Kara R. Wong. Vendor-hosted versus Self-hosted Implementation of Open-Source Software at GLAM Institutions. A Master's Paper for the M.S. in I.S degree. April, 2022. 61 pages. Advisor: Jason Casden.

This study investigates how those with input in software purchasing decisions choose to host open-source software at their galleries, libraries, archives, and museums (GLAM institutions). A survey was distributed to several GLAM-specific open-source community listservs to collect data on the various factors considered and overlooked. Responses suggest that decisions are made based on constraints and not preference. The level of technical expertise at the participant's institution greatly affected how funds are used. Analysis also shows that participants underestimate the total costs of maintaining open-source software and overestimate the vendor/consortium's ability to customize software.

Headings:

Library software

Open-source software

Library applications of open-source software

Information technology software

VENDOR-HOSTED VERSUS SELF-HOSTED IMPLEMENTATION OF OPEN-SOURCE
SOFTWARE AT GLAM INSTITUTIONS

by
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Introduction

Open-source software has always garnered interest and support from the GLAM (galleries, libraries, archives, and museums) community. Not only does open-source share a philosophy of taking collective action for the benefit of the community (Arkles, 2002), but adopting open-source software also provides a number of benefits to GLAM institutions. Under increasingly dire financial pressures, many GLAM institutions are looking into the feasibility and cost-effectiveness of implementing and maintaining open-source software (Breeding, 2021).

But what is the most feasible way to adopt open-source software? The current body of literature on open-source software in GLAM comprises mostly articles on the benefits of open-source software and its performance in libraries (Palmer & Choi, 2014). There is little research on the software implementation process at GLAM institutions, outside of case studies on a specific library or open-source project. This study will hopefully provide a point of reference for GLAM institutions and their staff looking for guidance on how their institution can develop an open-source software implementation plan.

The following paper is a phenomenological study that examines how those with input in software purchasing decisions at institutions in the United States implement server-based open-source software designed for GLAM use cases. The goal of this study is to gain insight into how those study participants choose between vendor-hosted and self-hosted software implementations. Through surveys of GLAM staff, this study seeks

to better understand the software implementation process and the considerations

made while deliberating. In doing so, the findings of this research may help GLAM

institutions to develop more comprehensive evaluation rubrics to support the open-source

software implementation planning process.

Literature Review

An Overview of Software

Open-Source Software

Open-source software (OSS) is software with source code "designed to be publicly accessible—anyone can see, modify, and distribute the code as they see fit" (Red Hat, 2019). The development of OSS is both decentralized and collaborative, as it relies on an engaged community. Peer review heavily features in the production of open-source software. OSS can sometimes be cheaper and more flexible than commercial proprietary software, in terms of acquisition costs (Red Hat, 2019).

The term "open source" was first coined by Christine Peterson in 1998 (OSI, 2018). "Open Source" was later adopted by the Open Source Initiative (OSI). The OSI created and maintains the Open Source Definition, the set of ten criteria that must be met for a software license to be considered open source (OSI, 2018). In summary, for a software program to be considered open source, its license must allow access to the source code and contain specific distribution clauses.

Though the term "open source" originally referred to open-source software, it is now used to reference the broader open-source movement. The open-source movement "uses the values and decentralized production model of open-source software to find new ways to solve problems" (Red Hat, 2019). Today, the concept of open source is embraced by communities and industries beyond software development. Not only does open-source

software exist, but also open-source online databases and open-source

commercial online vendors.

There are multiple benefits to utilizing open-source software. As mentioned

previously, open-source software is often very cost-effective, at least in terms of

licensing. Other reasons people often choose open source include control, stability,

security, and community (Opensource.com, n.d.). OSS offers its users more control and

flexibility, allowing them to make changes and repurpose the software for their own uses.

OSS can be maintained for a longer period of time than its proprietary counterparts. OSS

with large user communities can opt to continue to sustain software that was abandoned

by its original creators. Its longevity makes it a safe, stable choice for long-term projects.

Open-source vendors have little reason to reduce maintenance support when that is their

primary source of revenue (Schneider, 2009). The transparency and ability to peer review

code increase the security of OSS. Communities often form around the users and

developers of OSS, encouraging collaboration and offering support. Most open-source

projects also have publicly accessible bug reports that include information on how the

problem is being addressed. This allows users to anticipate when fixes will be made to

the software (Murray, 2016). In addition to these benefits, using OSS may prevent

vendor lock-in, given sufficient vendor involvement, so users will not become dependent

on a specific vendor's services.

However, OSS does have disadvantages. If a particular software package is not

very widespread and has a small community, there may not be as much support or

documentation. Though it is rare, viruses and malware may occasionally be attached to

the software (Murray, 2016). The ease of installation can vary. Some may find OSS to be

very user friendly, with only minor customizations needed (Mandal, 2018).
Others may have trouble setting up and using the software, especially if there are
compatibility issues. There could also be hidden costs associated with the implementation
and future maintenance of the software (Pratheepan, 2015). The total costs of
implementation, maintenance, and extension of OSS can be greater than that of
proprietary alternatives.

By definition, open-source software is publicly accessible and free of charge.
However, it is important to give back to the community and organizations that support
the software. Contributing to an open-source project can come with perks, such as
ongoing support, access to documentation, or a seat on a committee. Sponsoring open-
source projects allows GLAM institutions to contribute to the value of sharing
information for the common good, in addition to benefiting from OSS updates and
upgrades (Puckett, 2012). Sponsored OSS projects are significantly more likely to be
positively correlated with indicators of OSS project success (Choi, 2013).

There are several ways to sponsor the continued existence of OSS: financial
contributions, in-kind contributions, and membership contributions (Germain, 2013).
Financial contributions are simply financial donations or paying for support from the
developers. The licensing fees for OSS are often much smaller than that of a proprietary
counterpart. In-kind contributions are donations of other resources, typically a
developer's time. Membership contributions are optional financial contributions.

