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Towards digital scholarship services in China's university libraries: Establishing a guiding framework from literature

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Abstract

Purpose - This paper reports on a literature review with the aim to establish a guiding framework for the development of digital scholarship services in China's university libraries.

Design/methodology/approach - The framework was developed through systematically searching, screening, assessing, coding, and aggregating digital scholarship services as reported in the existing body of literature. Three types of literature were included in the analysis: (1) international academic literature as reported in English; (2) academic literature in Chinese; and (3) relevant professional reports.

Findings - The literature analysis pointed to 25 different digital scholarship services, which emerged in six themes: supporting services, formulating research ideas, locating research partners, writing proposals, conducting research, and publishing results.

Originality/value - Although this literature review focused on university libraries in China, the research findings and the guiding framework developed provide useful insights and indications that can be shared across international borders.

Keywords: Digital scholarship, Digital scholarship services, Guiding frameworks, University libraries

Article classification: Literature review

1. Introduction

University libraries have always played an important role in supporting research and knowledge creation in all subjects and disciplines (Zhao, 2009). As we are increasingly accelerating towards a networked world, where academic resources are expected to be online, interactive, curated, and publicly available, libraries as information service providers have to deliver greater in number and more varied information services to researchers through digital and networked channels (Goh, 2001; McRostie, 2016; Russell *et al.*, 1999). Thus, university libraries have become even more important players in the creation, preservation, and dissemination of information, as well as in providing collaborative research embedded services that encourage, facilitate, and catalyse knowledge and practice innovations (Tzoc and Millard, 2017).

In China's professional library and research communities, there is a general perception that digital scholarship is an emerging and effective service model, not only for the reform of traditional library management and service infrastructure, but also to bring university libraries closer to their users through the provision of user-centric research support services.

Nevertheless, and interestingly, there is a lack of widely accepted definition for digital scholarship as an emerging field (Mulligan, 2016). Some researchers, for instance Lynch (2014, p. 10), even claim that digital scholarship is "an incredibly awkward term that people have come up with to describe a complex group of developments". Mulligan (2016) asserts that some researchers resist adopting a rigid definition of digital scholarship fearing that it can constrain experimentation or adoption by fellow researchers, who may get bogged down in what 'is' or 'is not' within the bounds. The most widely adopted definition by far has been coined by

Rumsey (2011, p. 2), a former director of the Scholarly Communication Institute at the University of Virginia: "digital scholarship is the use of digital evidence and method, digital authoring, digital publishing, digital curation and preservation, and digital use and reuse of scholarship". By synthesizing existing definitions, Tzoc and Millard (2017) maintain that digital scholarship transcends traditional methods and techniques of research by applying new technologies to advance the processes of research and innovation.

Actually, the provision of digital scholarship services (DSS) is not completely different from traditional library services. They can be seen as a natural extension to better facilitate the generation and sharing of knowledge, ranging from providing virtual and physical spaces for learning and research to supporting interdisciplinary research activities on big data, digital application development, and longitudinal investigations (Sinclair, 2014). DSS brings together researchers, students, technologists, and librarians in university libraries to develop digital projects by providing a variety of scholarly support and research services (Tzoc and Millard, 2017).

Many Chinese library professionals and researchers (e.g. E, 2017; Shao, 2017; Xie and Liu, 2017; Zhou, 2015) believe that developing DSS is an unavoidable and important step for the growth and advancement of China's university libraries. However, and in truth, the DSS development in China's university libraries is merely at an early, exploring stage (Xiong *et al.*, 2016). There is a lack of effective and practically applicable approach, which can clearly demonstrate and drive the processes of DSS development through remodelling and restructuring the existing library service model and management structure.

This article reports on a research project, which aims to develop a comprehensive guiding framework for the development of DSS in China's university libraries. Specifically, this article presents the research findings drawn from a literature review as the first stage of research. The literature review focuses on developing a framework by identifying DSS as reported in the existing body of literature. The DSS framework is expected to be of practical value to Chinese university libraries. It can also serve as a theoretical base for empirical studies to be carried out at later stages.

2. Review methods and process

2.1. Review objectives and questions

As stated above, this review aims to establish a comprehensive and integrated DSS framework, which can be used for guiding the development of DSS in China's university libraries. Hence, the following review questions were formulated to orient the practice of literature selection and analysis:

RQ1 - What types of DSS should be provided in China's university libraries?

RQ2 - How can DSS support research activities along the research project life cycle?

RQ3 - How can DSS be grouped to form a framework?

Literature reviews are a common and widely used research approach in library and information studies (Zhou, 2017). A literature review aims to achieve conceptual development and innovation through systematically retrieving, selecting, analysing, and synthesising existing literature (Grant and Booth, 2009). Considering that DSS have been widely reported and discussed in the existing literature, an extensive and systematic review of the literature can provide not only good responses to these research questions but also a robust theoretical framework that can be used as the basis for empirical exploration and analysis in the remainder stages of this research

project.

2.2. Literature retrieval and selection

The literature review was carried out in two stages. A general review of existing literature was performed at the first stage, which aimed to provide a theoretical and contextual basis for more systematic literature retrieval and analysis in the second stage. To be more specific, there were two main aims at this stage: (1) to obtain a holistic understanding of the emergence and development of digital scholarship and the latest development of DSS provision in the library environment; and (2) to gain a general view of DSS as provided in China's university libraries.

A more structured and rigorous literature review was performed in stage two. Academic works both in English and Chinese were retrieved and analysed. It is because these two types of academic articles can be very useful, not only to respond to the research questions and achieve the research objectives, but also to ensure that the framework can be "contextually sensitive" and hence applicable to university libraries in China.

