library professionals' point of view, while the customer's point of view also needs to be studied in the future. Thirdly, further research can attempt to define library smart devices' different categories and conduct a deeper investigation into a certain type of device. Fourthly, it is suggested that more factors can be found and put forward based on other theories. Finally, future research can try to shed light on how to help technologies borrowed from other fields adapt to the library field's needs.

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APPENDICES

Appendix 1. Questionnaires in English

Library professional's adoption of library smart devices

Dear library staff, Sir/madam：

You will fill out a survey of library professionals' use of the library's smart devices. This questionnaire will be anonymous, and please feel free to answer it. You may have been exposed to many of the smart devices in the library in your daily work, or not yet. And it does not affect your answer to this questionnaire. If you've already used smart device to work, you can respond as you actually feel. If you're not already working with a smart device, you can answer with your expectations and intentions. There is no right or wrong answer to this questionnaire, and it is only used for the research mentioned in this paper. This is devoted to exploring the relationship between library professionals and new technologies and smart devices. Exploring the pressure and opportunities brought by new devices to library professionals and Library professionals' expectations and requirements for library smart equipment.

1. *Your gender*： [Single choice]

   Male   Female

2. *Years of service* [Single choice]

   Within 5 years   6-10 years   11-15 years   above 16 years

3. *What are your responsibilities or departments in the library? This question is multiple-choice, you can choose more than one department.* [Multiple choice]

   Circulation department

   Customer service department

   Security department

   Back office

   Resource construction department

   Information technology department

   Children's reading department

   Others _____ *

4. *Do you know what kind of smart devices library has? (smart devices include electronic devices with screens, electronic devices that can operate, electronic devices that do things automatically by themselves, and so on. Anything you think of as high-tech counts)* [Single choice]

Very familiar   Roughly familiar   Rarely familiar   Unfamiliar

5. *Have you ever used library smart devices in your work?* [Single choice]

never   seldom   Sometimes

often

6. *Which of the following smart devices have you worked with (used or seen/heard from colleagues)?* [Multiple choice]

Intelligent (self-help) book borrowing and returning equipment

Smart (self-help) card machine

Intelligent lighting control system

Intelligent air conditioning control system

Intelligent anti-theft device

Intelligent fire protection equipment

Intelligent music equipment

Intelligent printer (including thermal intelligent printer, needle intelligent printer, 3D printer, etc.)

Integrated inquiry equipment

Smart wearable mobile devices (including mobile phones associated with libraries, etc.)

AR/VR devices

Intelligent robot (if this is selected, please explain what kind of robot in the underline）
_____*

Smart bookshelf (for example, a device with a screen showing information from the bookshelf to the user）

Others _____*

7. *What do you think appeals to you most about smart library devices?* [Multiple choice]

Attractive appearance

solid and durable

easy to use

Perceived to improve my work efficiency and quality

Good reputation

Customers want or like us to use them

My superiors require me to use them

Smart devices are novel and I want to give them a try

The interaction between smart devices is so good that it makes me want to use them

Others _____*

8. *What is your motivation for using smart library devices in your work? (If you haven't already, you can answer with the motivation you want.)* [Multiple choice]

Reduce workload

Reduce work time

Improve work quality

Just think them novel

My job duties ask me to use

Compatible with my task

Others _____*

9. *Please answer questions related to Facilitating condition (FC). The facilitating condition mainly refers to whether your organization (library) provides the necessary help and convenience to make it easier and effective for you to use smart library devices in your work.* [Matrix scale]

1. Strongly disagree 2. Disagree 3. Partial agree 4. Agree 5. Strongly agree

	1	2	3	4	5
The library where I work has IT specialists to help me get used to smart devices					
The library regularly collects feedback on our use of smart devices and works to improve defects in their operation					
The smart device will provide me with the necessary and easy to understand instructions					

10. *Please answer questions about performance expectations (PE).* [Matrix scale]

1. Strongly disagree 2. Disagree 3. Partial agree 4. Agree 5. Strongly agree

	1	2	3	4	5
Smart devices will improve the quality of my work					
Smart devices will bring convenience to my work					
Using smart devices in my work will improve my efficiency					

11. *Please answer the question about effort expectation (EE). Effort expectations mainly refers to how much time and effort you think it takes to get to your ideal state of using smart devices.* [Matrix scale]