Proprietary Software

Any strengths or weaknesses of open-source software are defined relatively to
competing proprietary software. Proprietary software, also known as closed-source

software, is software that only publishes the object code. The source code is exclusively controlled by the person, team, or company that created it (Pratheepan, 2015). To use any software, consumers must abide by the terms of the software license and agree they will not do anything the software's authors have not expressly permitted. OSS tends to have more permissive licenses than proprietary software. Most modern proprietary software utilizes the Software-as-a-Service (SaaS) business model, where subscription fees cover all features of the product, including upgrades and support. Using SaaS products eliminates the need for local servers, local software installs on user computers, and systems admin (Pratheepan, 2015).

Using commercial proprietary software has its advantages. Commercial proprietary software often has specific features and abilities catered to a specific audience. It is typically very polished, user friendly, and focuses on providing quality user experience. Proprietary software also often follows more formal product management practices including regular updates and funded technical support services (Pruett & Choi, 2013). Though there are subscription fees, these fees cover all aspects of the product and provide support if necessary.

There are several drawbacks to proprietary software. A proprietary software license can be limited to a single user or computer. Users are completely dependent on the developers for support, bug fixes, and updates, even if they have developers on staff. Consumers are often prohibited from modifying and customizing proprietary software (Pratheepan, 2015). Proprietary vendors may also stop maintaining software, forcing consumers to find and switch to an alternative. When OSS vendors stop maintaining software, the community could potentially carry on the OSS project. Also, commercial

proprietary software requires paying for a license and the ongoing subscription

fees associated with it. Budgeting for several different proprietary software payments can

be difficult. The subscription pricing models each vendor uses can vary wildly from

freemium and flat monthly fees to fluctuating costs based on the customer's usage and

per-user pricing (O'Brien, 2021).

Software Examples

The following table includes examples of open-source software and their

proprietary software counterparts.

	Open-Source Software	**Proprietary Software**
Operating System	Linux	Windows, macOS
Graphics Editor	GNU Image Manipulation Program (GIMP)	Adobe Photoshop
ILMS	Koha	Endeavor Voyager

Software and GLAM Institutions

Background

The GLAM technology industry differs from most businesses because it caters to

a clientele of nonprofits with limited funding and long financial cycles (Breeding, 2021).

However, commercial GLAM technology is still susceptible to the current business

practices of many technology companies. Opaque pricing, inflationary increases, and the

consolidation of the GLAM technology industry in combination with libraries' stagnant

budgets have taken a toll on libraries.

In general, GLAM budgets have not kept up with inflation. The COVID-19

pandemic has disrupted university budgets and exacerbated this issue. GLAM institutions

are likely to receive decreased funding, forcing them to make even more cuts in their

already constricted budgets (Breeding, 2021). The costs for information technology and software, particularly automation systems, fall within these challenging budgeting decisions. Fortunately, open-source software can be a potential solution and offer financial relief to GLAM institutions.

Open-Source Software in GLAM Institutions

Throughout the past few decades, GLAM institutions have increasingly turned to open-source software to provide services for their community. In the 2000s, those with internal IT staff created and contributed to open-source projects. GLAM institutions with limited IT and without developers used open-source software through service providers (Murray, 2016). There was an increase in the number of open-source service providers in the early 2010s. Additionally, many consortia began supporting open-source software for its members. In libraries, OSS is most frequently used for archival management, digital exhibits, and institutional repositories (Rosen & Grogg, 2021).

GLAM institutions appear to prefer OSS for its community relationships, preservation of digital content, digital workflows, integration with other systems, and metadata control (Rosen & Grogg, 2021). In terms of technical support, a study on the support for open-source integrated library systems found that the majority of librarians (77%) were satisfied with the vendor's technical support and 96% were satisfied with the quality of the support (Singh, 2014). This study also found that 78% of librarians had multiple channels of technical support available.

Regarding contributions toward open-source, most GLAM institutions do not financially contribute to OSS projects (Rosen & Grogg, 2021). According to the LYRASIS 2021 OSS Survey Report, roughly 52% of respondents allocate work time for

technical contributions. Only 13% dedicate one or more full-time equivalent

personnel to OSS technical contributions (Rosen & Grogg, 2021). More institutions are

willing to allocate staff time to non-technical contributions, such as governance meetings,

community feedback, and user testing.

Benefits and Barriers to Accessing Open-Source Software

As discussed previously, the general benefits of OSS may include cost savings,

flexibility and autonomy, stability, and reliable support. The apparent cost-effective

nature of OSS may allow budget funds to be devoted to other areas of the institution.

However, this is dependent on the total implementation costs, which should be

thoroughly assessed when considering an open-source solution. There are also several

GLAM-specific benefits: preservation, privacy and security, and scholarly standards and

exchange (Pratheepan, 2015). OSS can be ported to new hardware and systems, making

the preservation of digital objects easier. It is also easier to protect the privacy of GLAM

users with OSS. Because the source code is open and publicly accessible, auditing the

software to reduce security vulnerabilities is also simplified (Pratheepan, 2015). OSS

supports scholarly standards and exchange through its open-source infrastructure, a

necessity for GLAM institutions' use of open standards (Altman, 2001).

However, there are barriers to adopting open-source software in GLAM

institutions. This includes the previously mentioned problems with documentation, lack

of support, and usability. Other non-technical reasons that affect the adoption of OSS

include personal motivation, organizational culture, and age and gender (Spirov,

2007). OSS communities have significant barriers to entry, especially for women and

others from marginalized backgrounds. These barriers to entry range from social/cultural

factors, such as lack of formal mentorship programs in OSS, to

tool/infrastructure barriers, such as problems with documentation (Mendez et al., 2018).

OSS has traditionally been criticized for its lack of technical support, particularly

during implementation. Library OSS is typically designed for and supported by well-

resourced institutional and developer communities (Davidson & Casden, 2016). Without

developers, the adoption of OSS in diverse user communities is often challenging. The

institutional lack of internal IT personnel and technical expertise is perhaps the greatest

challenge to adopting OSS in GLAM (Rosen & Grogg, 2021). Though OSS communities

offer some support, staff time and knowledge are crucial for the successful adoption of

OSS.