Therefore, two sets of academic databases were selected and systematically searched. The first set included three international academic databases: Web of Science, ScienceDirect, and Emerald. The second set included three Chinese academic databases: CNKI, Wanfang, and CQVIP. The database search was performed in early October 2017, using the search strategy presented below:

("digital scholarship" or "digital humanities" or "research support") and librar*

The search strategy was constructed after careful consideration, aiming to be as inclusive as possible. According to the authors' observation and experience, also as pointed out by Jie and Sheng (2016), digital scholarship in China's university libraries is understood as closely related to digital humanities and library subject services. Specifically, digital scholarship is an expansion of digital humanities as it spans across all disciplines in a university and supports all research activities. Also, when compared with traditional subject services, digital scholarship is more effective and systematic to provide a variety of research supports. Thus, "digital scholarship", "digital humanities", and "research support" were selected and included as search terms.

The search strategy was designed to be broad and inclusive of as many relevant articles as possible. The database search returned a total of 426 articles, including 112 articles in English and 314 articles in Chinese. All these retrieved articles were carefully screened and selected using the following exclusion criteria: (1) exclude duplicated articles retrieved from different databases; (2) exclude articles which are not focusing on library services; (3) exclude subjective opinion articles without adequate and justifiable theoretical support. The screening processes are demonstrated in the preferred reporting items for systematic reviews and meta-analysis (PRISMA) flow diagram in Figure 1.



Figure 1. Process of literature selection using a PRISMA flow diagram

As shown in Figure 1, overall 79 articles (43 in Chinese and 36 in English) were included in the literature analysis along with a set of relevant professional reports which are shown in Table I below.

Table I.	Profes	sional	reports	incluc	led in	the	litera	ature	analysis
			1						2

Report names	Organisation		
Supporting Digital Scholarship SPEC	Association of Research Libraries (ARL)		
Kit 350			
Digital Scholarship Support Profiles	Association of Research Libraries (ARL)		
Survey of Digital Scholarship Centers	Association of College and Research		
Final Report	Libraries (ACRL)		
Building Expertise to Support Digital	Council on Library and Information		
Scholarship: A Global Perspective	Resources (CLIR)		
Working Together or Apart:	Council on Library and Information		
Promoting the Next Generation of	Resources (CLIR)		
Digital Scholarship			
Report of a One-Day Seminar on	Council on Library and Information		
Promoting Digital Scholarship	Resources (CLIR)		
Digital Scholarship Centers: Trends	Coalition for Networked Information (CNI)		
& Good Practice			
Planning a Digital Scholarship Center	Coalition for Networked Information (CNI)		
International Advances in Digital	Joint Information Systems Committee (JISC)		
Scholarship	and Coalition for Networked Information		
	(CNI)		
The Role of Research Libraries in the	Research Libraries UK (RLUK)		
Creation, Archiving, Curation, and			
Preservation of Tools for the Digital			
Humanities			

Mapping the Future of Academic	Society of College, National & University
Libraries	Libraries UK (SCONUL)
A Report on the Development of	Steering Committee for Academic Libraries
Academic Libraries of China in 2015	of China (SCAL)
(2015年高校图书馆发展概况)	
Blue Book on the Development of	Steering Committee for Academic Libraries
Academic Libraries in China 2015	of China (SCAL)
(2015 高校图书馆发展蓝皮书)	
2017 Blue Book on the Development	National Library of China
of Libraries in China: Digital	
Libraries	
(2017 中国图书馆事业发展报告:数	
字图书馆卷)	

All academic articles and professional reports were uploaded into a qualitative data analysis software, NVivo 8. The literature analysis was performed using this platform.

2.3. Literature analysis

The literature analysis was exploratory in nature and thus adopted King and Horrocks' (2010) thematic analysis approach, which can be simply defined as a systematic approach of coding and representing qualitative data (Zhou and Nunes, 2016). Data in this study refer to the articles retrieved from the literature search. Coding represents the processes of identifying, verifying, and labelling DSS in the articles and reports included. Representation means the production of a theoretical narrative that summarises, describes, and discusses DSS identified and organises them in a meaningful and useful manner.

Throughout the literature analysis, the DSS identified should be able to be organised along with individual stages and processes in a research lifecycle. Thus, the research lifecycle model developed by the Joint Information Systems Committee (JISC, 2014) in the UK was adopted as a preliminary theoretical framework used to orient the processes of coding. The JISC (2014) research lifecycle model consists of five incremental research stages:

- *Ideas*: generating, exploring, and verifying research ideas through literature search, locating resources, and background reading.
- *Partners*: finding, contacting, communicating, and negotiating with research partners and teams. Tools that help to find partners include not only social networking tools, such as Facebook and Twitter, as well as WeChat and Weibo in China, but also research-oriented networking platforms, such as Kudos and ResearchGate.
- *Proposal writing*: an important and indispensable stage when pursuing a graduate degree or a research funding opportunity. Normally, a research proposal needs to illustrate all the key elements involved in research and to include sufficient information for the readers to evaluate the study proposed.
- *Research process*: varies enormously across disciplines, but usually experiences four major steps: (1) simulate, experiment, and observe; (2) manage data; (3) analyse data; and (4) share data.
- Publication: systematically reporting the entire research study, either as a

dissertation or to be considered for publication in an academic journal or a conference presentation.

The JISC (2014) framework was used to guide and orient the coding processes. Specifically, the five research stages discussed above were adopted as a set of theoretical themes and used to frame the practice of coding. Moreover, the following three additional coding techniques were employed: open coding, axial coding, and selective coding, as suggested by Strauss and Corbin (1998). Open coding was used to anticipate and identify DSS in data. When a potential new DSS emerged, it was compared with the existing list of codes in order to verify if it was completely new, if it had already existed, or if it could be merged with the existing codes. Axial coding was used to relate the DSS identified with the preliminary theoretical framework, as well as to develop vertical relationships between different codes. Finally, the practice of selective coding focused on checking and verifying the emerging research findings against the literature included (Strauss and Corbin, 1998). Nevertheless, it is necessary to note that the exercise of selective coding did not attempt to identify horizontal relationships among the themes, as proposed by Strauss and Corbin (1998). Rather, the horizontal relationships were actually pre-defined and provided by the JISC (2014) framework.