1. Strongly disagree 2. Disagree 3. Partial agree 4. Agree 5. Strongly agree

	1	2	3	4	5
skillfully using smart devices in my work is not hard					
The operation of smart devices is not very complicated					
I can learn to use smart devices quickly and easily					
The interaction between the smart device and me at work is very smooth and the process is easy to understand					

12. *Please answer the following IT literacy questions. It mainly refers to whether you have experience in using smart devices or whether you volunteer to use smart devices in your work.* [Matrix scale]

	1	2	3	4	5
I would actively seek to use the library smart devices					
I have rich experience in using smart devices in my life					
I have a strong interest in using new smart devices					

13. *Please answer the questions on the social influence (SI). Social influence refers to whether others will influence your use of smart library devices.* [Matrix scale]

1. Strongly disagree 2. Disagree 3. Partial agree 4. Agree 5. Strongly agree

	1	2	3	4	5
People who are important to me think I should use smart devices.					

The reputation of LSD will affect my use intention.				
People who can influence my behavior think I should use smart devices in my work.				

14. *Please answer the questions of using intention.* [Matrix scale]

1. Strongly disagree 2. Disagree 3. Partial agree 4. Agree 5. Strongly agree

	1	2	3	4	5
I hope to use smart devices in my work					
Smart devices will well meet all the needs of my work					
I like to work with LSD.					

15. Please answer questions about the use behavior (UB). [Matrix scale]

	1	2	3	4	5
I am going to use smart devices at work					
I will recommend other library professionals, my leaders or customers to use the library smart devices					
Working with LSD make my work better.					

Appendix 2. Questionnaires in Chinese

图书馆员智能设备采纳研究调查问卷

尊敬的图书馆工作人员，先生/女士您好：

　　您将填写一份图书馆员对馆内智能设备使用意愿的调查问卷。该问卷将采取匿名的方式，请您放心回答您可能已经在日常工作中接触过馆内许多智能设备，或者还未触。但这都不影响您对该问卷的回答。如果您已经将智能设备应用进工作，那么您可以按照实际的使用感受回答。如果您还未在工作中使用智能设备，那么您可以用您的期待和意愿来进行回答。本问卷的答案没有对错，仅用作本文所提到的研究。本研究致力于探索图书馆员与新技术、新设备的关系，探寻新设备给馆员带来的压力和机遇，研究馆员心中对智能设备的期待和要求。

1. 您的性别：[单选题]

　　男　　　　　　　　　　　　　　女

2. 您的工作年龄 [单选题]

　　5 年以内　　　　　6-10　　　　　11-15　　　　　16 年以上

3. 您在图书馆的工作职责或者部门是？本问题为多选题，您可以选多个部门。[多选题]

　　流通阅览部门

　　读者服务部门

　　安全保障部门

　　后勤供给部门

　　资源建设部门

　　信息技术部门

　　儿童阅览部门

　　其他 _____*

4.您了解图书馆都有哪些智能设备吗？（智能设备包括有屏幕的电子设备，能够操作的电子设备，会自动自己做一些事儿的电子设备等，您认为高科技的东西都算）[单选题]

　　非常了解　　　　　大致了解　　　　　不怎么了解　　　　　完全不了解

5. 您有在工作中使用过图书馆智能设备吗？[单选题] *

从不   很少   有时

经常

6.您工作中接触过（使用过或者看/听同事用过都可以）以下哪些智能设备？（*如果您了解过其中哪些，那您就选哪些*）[多选题]

智能（自助）借还书设备

智能（自助）办卡机器

智能灯光控制系统

智能空调控制系统

智能防盗设备（比如图书馆的智能报警器等）

智能防火设备

智能音乐设备

智能打印机（包含热敏智能打印机、针式智能打印机、3D打印机等）

综合查询设备（包含文献、位置、图书馆机构设置等）

智能穿戴可移动设备（包括与图书馆关联的手机等）

AR/VR等虚拟或增强现实设备

智能机器人（若选此项，请在下划线中解释什么样的机器人）_____*

智能导航设备（比如常放在一楼的导航屏幕）

智能书架

其他 _____*

7.您觉得图书馆智能设备最吸引你使用的地方是什么？（不论您已经用了或者还没用过，您都可以回答此项问题，按照您的实际使用感受或者期望来回答）[多选题]