Another potential barrier to OSS is economics. Open-source software is often

cited to have a lower total cost of ownership (TCO) than a proprietary alternative with

subscription pricing. However, it is unclear if open-source software is less expensive and

appears to be dependent on the library's situation (Thankachan & Moore, 2017). Due to

limited data, there is little research comparing the operating costs of open source and

proprietary products. GLAM institutions would need to account for all the operating costs

for an open-source software to accurately compare it to the price of proprietary software

(Breeding, 2021). These cost components include hosting, maintenance, support, and

potentially additional personnel. Another possibly prohibitive cost is the expense of

switching over to different software, though this can be an issue for both commercial

proprietary software and OSS. Not only will GLAM institutions need to contend with

installation fees and training, but also a temporary decrease in productivity (Pruett &

Choi, 2013).

Current Literature on Open-Source Software

The current literature on GLAM OSS focuses greatly on libraries. In a 2014 review of the current state of library OSS research, the majority of articles were case studies and discussion pieces (Palmer & Choi, 2014). The discussion pieces either focused on a specific kind of software or compared software applications. Interestingly, articles that provide a general overview of open-source software were also fairly prevalent. Additionally, there appeared to be a distinct lack of survey research. Survey studies only accounted for 7.7% of the total research conducted (Palmer & Choi, 2014).

Significant amounts of research have been done on open-source repository applications, online public access catalog (OPAC) software, and integrated library systems (ILS) (Palmer & Choi, 2014). The vast majority of articles also centered on academic libraries, when a library was specified. Multiple studies have been devoted to the benefits of implementing open-source software and its performance in the library (Palmer & Choi, 2014). This can provide insight for those considering a shift to open source. Though there has been research on OSS adoption, development, and performance, there is little on the implementation process itself. This lack of literature highlights the need for more studies that look into how GLAM institutions, not only libraries, choose to implement open-source software at their institution.

Research Questions

The purpose of this phenomenological study was to investigate how those with input in software purchasing decisions select and implement open-source software designed for the galleries, libraries, archives, and museums (GLAM) field. It sought to better understand the various factors IT and other staff considered or neglected to account for during the decision process. This study also looked into whether they have any regrets about their chosen method of implementation.

The central question of this research study and the following sub-questions are listed below.

1. How do academic libraries, and other GLAM institutions, choose between vendor-hosted and self-hosted implementation of open-source software?

    a. What factors do they consider?

    b. What factors do they neglect to consider?

    c. Do they regret their decision?

Key concepts and terms central to this research topic include proprietary software and open-source software. It is important to note that these terms refer to how software distribution and licensing work. Though software may be open-source, it may not be free to use.

- Proprietary Software: software with "source code that only the person, team, or organization who created it—and maintains exclusive control over it—can

modify" (Opensource.com, n.d.), also known as closed source software
and commercial software

- Open-Source Software (OSS): software with source code "that can be freely accessed, used, changed, and shared (in modified or unmodified form) by anyone. Open-source software is made by many people and distributed under licenses that comply with the Open Source Definition" (Open Source Initiative, 2018)

- Vendor-hosted: software that is hosted by the vendor or consortium on the vendor's or consortium's servers

- Self-hosted: software that is hosted locally by the institution itself on its own servers

Methods

In this study, I used a phenomenological, survey-based approach to investigate how GLAM institutions host open-source software. A phenomenological approach allowed me to gather data on how participants experience and understand the software selection and implementation process.

Data was collected through a Qualtrics survey consisting of multiple-choice and free-response questions. Surveys are inexpensive and standardized, which simplifies data analysis. Additionally, participants can remain anonymous, which allows them to answer questions more freely and without time-constraint pressures (Wildemuth, 2017, p. 276).

Sampling and Recruitment

The population studied was employees and staff with input in software purchasing decisions at GLAM institutions in the United States. The characteristics of this population varied in terms of demographics. The departments, their roles and responsibilities, the input they have on software purchases, and amount of funding are dependent on the institution. The sampling unit was a member of the institution.

Participants were recruited using convenience sampling. This non-probability sampling technique was relatively easy, inexpensive, and not time-consuming. Participants were recruited through several listservs: ArchivesSpace, Samvera, DuraSpace, Koha, Archivematica, and Islandora. These listservs were chosen because

they are listservs for established GLAM-specific open-source software communities and vendors that support these technologies.

A recruitment email with an invitation to participate in the survey was sent to each of the listservs. The text of this email can be found in Appendix B. A consent form with more details on the study was included at the start of the survey. The text of this consent form is in Appendix C.

All responses were anonymous. Qualtrics settings were enabled to prevent the collection of participant IP addresses, location data, and contact information. For free-text responses, potentially identifiable information was redacted or generalized. For example, the "University of North Carolina" was replaced with "[university]."

Survey Design

The survey consisted of 12 required multiple-choice questions and 4 optional free-response questions. The survey questions can be found in Appendix A. Survey questions can be separated thematically into three sections.

Section 1 (Questions 1-3) collected participant demographic data. Participants were asked to state the type of GLAM institution they are affiliated with and what types of input they have in their institution's software purchasing decisions. One of the questions (Question 2) in this section filtered out subjects who were not eligible to participate in this study.

Section 2 (Questions 4-7) collected demographic data on the participant's institution. Participants were asked about how their institution used and hosted open-source software as well as how long their institution has supported open-source software. Section 2 also included a question asking participants to select their reason(s) in

situations they chose not to use open-source software. This data about the

participant and their institution helped contextualize the data obtained about their

decision process and potential regrets.

Section 3 (Questions 8-12) asked participants about their experiences making

decisions about open-source software. Participants were asked to select factors that

affected the subject's software hosting decisions, factors they should have evaluated more

thoroughly, whether they had regrets about their chosen method of hosting, and whether

they have switched between vendor and self-hosted open-source software. Each question

included an option free-response question that allowed participants to elaborate on their

answer choices. Question 12 was only displayed to participants who selected "yes" for

the previous question asking if their institution switched hosting services.

Survey questions were reviewed by my advisor and members of the University of

North Carolina at Chapel Hill University Libraries Software Development department for

relevance and applicability. The survey received approval from the Institutional Review

Board of the University of North Carolina at Chapel Hill in January 2022.

Data Analysis

After the survey closed, I exported the data into a non-coded .csv file and a

Qualtrics report. The raw data in the .csv file was formatted and examined in Excel. I

assigned numbers to each participant to differentiate their survey responses and maintain

anonymity. Responses to the open-ended questions were coded by hand. I did not

establish categories before coding open-ended responses. Instead, I created categories as

they emerge through analysis (Wildemuth, 2017, p. 277). All free-response answers and

their codes are displayed in Appendix D. The cleaned and coded data was

compared to the Qualtrics report to gain a more complete understanding of the data.