3. Review findings

The literature analysis pointed to 25 DSS in six different themes: supporting services, formulating research ideas, locating research partners, writing proposals, conducting research, and publishing results. Of these main themes, the supporting services are essentially the core provision for library DSS – supporting the five themes derived from the JISC (2014) framework. The supporting services are discussed in 3.1, and the other five themes are discussed in 3.2.

3.1. Digital scholarship supporting services

The literature analysis identified several DSS. Although they are not directly related to the individual stages in the research lifecycle, these services provide necessary and indispensable support to the provision of DSS throughout the research lifecycle. These DSS are strongly overlapping with traditional academic library services and consist of the following components:

- Digital scholarship IT infrastructure
- Digital and physical spaces for collaboration
- Teaching and training services
- Consulting services

The literature analysis revealed that developing a large and comprehensive digital scholarship IT infrastructure is widely considered as an indispensable foundation for the provision of DSS (Lijun E, 2015; Liu and Gong, 2015; Yang *et al.*, 2016). According to ARL (2017), the IT infrastructure should be customizable and incorporate any necessary technical tools and support that may be required by digital scholars. Lippincott and Goldenberg-Hart (2014) added that the IT infrastructure should be capable of serving a wide range of disciplines (not just humanities), provide extensive hardware, software, and tools for all members of the campus community. Ideally, the IT infrastructure requires minimal training for the users and no ongoing interventions from the service team. Examples include learning management systems, wikis, video streaming, individual and shared file storage, and virtual computer labs (Lijun E, 2015; Huang and Li, 2016; Vinopal and McCormick, 2013).

Moreover, the IT infrastructure is expected to facilitate and support big data or

The Electronic Library

data-driven projects (Lai, 2016; Miao, 2017). By closely collaborating with the library's IT team, Kong *et al.* (2017) developed a geographical information system (GIS) to facilitate data organisation, field data collection, and data publication needs. Chitty and McRostie (2016) asserted that the digital scholarship IT platform ensures that research data management and sustainability become a core part of all research activities.

Nevertheless, many researchers claim that the IT infrastructure is much more than making a collection of systems, software, and tools available (ARL, 2017). It should provide a convenient virtual online meeting space that will not only encourage interdisciplinary communication and collaboration but also foster a data-centric culture within the faculties (Chen, 2015; Qian, 2017; Sheng *et al.*, 2017).

Moreover, apart from providing digital environment for collaboration, university libraries and digital scholarship centres, mostly in North American and Europe, have offered a variety of physical spaces, which include both informal and relaxation spaces where faculties and students can enjoy a cup of coffee and share ideas through casual conversations (Li, 2016; Wang, 2014; Zeng, 2017) and relatively more formal spaces in which specialized equipment, tools, information materials, and consultation services are available, such as makerspace, media production studio, and visualization studio (Lippincott and Goldenberg-Hart, 2014). Cox (2016) described the increase in different learning spaces as multi-sensory whereby users have the ability to shape their own learning space using a multitude of different tools provided by the library. Physical and digital spaces are increasingly overlapping with users being able to access the digital space in a designated physical space suitable for a variety of uses, including small group meetings, conference calls, workstations, and so on (Lijun E, 2017; Liu and Tu, 2017).

Whilst a service team should not intervene with users too much (Huang and Li, 2016; Vinopal and McCormick, 2013; Xue *et al.*, 2016), McRostie (2016) suggested that teaching, training, and consultation services should be available if needed. This view is supported by many researchers. For instance, Zhao (2014) stated that university librarians are well-positioned to enact a proactive role in providing teaching and consultation services, considering their knowledge of open access, understanding of copyright and licensing, and expertise in bibliometrics and research in quality evaluation. Kong *et al.* (2017) proposed that teaching and training can be delivered in the following forms: online learning resources, classroom visits, workshops, and credit courses.

3.2. Digital scholarship services

In this section, five themes of DSS derived from the JISC (2014) framework are presented and discussed. These five themes are formulating research ideas, locating research partners, writing proposals, conducting research, and publishing results.

3.2.1. Formulating research ideas

Formulating, confirming, and validating ideas are considered as the first stage in the research lifecycle. The literature analysis pointed to three DSS to support the research activities at this stage:

- Hypothesis/question development
- Background literature search
- Bibliometric services

According to the literature analysis, these three types of DSS are in fact usually considered as basic and traditional research supports from university libraries (Chitty

and McRostie, 2016). Whilst faculties and students can seek guidance on formulating and revising research hypothesis or questions (ARL, 2017), Corral *et al.* (2013) pointed out that background literature search is frequently requested by researchers at the beginning of a research project. Many Chinese researchers (e.g. E and Cai, 2015; Liu, 2015; Sheng *et al.*, 2017) assert that the library digital scholarship team should provide three essential types of literature search services: search training, access guidance to both digital and print resources, and literature assessment.

Moreover, bibliometric services are extremely useful at this research stage and have been widely offered in several university libraries around the world (Kang, 2017; Petersohn, 2014; Sun, 2014). According to a study performed by Corral *et al.* (2013), the most frequently used service is bibliometric training or literacy, followed by citation reports and calculation of research impact. They also claimed that the evaluation of candidates for recruitment, promotion, or tenure, and disciplinary research trend reports are among the less frequently offered and used.

3.2.2. Locating research partners

After formulating and validating research ideas, researchers often expect to talk to more experienced colleagues from the related fields about their research-related struggles (Hensley and Bell, 2017; Nie, 2016; Zhu and Nie, 2017). The literature analysis identified three DSS to support research activities at this stage:

- Identifying potential collaborators
- Contacting potential partners
- Recruiting a research team

Nearly all digital scholarship projects rely on the collaboration of researchers from various disciplines. Thus, ARL (2017) states that university faculty often approach the library or DS centres when looking for expertise outside of their own domain-specific knowledge. A number of Chinese researchers share a similar view. For instance, Kang (2017) and Zhu and Nie (2017) asserted that useful human resources (research partners, supports, and advisors) are one of many important resources required to be identified before commencing a digital scholarship research. Nie (2016) suggested that a DSS team should actively help identify and recruit new team members, creat a collaborative team culture, set up communication mechanisms, organise regular team meetings, and formulate and continuously revise team vision and missions.