外观精美

结实耐用

感觉上简单易用

感觉上会提升我的工作效率和质量

口碑很好，很多人都说好用

读者们都想或者喜欢用这些设备

我的上级或者工作要求我必须使用

其它 _____*

8.您工作中使用图书馆智能设备的动机是什么？（如果您还没使用，您可以按照您希望的动机来回答）[多选题]

减轻工作量

减少工作时间

提高我的工作质量

觉得智能设备很新颖

工作要求必须使用

跟工作可以很好兼容

智能设备可以帮我吸引更多读者参与

其他（请注明具体原因）_____*

9.请回答有关促进智能设备使用氛围（FC）的相关问题。*促进环境主要指的是，您认为单位（图书馆）是否提供了必要的帮助，让你在工作中使用图书馆智能设备更加的轻松和有效。*[矩阵量表题]

1.强烈不同意 2.不同意 3.一般 4.同意 5.非常同意

	1	2	3	4	5
我在的图书馆有 IT 专家帮助我适应智慧设备的使用					
图书馆会定期收集我们对智能设备的使用反馈并改善智慧设备运行中的缺陷					
智能设备会为我提供必要且容易理解的使用说明					

10. 请回答有关绩效期待（PE）相关问题。[矩阵量表题]

1.强烈不同意 2.不同意 3.一般 4.同意 5.非常同意

	1	2	3	4	5

智能设备会改善我的工作质量					
智能设备会给我的工作带来方便					
工作中使用智慧设备会提高我的效率					

11. 请回答关于努力期待（EE）的问题。*努力期待主要指的是您认为达到您理想的使用智能设备的状态需要有多费事件和精力。*[矩阵量表题]

1.强烈不同意 2.不同意 3.一般 4.同意 5.非常同意

	1	2	3	4	5
熟练地在工作中使用智能设备对我来说非常简单					
智能设备的操作过程简单不会很复杂					
我可以很快而且轻松的学会使用智能设备					
工作中智能设备与我的交互非常顺利，过程易理解					

12. 请回答以下 IT 自我效能的题目（IT literacy）。*It 素养主要指的是您是否有智能设备的使用经验或者您是否有足够的能力在工作中使用智能设备等。*[矩阵量表题]

	1	2	3	4	5
我会主动的寻求使用图书馆智能设备					
我在生活中有着丰富的使用智能设备的经验					
我对新的智能设备有着很强烈的兴趣					

13. 请回答关于社会影响(SI)部分的问题。*社会影响指的是外界的人会或多或少向您推荐工作中使用智能设备。*[矩阵量表题]

1.强烈不同意 2.不同意 3.一般 4.同意 5.非常同意

	1	2	3	4	5
对我重要的人认为我应该使用智慧设备（比如您的业界同事，专家或者领导等）					
能够影响我使用行为的人认为我应该在工作中使用智能设备					

	1	2	3	4	5
图书馆智能设备的声誉会影响我的使用意愿					

14. 有关使用意愿（using intention）的问题。[矩阵量表题]

　1.强烈不同意 2.不同意 3.一般 4.同意 5.非常同意

	1	2	3	4	5
我希望在工作中使用智能设备					
智慧设备能够很好地满足我工作的一切需要					
我喜欢和图书馆智能设备一起工作					

15.请回答有关使用行为（UB）的相关问题。 [矩阵量表题]

	1	2	3	4	5
我将要在工作中接触和使用智能设备					
我会推荐别的馆员、领导或者读者也使用图书馆智能设备					
跟图书馆智能设备一起工作让我的工作变得更好					

Appendix 3. Used Abbreviations

AI	Artificial Intelligence
AR/VR	Augmented/Virtual reality
AST	Adaptive structuration theory
CFA	Confirmatory factors analysis
CR	Composite reliability
EE	Effort expectation
FC	Facilitating condition
IDT	Innovation diffusion theory
IOT	Internet of Things
IS	Information system
IT	Information technology
ITL	Information technology literacy
LSD	Library smart devices
MI	Modification index
NLP	Nature language processing
PE	Performance expectation
QR	Quick Response
SEM	Structural equation model
SI	Social influence
SOR	Stimulation organism reaction
TAM	Technology Acceptance Model
UB	Using behavior
UI	Using intention
UTAUT	Unified Theory of Acceptance and Use of Technology