Results

Overview

30 responses were recorded for the survey. Of these responses, 21 were complete and used in data analysis. The 9 incomplete survey responses were set aside, and no portion of those responses was used. The survey was open for two weeks. Participants could choose to begin the survey at any time and were given 7 days to complete the survey. Of the 21 complete responses, the average completion time was 11 minutes and the median completion time was 9 minutes. One response was omitted from this calculation, as the recorded time was a little over a day. This participant likely opened the survey and completed it later.

Participant Demographics

About half of the participants (11 participants or 52.38%) were from academic institutions, including one participant who listed their institution in the other category. The remaining participants include 4 from public libraries, 1 from an archive, 2 employed by museums, and 3 employed by other institutions. These 3 other institutions are a teaching hospital, a computing center, and a research library for a charitable organization. No participants were from galleries. This data can be found in Table 1 below.

Table 1. Participant breakdown by institution type

Institution Type	Responses
Doctoral University	8 (38.10%)
Master's College and University	1 (4.76%)
Baccalaureate/Associate's College	1 (4.76%)
Academic Library	1 (4.76%)
Public Library	4 (19.05%)
Archive	1 (4.76%)
Museum	2 (9.52%)
Gallery	0 (0%)
Other Institutions: • P3: Teaching hospital • P9: Computing center • P13: Research library for a charitable organization • P19: Academic library (counted in row 5 above)	3 (14.29%)

Influence on Software Purchasing Decisions

Q2. Do you have any input in or influence over software selection decisions at your institution?

All 21 participants have input in or influence over software selection decisions at their institution.

Q3. What type(s) of input/influence do you have in software selection decisions at your institution?

Participants were asked to provide information on the types of input and influence they have in software selection decisions at their institution. Participants were allowed to select all types of input that applied. All participants participated in the review of software for possible implementation, and many participated in multiple parts of the decision-making process.

Table 2. Participant breakdown by type(s) of input/influence

Type(s) of input/influence	Responses
I have participated in the review of software for possible implementation	21 (100%)
I have proposed that a particular software be implemented	19 (90%)
I have conducted feasibility assessments of software under consideration	16 (76%)
I have made/coordinated final software selection decisions	13 (62%)
I have negotiated and/or allocated resources for software implementation	10 (48%)
Other input/influence: • P3: I installed the software	1 (4.76%)

To better understand how much influence participants had in their institution's software purchasing decisions, the following figure displays the number of input/influence options selected by participants. An overwhelming majority of participants (95.23%) had at least 2 types of input in the decision-making process, and 90.47% of participants had 3 or more types of input.

Figure 1. Participant breakdown by the amount of input/influence
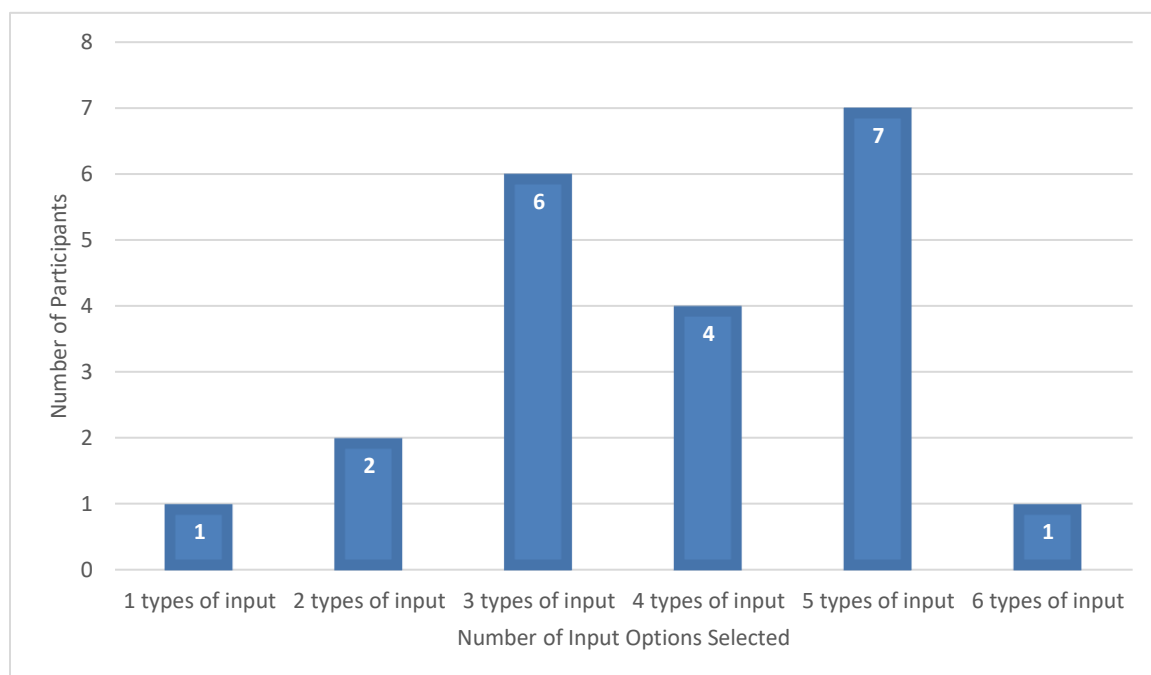
Open-Source Software at Their Institution

Participants were also asked about open-source software at their institutions. Questions 4 through 7 helped contextualize their institution's relationship with open-source software and level of comfort using such software.

Q4. In what area(s) of your institution do you use open-source software designed for GLAM?

Participants were able to select all areas in which their institutions used open-source software. The breakdown of institution by area of open-source software usage is listed in Table 3 below. The areas where open-source software is most often used include digital asset management, library services platforms, and archival management. No participant's institution uses open-source software in collection management. Some institutions also use non-GLAM-specific open-source software. OSS was used for their operating systems (Linux Mint), content management systems (Drupal), file sharing, and more.