According to ARL (2017), relevant services have been provided in a number of universities in North America. For instance, McMaster University's Sherman Centre for Digital Scholarship provides not only consultation and support when expertise is in-house but also connections and referrals when expertise resides elsewhere (ARL, 2017).

In China, as reported in Zhu and Nie (2017), the Beijing University Library established a Digital Scholarship Information Sharing and Communication Network using WeChat (a very popular social networking application in China). The network includes not only active digital scholarship researchers, students, and librarians from all over the world but also non-academic and commercial organisations, such as publishers, digital resource suppliers, technological service providers, and Internet-innovation start-ups. The network is mainly used to discuss research problems, find out potential research partners, and recruit team members and assistants. Nevertheless, all kinds of information can be shared on this network, such as information about upcoming digital scholarship conferences, new books, calls for papers, and grant opportunities.

3.2.3. Writing proposals

As stated in Cox (2016) and Huang and Wang (2017), library professionals are an invaluable asset when developing a research proposal or applying for a research grant. According to the literature analysis, four DSS can be provided at the stage of writing proposals:

- Grant seeking
- Grant proposal development
- Project planning
- Data management planning

As emerged in the literature analysis, grant seeking and proposal development are frequently seen as one of the core library services to support digital scholarship studies (Chen, 2015; Cox, 2016; Lijun E and Lijing Cai, 2015; Lewis *et al.*, 2015). Carlson and Garritano (2010) pointed out that digital scholarship librarians collaborate with other faculties and staff in the processes of grant building, negotiating, and writing-up. Lippincott and Goldenberg-Hart (2014) claimed that digital scholarship librarians often enact a role in grant writing assistance.

Project planning repetitively appeared in the literature selected and analysed (e.g. Chitty and McRostie, 2016; Jie and Sheng, 2016; Yang *et al.*, 2016). The analysis showed that researchers can seek assistance from digital scholarship librarians with structuring their project by defining milestones for different research stages, identifying appropriate tools and methodologies for data analysis, and publishing their digital research projects (Chitty and McRostie, 2016; Fan, 2014; Yang *et al.*, 2016).

However, Carlson and Garritano (2010) maintained that digital scholarship librarians should be involved to a greater depth and work as a member of the research team. Their responsibilities include not only planning and managing projects but also writing up the proposal following the terms and guidelines specified in the grant, contacting program officers of the grant, negotiating a budget for the project, soliciting letters of support, and creating or collecting other documentation needed for grant application (Carlson and Garritano, 2010; Huang and Li, 2016; Lai, 2016; Woodsworth and Penniman, 2012).

Further, both inside and outside of China, an increasing number of research funding agencies require an inclusion of an actionable data management plan in the project proposal. Therefore, researchers often need help in composing a successful data management plan (Chen *et al.*, 2016; Chen *et al.*, 2015; McRostie, 2016). McRostie (2016) specified that, in terms of data management planning, the role of digital scholarship librarians is to support researchers in managing their data assets, ensure they comply with data policies and mandates, and provide access to resources and tools that help with data management planning and tasks.

3.2.4. Conducting research

This stage focuses on the provision of DSS in supporting the management, gathering, analysis, sharing, and preservation of data. Specifically, the literature analysis pointed to five DSS:

- Digital project management
- Data curation and management
- Data analysis and visualization
- Digitisation and preservation
- Embedded research services

According to Bell and Hensley's (2016) survey of 76 institutions in the US, digital project management is one of the most popular services offered at digital scholarship

centres. Lippincott and Goldenberg-Hart (2014) asserted that most of digital scholarship librarians' time is spent on digital project development and management. Moreover, ARL (2017) proposes that whilst digital projects are usually led by a faculty member or a graduate student as principle investigator, digital scholarship librarians should take on the role of project manager.

Thus, Lewis *et al.* (2015) claimed that digital scholarship librarians need to possess project management competencies. Specifically, four types of competencies are considered as important and indispensable according to Lewis *et al.* (2015) and Schaffner and Erway (2014). They include personal competencies (e.g., risk mitigation and time management), administrative competencies (e.g., project planning and controlling), library competencies (e.g., metadata expertise, reference services, information, and knowledge organisation), and mathematical and technology competencies (e.g., statistics, programming, database, and interface design).

Driven by the advances in computing infrastructure and networking technologies, as well as by the development of large-scale global interdisciplinary research collaborations, supporting data analysis and management represent a completely new and arguably more challenging development in the library service portfolio (Cui, 2012; Huang and Deng, 2016; Kong *et al.*, 2017; Xiang *et al.*, 2013). Bell and Hensley (2016) point out that the majority of digital scholarship centres in the US have specialised functions for data curation, management, and analysis. In Mulligan's (2016) survey, more than 90 percent of the responding librarians claim that their tasks involve offering comprehensive data management support to researchers, ranging from making a data collection, creating metadata, performing data analysis and visualization to offering data management training and consulting.

Furthermore, the literature analysis shows that researchers from a variety of disciplines, although mostly from the arts and humanities fields at present, often need digitisation and data preservation services provided by the libraries (Carlson and Garritano, 2010; Chitty and McRostie, 2016; Tzoc and Millard, 2017). These services should not only provide and promote the development of reusable digital tools, platforms, and methods but also facilitate the creation of preservable and reusable scholarly content (Vinopal and McCormick, 2013).

In China, 83 university libraries in the top 100 of China's universities provide digitisation and preservation services (Li, 2012; Pei *et al.*, 2017; Yuan, 2012). So far, these services are mostly used for the development of academic and research databases, such as the Digital Library on the History of Science & Technology in China developed by the Tsinghua University Library; the Family History Documentation Database developed by the Nankai University Library in Tianjin; and the Traditional Medicine Ancient Manuscript Database developed by the Library of Nanjing University of Chinese Medicine.