Table 3. Institution breakdown by areas that use open-source software

Area	Responses
Library services platforms	12 (57.14%)
Archival management	10 (47.62%)
Digital asset management	10 (47.62%)
Digital exhibits	7 (33.33%)
Digital preservation	7 (33.33%)
Institutional repositories/institutional publishing	6 (28.57%)
Discovery layers	3 (14.29%)
Collection management	0 (0%)
Other area(s): • P13: We run Linux (Mint) on some of our patron-useable laptops. • P15: publications - Pressbooks and Drupal	3 (14.29%)

| • P18: File sharing, instant messaging, calendar, VPN, CMS, office and productivity, public access kiosks, VNC | |

For many participants, their institutions used open-source software in more than one area. Figure 2 depicts the number of institutions by the number of areas they used open-source software. Most institutions (71.43%) use open-source software in multiple areas. Of the institutions that only use open-source software in one area, 4 use OSS for library services platforms and 2 for archival management.

Figure 2. Institution breakdown by number of areas they use open-source software
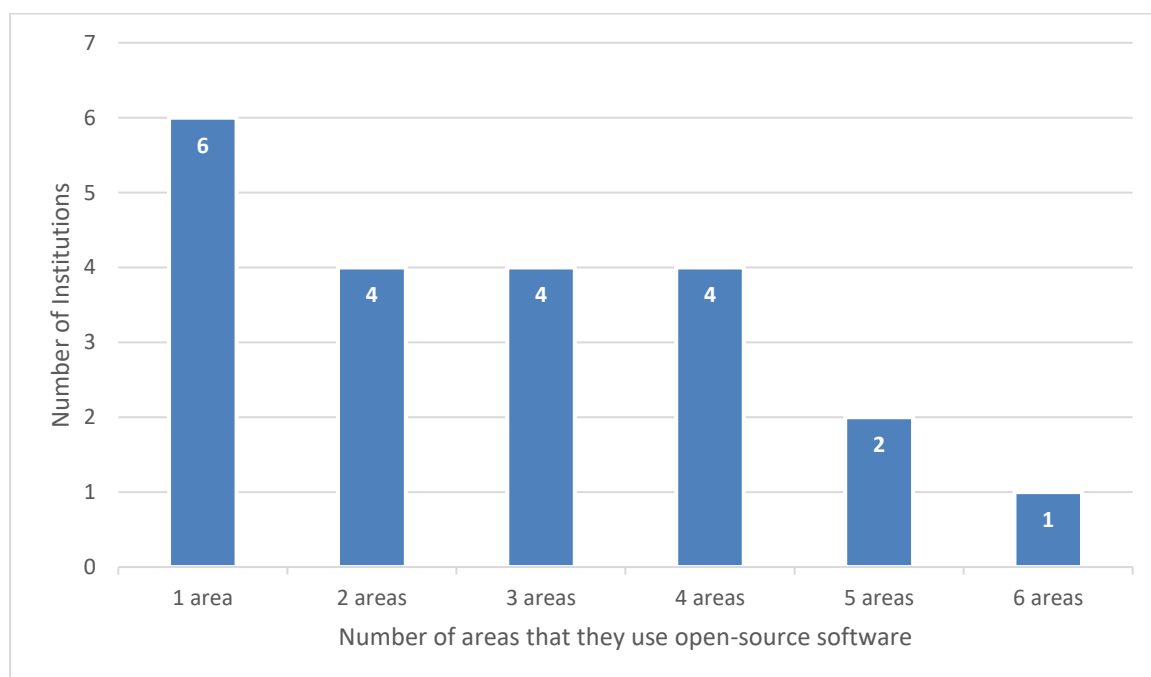
Q5. In situations where you chose not to use open-source software please indicate the reason(s) why.

Participants were given a list of 10 reasons they might prefer proprietary software over open-source and were able to select all that applied. The most common reasons for

preferring proprietary software include proprietary software meeting more of

their requirements and a lack of technical expertise at their institution. Other often cited

reasons were a lack of technical support from open-source developers/vendors and

proprietary software being more affordable overall. Participants also listed a variety of

other reasons for preferring proprietary software. These reasons range from a lack of

open-source options at the time of implementation and higher-level decisions that chose

proprietary to familiarity with the proprietary software and proprietary software

providing an entity that is legally responsible for fixing problems.

Table 4. Institution breakdown by reasons to not use OSS

Reason	Responses
Proprietary software met more of our requirements	9 (42.86%)
Proprietary software met more of our requirements at a higher level of quality	4 (19.05%)
Proprietary software was more affordable, with all costs considered	6 (28.57%)
Proprietary software provided more predictable costs	4 (19.05%)
Proprietary software seemed more stable	5 (23.81%)
Not enough technical expertise within our institution to maintain the open-source software implementation	8 (38.10%)
Not enough technical support from the open-source software developers/vendors	6 (28.57%)
Our institution prohibits the use of open-source software	0 (0%)
Our institution discourages the use of open-source software	0 (0%)
Other reason(s): - P3: I am responsible for only a teeny little bit of our organization—the library. The hospital IT department takes care of everything else - P4: Perception of cost and quality - P7: Higher level decisions were made to implement proprietary software and we have no choice but have to use it - P8: All other systems were implemented before open-source solutions were available - P12: The librarian was more familiar with windows, so continues to use it, despite linux working well for nearly all purposes	8 (38.10%)

- P13: Proprietary was the only thing available at the time
- P15: We have chosen to use open-source if there is an option to do so and it meets our needs
- P19: Proprietary software provides someone who's legally responsible if things go wrong

Q6. How is open-source software hosted at your institution?

Institutions often use multiple methods of hosting to accommodate their various implementations of the open-source software. Participants were able to select all options that applied to how open-source software is hosted at their institution. 8 institutions use 2 types of hosting, while the remaining 13 use 1 hosting service. 8 (38.10%) both self-host and use hosting services, 7 (33.33%) exclusively self-host, and 6 (28.57%) exclusively used hosting services. Only academic libraries used non-fee-based hosting services from a consortium.

Table 5. Institution breakdown by OSS host

Host	Responses
Hosted by our own institution	14 (66.67%)
Fee-based hosting services from a vendor or consortium	13 (61.90%)
Non-fee-based hosting services from a consortium	2 (9.52%)

Q7. How long has your institution used/supported open-source software?