Moreover, embedded services are highly valued in the literature, because they facilitate and encourage the development of a close connection between digital scholarship librarians and researchers (Carlson and Garritano, 2010; Yang *et al.*, 2016). In China, a large number of universities either have already fully established or are currently trying to develop embedded research services (Si and Xing, 2012). Nevertheless, Lu (2015) claimed that these embedded services are actually rarely used by faculties and students in China's universities. On the one hand, Si and Xing (2012) reported that this could be the result of the fact that these researchers are often unaware of this type of service. On the other hand, Lu (2015) pointed out a sheer lack of trust towards digital scholarship librarians. Many of them, as asserted by Lu (2015), are inadequately trained and skilled, as well as insufficiently encouraged and

motivated to outreach to potential users.

3.2.5. Publishing results

This stage focuses on systematically reporting the entire research process as well as the research findings. This stage is often considered as the last step in a research project. However, publishing research results provides opportunities to generate new research ideas, identify new research partners, and articulate innovative visions and perspectives for future research. Through the literature analysis, six DSS have emerged:

- Publication guidelines
- Digital and open publishing
- Copyright and fair use expertise
- Digital repository
- Research dissemination
- Research impact measurement

Many libraries and digital scholarship centres help researchers to publish their scholarly works (Dishman, 2017; Park and Shim, 2011; You, 2015; Zhao and Mao, 2012). According to ARL (2017), a large number of libraries in North American universities maintain a consolidated list of peer review and publication guidelines. Many university libraries in China provide very similar services (Lu *et al.*, 2014; Miao and Liu, 2016; Rong, 2015; Xia *et al.*, 2017). For example, the Wuhan University Library develops and maintains a Web of Science journal database, which provides comprehensive journal information, including aim and scope, editorial board, manuscript submission guidelines, abstract and indexing information, impact and ranking analysis, and contact information.

However, a report jointly published by UK's Research Information Network and Consortium of Research Libraries (2007) shows that librarians have little influence over researchers' publishing processes and habits. They report that only four percent of researchers claimed librarians advised them to publish in traditional subscription-based journals. Moreover, only one percent of stated librarians guided them to publish in open access journals and repositories. It is necessary to highlight that, although this report was published nearly ten years ago, this work reveals that digital scholarship librarians need to outreach to researchers and faculties, understand their requirements and needs, and gain their trust.

Furthermore, the literature analysis showed that DSS should support the copyright and intellectual property management, consultation, and assistance (Vinopal and McCormick, 2013; Zhao, 2014). A survey reported in Research Information Network and Consortium of Research Libraries (2007) shows that nearly 74 percent of researchers who participated believe that librarians should offer specialist advice on copyright and other intellectual property rights issues. Moreover, Mutula (2011) suggested that digital scholarship librarians can work with authors, publishers, and other stake holders to develop appropriate business models, which can be used to resolve copyright restrictions and enhance access to digital content.

Also, digital scholarship librarians have been advocating for and have been involved in the development of open access of digital institutional repositories (Kretzschmar and Potter, 2010; Zhao, 2014). As claimed by Carlson and Garritano (2010), librarians have already acquired skills to develop, manage, and maintain digital repositories and invested resources to digitise traditional materials and house, preserve, and disseminate digital collections in these repositories.

In China, digital institutional repositories are considered as highly useful to

collect, manage, and disseminate research materials and outputs (Ma, 2017; Miller, 2017; Zhang, 2014). In September 2016, 17 of China's leading universities (e.g., Peking University, Tsinghua University, Wuhan University) jointly established a Confederation of China Academic Institutional Repository (CHAIR). By June 2017, the number of participating institutions has reached 46 (Liu and Tu, 2017).

Research impact measurement is another type of highly used services at the publication stage. According to Drummond (2014), these services are expected to assist researchers in quantifying and qualifying the impact of their published work. Furthermore, Drummond (2014) explained that research impact measurement services involves a reporting service, where impact reports are generated using various bibliometric measures to demonstrate scholarly impact.

In China, nearly all university libraries provide impact reporting services. These reports are issued for individual academics, schools, and faculties for a variety of purposes, such as individual performance assessment and promotion (Sun *et al.*, 2014; Zhu *et al.*, 2016). Nevertheless, Braun (2017) and Keller (2015) pointed out that research impact measurement services should really focus on enhancing the research impact of individual researchers and helping researchers to manage publications, maintain profiles, measure and demonstrate impact, and develop publishing strategies.

4. Discussion

Through a conceptualisation and visualization of the literature review findings, a diagram is developed exhibiting individual DSS identified, grouped into six themes, through which relationships can be succinctly captured, exhibited, and discussed. The diagram is shown in Figure 2.



Figure 2. A framework of digital scholarship services in university libraries

As show in Figure 2, a total of 25 DSS are grouped in six themes along the research project life cycle. These 25 DSS emerged throughout the literature analysis and should be considered for provision in Chinese university libraries. Thus, RQ1 is addressed. Moreover, the supporting services are placed at the centre of this diagram because these services are the basis of the provision of other types of services, which are included in five stages in a research life cycle: formulating research ideas, locating research partners, writing proposals, conducting research, and publishing results. These research stages are presented in a circular formation to present a continuously iterative circle connecting the themes. RQ2 and RQ3 are, therefore, addressed.

It is necessary to highlight that this framework was developed with an aim to provide a basis for the development of DSS in China's university libraries. This framework was expected to provide useful indications and guidance at initiating stages of DSS development, specifically in the planning and designing stages.

Moreover, it is relevant to stress that the majority of DSS identified in this study are natural progressions on existing and traditional scholarship services already provided by university libraries. What distinguishes these existing services from DSS is the focus on the digital elements. By providing the diagram in Figure 2, it becomes possible to communicate the changing identity of academic libraries in the twenty-first century. In equal measure, it also illustrates the important role of university libraries in the scholarly processes and in supporting research activities. The benefit of embracing DSS by university libraries stems from their ability to communicate the unique selling points in the broader academic processes whilst not forgetting about existing non-digital traditional services that remain important.