Most institutions (85.71%) have used or supported open-source software for at least 6 years. Only 3 participants' institutions began using or supporting open-source software more recently. No institutions new to open-source software participated in this survey. This lack of participants from institutions with little experience with OSS is likely

caused by sampling population and some degree of selection bias, given that

participants were recruited via open-source software community listservs.

Table 6. Institution breakdown by number of years spent using/supporting OSS

Number of years	Responses
We do not intentionally use/support open-source software.	0 (0%)
Less than 1 year	0 (0%)
1 year	1 (4.76%)
2-5 years	2 (9.52%)
6-10 years	10 (47.62%)
10 or more years	8 (38.10 %)

Open-Source Software Hosting Decisions

The remainder of the survey asked participants about their open-source software

hosting decisions. This included questions on the various factors that participants

considered or neglected to consider, whether they had regrets about their final selection,

and whether they switched between hosting services. There were few notable differences

between responses from academic libraries and responses from other GLAM institutions.

Factors Considered and Factors Overlooked

Q8. What factors affected your decision when choosing between vendor/consortial-hosted

and self-hosted implementation of open-source software?

The lack of technical expertise within a participant's institution was the most

common factor that affected the participants' decision-making process. Slightly more

than half of the participants stated the lack of technical expertise impacted their decision.

Interestingly, only 2 participants selected the lack of technical support from

developers/vendors/consortia as a factor.

A third of participants stated that vendor/consortial hosting services were more affordable and seemed more stable. Additionally, more participants found vendor/consortial hosting services to provide more predictable costs than self-hosting. For another third of participants, self-hosting services were perceived as more affordable, with all costs considered. Self-hosting services also met more of their requirements, though not necessarily at a higher level of quality.

An outside factor that affected Participant 12's hosting decision was that their state consortium was closed to new members. Their institution was essentially forced to choose a self-hosted service. Participant 3 switched to self-hosting when their previous vendor migrated to a new software version.

Table 7. Factors affecting their hosting decision

Factor	Responses
Vendor/consortial hosting services met more of our requirements	3 (14.29%)
Self-hosting services met more of our requirements	7 (33.33%)
Vendor/consortial services met our requirements at a higher level of quality	4 (19.05%)
Self-hosting services met our requirements at a higher level of quality	3 (14.29%)
Vendor/consortial hosting services seemed more stable	8 (38.10%)
Self-hosting services seemed more stable	4 (19.05%)
Vendor/consortial hosting services were more affordable, with all costs considered	7 (33.33%)
Self-hosting services were more affordable, with all costs considered	8 (38.10%)
Vendor/consortial hosting services provided more predictable costs	6 (28.57%)
Self-hosting services provided more predictable costs	3 (14.29%)
Not enough technical expertise within our institution to maintain the self-hosted open-source software implementation	11 (52.38%)
Not enough technical support from the open-source software developers/vendors/consortia	2 (9.52%)

Other	1 (4.76%)
• P12: The Koha consortium in [state] was closed to new members, so self-hosting on Linode was our solution.	

13 participants filled out the optional follow-up question. Table 8 below lists the coded factors and number of responses. To view participants' responses in full, please refer to Table 1 in Appendix D.

6 participants had some level of in-house technical expertise at their institution, while only one participant mentioned their institution's lack of in-house expertise. For a couple of participants, vendor/consortium agreements lowered the costs of vendor-hosting services. Participants that chose self-hosting services cited factors including in-house technical expertise, learning/collaboration opportunities, high vendor fees, more customization, more cost-effective than vendor/consortial hosting, and the "only" cost being hardware.

Several participants discussed the importance of customization and stated they would only use consortial hosting if the consortium was willing to meet their specific requirements. Another mentioned that the staff's familiarity with a given software would influence their decision.

In most cases, when funds are limited, the decision to use vendor/consortial or self-hosting is dependent on the institution's amount of in-house technical expertise. Participant 19 stated that they chose vendor hosting because they lacked funds and could not hire someone to provide technical support. In contrast, Participant 13 used a self-hosting implementation because they had a small budget and local technical expertise.

Table 8. Coded factors that participants considered

Code	Responses
In-house technical expertise	6 (28.57%)
Self-hosting cheaper	4 (19.05%)
Vendor/consortium agreements lowered costs	2 (9.52%)
Vendor/consortial hosting cheaper	2 (9.52%)
Self-hosting's "only" cost is hardware	2 (9.52%)
Outside factors	2 (9.52%)
Familiarity with software	2 (9.52%)
Limited funds	2 (9.52%)
Customization	2 (9.52%)
Learning/collaboration opportunities	2 (9.52%)
Use consortial hosting if it meets requirements	2 (9.52%)
Lack of in-house technical expertise	1 (4.76%)
High vendor fees	1 (4.76%)
Use proprietary software if it has more features	1 (4.76%)

Q9. Were there any factors that you feel you should have evaluated more thoroughly

before selecting an open-source software implementation?

4 (19.05%) participants were satisfied with their final selection and did not list

any neglected factors. In the optional free-response, one of the participants that was

satisfied stated that they were happy with their current setup.

Of the remaining participants, most felt that they should have evaluated various

aspects of vendor/consortial hosting services more thoroughly, particularly the stability of

said hosting services. Several participants neglected to consider whether there was

enough technical support from the open-source software developers/vendors/consortia.

Other neglected factors cited by a few participants were the level of technical expertise at

their institution and the affordability of self-hosting when all costs are considered.

In regard to self-hosting, several participants overlooked the affordability of self-

hosting when all costs are considered.

Table 9. Neglected Factors

Neglected Factors	Responses
Whether vendor/consortial hosting services met more of our requirements	4 (19.05%)
Whether self-hosting services met more of our requirements	1 (4.76%)
Whether vendor/consortial hosting services met our requirements at a higher level of quality	4 (19.05%)
Whether self-hosting services met our requirements at a higher level of quality	2 (9.52%)
Whether vendor/consortial hosting services seemed more stable	6 (28.57%)
Whether self-hosting services seemed more stable	1 (4.76%)
Whether vendor/consortial hosting services were more affordable, with all costs considered	4 (19.05%)
Whether self-hosting services were more affordable, with all costs considered	3 (14.29%)
Whether vendor/consortial hosting services provided more predictable costs	4 (19.05%)
Whether self-hosting services provided more predictable costs	2 (9.52%)
Whether there was enough technical expertise within our institution to maintain the self-hosted open-source software implementation	3 (14.29%)
Whether there was enough technical support from the open-source software developers/vendors/consortia	4 (19.05%)
Other • P3: Are these the right selections for this questions • P7: None • P12: Whether I could acquire the technical expertise to support Koha adequately • P13: None • P21: No, I am happy with our decisions	5 (23.81%)

In the optional free response, 10 participants expanded on the factors they wished they considered more carefully. Table 10 contains the coded factors and number of responses. To view the complete participant responses, refer to Appendix D Table 2.