Finally, the literature review seeks to synthesise the various perspectives about DSS and provides an understanding of the relationship between the delivery of DSS and traditional scholarship services provided by university libraries. From the perspective of university libraries, DSS are an extension of the existing "brick and mortar" services. This can be seen in the DSS space, for example, where the debate about space in libraries previously concerned physical spaces, whereas DSS requirements demand that libraries increasingly think about digital repositories and creative collaborative platforms. Also, teaching and training services are naturally shifting towards a focus on digital scholarship as a result of the rising importance of digital resources and reliance on digital communication for scholarship in general. Subject librarians are increasingly involved with the provision of training in using digital resources, from specialist databases to the use of social media for researchers, and more and more teaching takes place in the digital space as a result of increased use of the virtual learning environment.

5. Conclusion

This paper reports on a literature review, which aimed to formulate and propose a framework that can guide the development of DSS in China's university libraries. Through the analysis of relevant academic articles and professional reports in both English and Chinese, the framework was developed consisting of 25 DSS, which are grouped in six themes: supporting services, formulating research ideas, locating research partners, writing proposals, conducting research, and publishing results. The DSS framework developed in this literature review can be used for the development of DSS in China's university libraries and can inform the articulation of relevant strategies and decision-making. Furthermore, this literature review points to the following directions for future studies:

- It is necessary to understand the current stage of DSS development in China's university libraries. The research objective can be achieved by surveying a large sample of university libraries in China. The survey can be accompanied by several in-depth case studies investigating those leading university libraries.
- It is useful to compare the DSS in university libraries in China against those in North American and European university libraries. In this case, practical insights and experiences can be gained. Also, pragmatic strategies for development can be formulated.
- The framework proposed in this article requires further development, validation, and verification through collecting and analysing empirical data (both qualitative and quantitative) gathered in the field.
- The development and establishment of successful, systematic, and well-organised library DSS cannot dismiss the requirements and expectations of end users. Therefore, user requirements should be identified, qualified, and confirmed in future research. The framework proposed can be used as a theoretical base.

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Dear Marie Bloechle,

We would like to thank you and the reviewers for the very thorough assessment and for providing very constructive comments. In truth, our manuscript has become much better and stronger after revision according to your comments.

We have carefully studied your comments and revised the manuscript accordingly. To clearly demonstrate our corrections, we have prepared a list of corrections as follows.

If you have more questions, comments or correction requirements, please kindly let us know.

Many thanks again.

Best regards,

Response to the Editor's Comments

(1) With this major revision request, please make these changes to the manuscript accordingly. In particular, I noticed, although there may be other instances:

Response: Thank you. We have revised the manuscript according to the editor's and reviewers' comments. Please see the corrections below, as well as the revised manuscript.

(2) The phrase "et al." should be in italics. **Response:** Corrected. All "et al." are now in italics, "*et al.*".

(3) When citing multiple articles in the text, they should be alphabetized by the first author's last name. For example, "(Russell et al., 1999; Goh, 2001; McRostie, 2016)" should instead be: "(Goh, 2001; McRostie, 2016; Russell et al., 1999)" [with "et al." in italics].

Response: All corrected. Thank you for pointing this out.

(4) Direct quotes from an article in the text should include the page number of the quote. If you do not include the page number, you will need to paraphrase the quote (re-write it in your own words). For example, the quote "awkward term to describe a complex group of development" is not only missing the page, but because of the sentence structure, the reader can't tell if it is from Lynch (2014) and Tzoc and Millard (2017).

Response: This is now corrected. The original text has been changed to:

"Some researchers, for instance Clifford A. Lynch (2014: 10), even claim that digital scholarship is "an incredibly awkward term that people have come up with to describe a complex group of developments"."

Moreover, the manuscript has been checked for similar problems. All are corrected.

5) Who is (E, 2015)? Please use the author's full last name in cites and references.

Response: Lijun E is a librarian at Yanshan University Library in China. She is one of the leading digital scholarship researchers in China. (E, 2015), (E, 2017) and (E and Cai, 2015) are corrected to (Lijun E, 2015), (Lijun E, 2017) and (Lijun E and Jingli Cai, 2015). The following is one of her publications, which we cite as (Lijun E, 2017):

The Digital Scholarship Support of Some University Libraries in America and Its Enlightenment

E Lijun

Library of Yanshan University, Qinhuangdao 066004

Abstract: **Purpose/significancel** This paper studies the status quo of digital scholarship support of some university libraries in America, and provides references for digital scholarship support of domestic university libraries. **Method/ process**] This paper analyzed the digital scholarship support of 14 university libraries in America by using the case analysis method. It also analyzed the concept of digital scholarship, the digital scholarship support institutions that were set up, and the content and form of digital academic support. **Result/conclusion**] On the basis of a clear digital scholarship concept, American university libraries establish digital scholarship support organization, take the construction of digital resources, digital project construction and research, data curator, digital publishing, digital humanities project research as digital scholarship support core contents, and provides digital scholarship support with various forms. Chinese university libraries should set up the digital scholarship support department, attach importance to the construction of the digital scholarship support team, attach importance to the digital scholarship common construction, innovate the library services that make digital scholarship service as the core.

Keywords: America university libraries digital scholarship

6) Do not use "%" in the text (it's okay in equations, tables, and parentheses). Replace with the word "percent".

Response: Corrected.

7) In-text numbers for 10 and below should be spelt out (ten, nine, eight, seven, six, five, four, three, two, one), except when referring to the Figures/Tables/Equations. **Response:** Corrected. These are very important knowledge. Thank you very much for letting us know.

Response to the Reviewers' Comments to the Author(s):

Reviewer 1

(1) This paper discusses an emerging research topic, digital scholarship. **Response:** Thank you for the positive comment.

(2) However, the scope of digital scholarship has not been appropriately addressed. Using only three search keywords ("digital scholarship" or "digital humanities" or

"research support") for literature identification seems to undermine the goal of this research. Here are the comments that are not covered in the structured review.