Participants discussed technical expertise/support, unexpected costs, lack of customization, and lack of resources. The most common factor that participants neglected to consider was the unexpected and additional costs associated with self-hosting services. Several participants stated the "only" cost of self-hosting is hardware in Question 8.5,

which indicates a misunderstanding about the ongoing costs of self-hosting. Though the software itself is free, the cost of maintenance can be unpredictable.

Regarding in-house technical expertise, only two participants stated they neglected to consider that they lacked it. One participant regretted that they did not choose to acquire in-house technical expertise. Interestingly, two other participants stated that they chose to acquire in-house technical expertise. Both Participant 3 and Participant 12 set up their local software installations without entirely knowing what they were doing, learning along the way and using the OSS community resources to guide them.

Another factor that two participants felt they should have evaluated more thoroughly was the vendor/consortium's service quality or lack thereof. Vendor/consortial hosting services can be inflexible. Often, they do not provide the level of access or customization that an institution requires. Vendor/consortial hosting can also lack updates, relegating institutions to specific versions without bug fixes, security updates, and new features. Even so, one participant stated that they preferred outside technical support, rather than doing it all themselves.

Table 10. Coded factors that participants neglected to consider

Code	Responses
Satisfied	3 (14.29%)
Unexpected/additional costs to self-hosting	3 (14.29%)
Lack of in-house technical expertise	2 (9.52%)
Acquired in-house technical expertise	2 (9.52%)
Prefer/need vendor technical support	2 (9.52%)
Lack of vendor service quality	2 (9.52%)
Lack of resources to invest in more OSS	1 (4.76%)
Could have acquired in-house technical expertise	1 (4.76%)

Regrets About Their Open-Source Software Implementation

Q10. Do you have any regrets about your chosen method of open-source software implementation?

Only 4 (19.05%) participants regretted their chosen method of open-source software hosting. Of those that regretted their hosting decision, 3 participants were from academic libraries and 1 participant was from a public library. The remaining 17 (90.95%) participants were satisfied with their decision.

Table 11. Whether participant has regrets about chosen implementation

Do they have regrets?	Responses
Yes	4 (19.05%)
No	17 (80.95%)

All 4 participants with regrets went into greater detail in the optional free-response section. The coded regrets and number of responses are displayed in Table 12. For the full-text responses, refer to Appendix D Table 3.

Each participant cited different reasons, with little overlap among them. One participant stated that the hosting decision was made with little input from library staff. Another participant had regrets because of vendor service quality and the lack of available features and customization. Several participants cited various technical-related issues: a lack of in-house technical expertise, a lack of support from their university's central IT, the difficulty of maintaining institutional knowledge, and local hardware.

Table 12. Coded regrets cited by participants

Code	Responses
Lack of input from library staff	1 (4.76%)
Lack of in-house technical expertise	1 (4.76%)
Difficult to maintain institutional knowledge of OSS	1 (4.76%)

Regrets regarding local hardware decisions	1 (4.76%)
Lack of support/options from central IT	1 (4.76%)
Lack of vendor service quality	1 (4.76%)
Lack of features/customization	1 (4.76%)

Changes in Hosting Services

Q11. Has your institution ever switched from vendor-hosted open-source software to self-hosted open-source software, or vice versa?

38.10% of the participants' institutions had switched between vendor-hosted and self-hosted open-source software at some point. Of those that switched hosting methods, 6 were academic libraries and 2 were other GLAM institutions. Only one participant, someone from an academic library, had switched hosting methods and had regrets about their hosting decision. Based on the 3 free-text responses, which are discussed in more detail in Q12, 2 participants switched to vendor hosting and 1 participant switched to self-hosting. A future study could investigate the degree to which the dissatisfaction with their previous open-source implementation was remediated by the switch.

Table 13. Institution breakdown by change in hosting

Institution switched hosting	Responses
Yes	8 (38.10%)
No	11 (52.38%)
I don't know	2 (9.52%)

Q12. What factors affected this decision to switch hosting services?

This question was only displayed to participants who selected "yes" for the previous question.

Based on the responses in Table 14, more participants switched to vendor/consortial hosting services. The most common factors for switching to

vendor/consortial hosting include the stability and affordability of these
services with all costs considered. For many participants that switched, vendor/consortial
hosting tended to meet more of their requirements in addition to meeting them at a higher
level of quality. A few also cited that their institution lacked technical expertise or
resources to maintain self-hosted services. One participant switched to vendor/consortial
hosting, because their institution lost local expertise and vendor/consortial services
provided more predictable costs.

The predictability of costs appears to have some impact on the switch to
vendor/consortial hosting. 3 (14.29%) participants said that vendor/consortial hosting
provided more predictable costs. No participants stated self-hosting services provided
more predictable costs.

For participants that switched to self-hosting services, self-hosting often met more
of their requirements and at a higher level of quality. These participants were likely
looking for more customization and features that were not available with
vendor/consortial hosting.

Table 14. Factors affecting the decision to switch hosting implementation

Factor	Responses
Vendor/consortial hosting services met more of our requirements	3 (14.29%)
Self-hosting services met more of our requirements	2 (9.52%)
Vendor/consortial hosting services met our requirements at a higher level of quality	3 (14.29%)
Self-hosting services met our requirements at a higher level of quality	2 (9.52%)
Vendor/consortial hosting services seemed more stable	4 (19.05%)
Self-hosting services seemed more stable	1 (4.76%)
Vendor/consortial hosting services were more affordable, with all costs considered	4 (19.05%)
Self-hosting services were more affordable, with all costs considered	1 (4.76%)
Vendor/consortial hosting services provided more predictable costs	3 (14.29%)
Self-hosting services provided more predictable costs	0 (0%)

Not enough technical expertise within our institution to maintain the self-hosted open-source software implementation	2 (9.52%)
Not enough technical support from the open-source software developers/vendors/consortia	0 (0%)
Other • P4: "We lost local expertise" • P9: "Not enough personal resources to maintain an OSS solution"	2 (9.52%)

3 participants filled out the free-response question following Question 12. A summary of the coded responses is depicted in Table 15. The full-text response and code are available in Appendix D Table 4. 2 participants switched to vendor/consortium, though for different reasons. One stated that it was a higher-level decision made by their institution. The other participant switched to vendor/consortial hosting to automatically shut down requests to bend the software for local business rules.