Response: In China's library practice and research circles, digital scholarship is not only a rather new terminology, but also a new field not very clearly defined. Actually, we aimed to perform this research to clarify and define the scope of digital scholarship by "establish a guiding framework for the development of digital scholarship services in China's university libraries".

We selected "digital scholarship", "digital humanities" and "research support" after careful consideration. In China, there is a general understanding that digital scholarship is closely related to digital humanities and library subject services. Specifically, digital scholarship is an expansion of digital humanities, as well as is much more effective and comprehensive than traditional subject services (Jie and Sheng, 2016).

In our understanding, digital scholarship should be adopted as a holistic paradigm, which can be used to transform and upgrade the existing service model in university libraries. This view has been supported by researchers in the West. For instance, the Association of Research Libraries (ARL, 2018) points out that: "Digital scholarship spans all disciplines".

When selecting the search terms, we aimed to be inclusive. Therefore, we not only kept "digital scholarship" and "digital humanities" as search terms to include all relevant articles, but also used "research support" to include all research supporting services (including subject services).

To further clarify our view in the manuscript, we added the following statement:

"The search strategy was constructed after careful consideration, aiming to be as inclusive as possible. According to the authors' observation and experience, also as pointed out by Jie and Sheng (2016), digital scholarship in China's university libraries is understood as closely related to digital humanities and library subject services. Specifically, digital scholarship is an expansion of digital humanities as it spans across all disciplines in a university and supports all research activities. Also, when compared with traditional subject services, digital scholarship is more effective and systematic to provide a variety of research supports. Thus, "digital scholarship", "digital humanities" and "research support" were selected and included as search terms."

References:

- ARL (2018). "Digital Scholarship", available at: http://www.arl.org/focus-areas/s cholarly-communication/digital-scholarship.
- Jie, F. and Sheng, X. (2016), "The center for digital scholarship: service transformation and space change in libraries: a case study of the CDS of academic libraries in North America", *Library and Information Service*, Vol. 60

No. 13, pp. 65-70 (in Chinese).

(3) p2 line 11 The definition directly quoted from Rumsey's work (2012) should include page number. BTW, the link in the reference is not working. Rumsey, A.S. (2011), "New-model scholarly communication: road map for change", available at: http://www.uvasci.org/institutes-2003-2011/SCI-9-Road-Map-for-Change.pdf **Response:** Corrected. The page number has been added and the link in the reference is now updated.

(4) p2 line 47 "Finally, this research project is supported by the National Social Science Fund of China." This sentence appeared abrupt in the Introduction. This statement should be listed in the end of the article as Acknowledgement when this paper is accepted.

Response: Thank you for pointing this out. This sentence is now removed.

(5) In 2.2 Literature retrieval and selection, the author(s) used the keywords "("digital scholarship" or "digital humanities" or "research support") and librar*" to search the relevant literature in the academic databases. In my opinion, "digital humanities" and "digital scholarship" are two different concepts. Digital humanities might be one of the applications of digital scholarship. What about the digital scholarship in other domains? Have the author(s) consider other relevant library services providing research support (e.g., research data services) that could be incorporated/extended to digital scholarship services in a variety of domains? Those relevant services could be included in the search keywords. In any case, the author(s) have to justify why the keyword, digital humanities, is included. If the author(s) aimed to focus on the digital scholarship in digital scholarship services" to "digital humanities services" in order to address the specific focus.

Response: Thank you for pointing this out. As discussed previously in Comment (2), the keywords were selected after careful consideration. There is a general understanding in China's library practice and research communities that digital scholarship is closely related to digital humanities and library subject services. Specifically, digital scholarship is an expansion of digital humanities, as well as is much more effective and comprehensive than traditional subject services (Jie and Sheng, 2016). In our understanding, digital scholarship should be adopted as a holistic paradigm, which can be used to transform and upgrade the existing service model in university libraries. Thus, "digital scholarship", "digital humanities" and "research support" were selected and included as search terms. Therefore, and respectfully, we would like to ask for permission not to change the title of this paper.

(6) In Figure 1, the author(s) reported the number of papers identified in Chinese academic databases and English academic databases separately. In the end, 79 articles were included but we cannot tell how many articles in the final list were written in Chinese and how many were in English. From Figure 1, the author(s) found more

relevant papers (n=314) in Chinese academic databases than those (n=112) in English. The author(s) should report the number of articles in both Chinese and English in the final list.

Response: This is a good point. Actually, there were 43 Chinese articles and 36 English articles. The manuscript is revised:

"[...] overall 79 articles (43 in Chinese and 36 in English) were included in the literature analysis [...]".

(7) p4 line 50 What does JISC stand for? It this is the first time this acronym appears, the author(s) needs to explain what JISC refers to.

Response: JISC stands for the Joint Information Systems Committee, which is a UK based non-profit organisation and research community. JISC is very active and well-known (in the UK) in the field of information management and information technology management. JISC has close and collaborative relationships with the British Library, various university libraries in the UK and a number of higher education institutions. According to this comment, the manuscript has been revised as follows:

"Thus, the research lifecycle model developed by the Joint Information Systems Committee (JISC, 2014) [...]".

(8) Additional Questions: Originality: Does the paper contain new and significant information adequate to justify publication?: This paper aims to establish a guiding framework for digital scholarship services in China's academic libraries. However, the literature review section is missing, so that the reviewer is unable to justify if there is any similar research published.

Response: This is a literature review paper. Actually, this manuscript reports on a structured and rigorous literature review exercise. Therefore, we perceive that adding a literature review section is not entirely appropriate. In fact, the originality of this paper has been discussed in the introduction: "there is a lack of effective and practically applicable approach, which can clearly demonstrate and drive the processes of DSS development through remodelling and restructuring the existing library service model and management structure". In this case, "this article [...] aims to develop a comprehensive guiding framework for the development of DSS in China's university libraries, [...] presents the research findings drawn from a literature review". Therefore, we would like to ask for your permission not to add a literature review section.

(9) Relationship to Literature: Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?: The literature review of digital scholarship services is missing. The author(s) have identified 79 relevant articles from both Chinese and English academic databases. However, the author(s) only reported the literature analysis results in a collective manner. The author(s) should synthesize

and compare the research focuses and methodologies of digital scholarship studies from Chinese and English articles in the literature review section.

Response: As discussed above, this paper is a literature review of digital scholarship services. The analysis of literature included 43 Chinese articles and 36 English articles. This information has been added into the manuscript, please see Comment (4).

Moreover, it is a brilliant idea to synthesise and compare the research focuses and methodologies of digital scholarship studies from Chinese and English articles. Nevertheless, since this article focuses on developing "a comprehensive guiding framework for the development of DSS in China's university libraries", this idea does not seem entirely relevant for this article. We will use this as the next step of literature analysis.

(10) Methodology: Is the paper's argument built on an appropriate base of theory, concepts, or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed appropriate?: In 2.2 Literature retrieval and selection, the author(s) used the keywords "("digital scholarship" or "digital humanities" or "research support") and librar*" to search the relevant literature in the academic databases. In my opinion, "digital humanities" and "digital scholarship" are two different concepts. Digital humanities might be one of the applications of digital scholarship. What about the digital scholarship in other domains? Have the author(s) consider other relevant library services providing research support (e.g., research data services) that could be incorporated/extended to digital scholarship services in a variety of domains? Those relevant services could be included in the search keywords.

Response: We have responded this in previous comments. Just briefly reiterate here, we agree that digital scholarship should include a variety of research support services, not just digital humanities. The search terms were designed to be inclusive and used three rather generic terms ("digital scholarship" OR "digital humanities" OR "research support"), in order to ensure a wide coverage.

(11) Results: Are results presented clearly and analysed appropriately? Do the conclusions adequately tie together the other elements of the paper?: The conceptualization and visualization of the findings (Figure 2) look good. However, when it comes to tying to the research design, it involves the scope issue (I previously pointed out) about search keywords used to derive the framework of digital scholarship services. The author(s) mentioned the lack of widely accepted definition for digital scholarship in the introduction as well. Therefore, using three keywords might leave out other relevant studies that support digital scholarship but have different labels/terms to define their services.

Response: We have responded the scope issue in our previous discussion. Also, it is important to highlight that the findings are developed through the literature review. Our work here is extremely important to future research and the development of

actual digital scholarship services in China's university libraries, as this study provides a clear scope. We chose the keywords to ensure a wide and good coverage, which provided a good basis for the literature analysis and for articulating strong and useful implications for research and library practice.

(12) Implications for research, practice and/or society: Does the paper identify clearly any implications for research, practice and/or society? Does the paper bridge the gap between theory and practice? How can the research be used in practice (economic and commercial impact), in teaching, to influence public policy, in research (contributing to the body of knowledge)? What is the impact upon society (influencing public attitudes, affecting quality of life)? Are these implications consistent with the findings and conclusions of the paper?: The framework of digital scholarship services (DSS) was developed to provide a guidance for DSS in China's university libraries, particularly for the planning and designing stages. At planning and designing stages, it is essential to identify the scope of DSS and how the existing services can be extended or re-positioned to DSS. The author(s) stated the definition problem of DSS which is a worth studying research gap. However, the research design (using few keywords in the systematic literature review) limits the implications for research and library practice.

Response: Thank you for the positive comment. Again, we have responded the research design comment. We chose the keywords to ensure a wide and good coverage, which provided a good basis for the literature analysis and for articulating strong and useful implications for research and library practice.

(13) Quality of Communication: Does the paper clearly express its case, measured against the technical language of the field and the expected knowledge of the journal's readership? Has attention been paid to the clarity of expression and readability, such as sentence structure, jargon use, acronyms, etc.: The major issue of this paper is the definition and the scope of DSS. Although the author(s) discussed the definition problem and quoted a definition of DSS, it is unclear whether Chinese scholars agree with the definition provided by the U.S. scholar or Chinese scholars have their own definitions/perspectives on DSS. The author(s) should elaborate the definition problem and propose the ways to address the issue in the research design.

Response: Again, we have responded the research design comment in Comment (2).

Reviewer: 2

(1) Comments: The author(s) addressed all queries of the reviewer and made corresponding changes in the main text. My previous review recommended the author(s) should name the methodology "systematic review" as systematic review is a "methodology" for collecting large volumes of data in order to reach conclusions and recommendations on the basis of the evidence. However, I noticed that the author(s) provided justification for why "literature review" is more appropriate approach for their study. In fact, literature review is an essential part of the research process but is

not a methodology. **Response:** Thank you for the positive comment. No correction is required.

Additional Questions:

(1) Originality: Does the paper contain new and significant information adequate to justify publication?: My feedback on the manuscript is provided under "Comments to Author."

Response: No correction is required.

(2) Relationship to Literature: Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?: My feedback on the manuscript is provided under "Comments to Author."

Response: No correction is required.

(3) Methodology: Is the paper's argument built on an appropriate base of theory, concepts, or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed appropriate?: My feedback on the manuscript is provided under "Comments to Author." **Response:** No correction is required.

(4) Results: Are results presented clearly and analysed appropriately? Do the conclusions adequately tie together the other elements of the paper?: My feedback on the manuscript is provided under "Comments to Author." **Response:** No correction is required.

(5) Implications for research, practice and/or society: Does the paper identify clearly any implications for research, practice and/or society? Does the paper bridge the gap between theory and practice? How can the research be used in practice (economic and commercial impact), in teaching, to influence public policy, in research (contributing to the body of knowledge)? What is the impact upon society (influencing public attitudes, affecting quality of life)? Are these implications consistent with the findings and conclusions of the paper?: My feedback on the manuscript is provided under "Comments to Author." **Response:** No correction is required.

(6) Quality of Communication: Does the paper clearly express its case, measured against the technical language of the field and the expected knowledge of the journal's readership? Has attention been paid to the clarity of expression and readability, such as sentence structure, jargon use, acronyms, etc.: My feedback on the manuscript is provided under "Comments to Author."

Response: No correction is required.