Participant 14 switched to self-hosting and cited the various limitations of consortial hosting. Though it was free, it suffered from severe limitations, lack of customization, and many outages. The consortial hosting also lacked system updates, which left the participant's institution open to security vulnerabilities. To rectify these issues, they invested resources into self-hosting services.

Table 15. Coded factors that influenced the decision to switch hosting services

Code	Responses
Switch to vendor/consortial hosting	2 (9.52%)
Switch to self-hosting	1 (4.76%)
Higher-level decision	1 (4.76%)
Bypass local business rules with vendor hosting	1 (4.76%)
Consortial hosting free but limited	1 (4.76%)
Invested resources to self-host	1 (4.76%)

Discussion

The central question of the project was, "How do academic libraries, and other GLAM institutions, choose between vendor-hosted and self-hosted implementation of open-source software?" Hosting implementation is dependent on institutional resources. Those with input in software selection decisions carefully consider the available institutional resources, the hosting service's features, and various outside factors during the decision process. Few participants have regrets about their decision. Even when they discussed the neglected factors, most participants remained satisfied with their chosen software hosting service.

A more thorough set of survey questions could have asked participants to discuss the resources they could devote to OSS and to rank the importance and influence of different factors on their software selection decisions. Future research could focus on one type of GLAM institution and its software decisions to provide a more detailed, in-depth analysis.

Factors Considered

The most considered factor was the level of in-house technical expertise. Many participants lacked the technical expertise to maintain a self-hosted open-source software implementation. Some participants chose to invest the time, funding, and resources into building technical expertise at their institution. One participant regretted that they did not consider building in-house technical expertise.

Another important factor was the affordability of the hosting services, with all costs considered. The affordability of vendor/consortial or self-hosted open-source software appeared to be dependent on the institution and its current circumstance. There appears to be some correlation between institutions with in-house technical expertise and limited funds choosing to self-host, and institutions with a lack of in-house expertise and limited funds choosing the vendor/consortial hosting option.

Participants found vendor/consortial hosting to be more stable and have more predictable costs, while self-hosting tended to meet more requirements.

Factors Neglected

The factor that participants most often forgot to consider was the unexpected and additional costs of self-hosted software. Many underestimated the unpredictable costs of self-hosting. This indicates misconceptions about the long-term costs of self-hosted open-source software.

Some participants were unaware of the restrictions that come with vendor/consortial hosting. They had frustrations with the inability to customize, the lack of new features, and being locked in a specific version. A few participants stated that they chose vendor/consortial-hosting for "standard" implementations and self-hosted open-source software when they required more customization. Vendor/consortial hosting services seemed to be best for institutions that only need the basic features. For those that have additional requirements, particularly customization, self-hosting was the better option.

Regrets

The large majority of participants were satisfied with their chosen software hosting service and had no regrets. Though several of them neglected to evaluate certain factors more thoroughly, these overlooked factors appear to have few notable negative effects. Only 4 (19.05%) participants had regrets. A higher percentage (27.27%) of participants from academic libraries were dissatisfied with their hosting decision compared to other GLAM institutions (10%). Even though 3 of these participants were from academic libraries, it is difficult to find similarities and draw conclusions among such a small number of responses.

Almost half of the participants had switched between vendor/consortial hosting services to self-hosted, or vice versa. Of the 8 participants that changed services, 75% were academic libraries. Though more academic libraries switched hosting services, it is unclear if they are satisfied with their new hosting service. It is possible that some participants have no regrets about their hosting decision because they switched hosting services, which solved their previous issues.

Limitations and Delimitations

Though this study was appropriately designed given time constraints, there were several limitations that should be addressed. The sample size was insufficient to study several relevant variables including trends within types of GLAM institutions and those who regretted their decisions. Because of the small sample size and overrepresentation of academic libraries, it was difficult to identify similarities within each type of GLAM institution. It was also difficult to draw conclusions among those who regretted their decisions. Participants who were satisfied with their decisions were overrepresented in

this study. This could be caused by self-selection bias. Those who are not

happy with their open-source software may not choose to participate in a survey about

open-source software.

Another limitation of this study was recall bias. I asked participants to recall and

reflect on past decisions and experiences. The participants may have misremembered

some details or chose not to share mistakes made during the software selection and

implementation process. My study also suffered from a lack of triangulation: only one

researcher performed the data collection and analysis, and data was collected with only

one method.

Additionally, the survey itself had limitations. The survey was designed to be

completed in less than 20 minutes to maximize the completion rate. Therefore, it did not

ask sufficiently detailed or in-depth questions that may have provided a more robust

understanding of how participants chose their software implementation. Most notably,

this survey did not thoroughly account for the resources each institution had available or

the nuance in different types of GLAM-specific open-source software. In several cases, it

was difficult to gauge the participant's knowledge of open-source software and their level

of technical expertise. Free-text responses suggested that some of these participants do

not have a well-informed understanding of the total costs of open-source software,

especially self-hosted versions. This suggests that user-reported data could misrepresent

the experiences of colleagues responsible for systems implementation.

There were several delimitations in this study. The first delimitation was that I

restricted this study to server-based open-source projects designed for the GLAM field.

This allowed me to avoid discussing widespread OSS infrastructures such as Linux,

Apache, or MySQL. Instead, I could focus on software adopted to support

services unique to libraries and GLAM institutions. Another delimitation is that I was not

looking into the specifics of institution-vendor contracts or institution policy and

standards for software. Though these factors may have impacted the decision process and

participants' reflection on their choice, it would be incredibly time-consuming to gather

the data, if it was publicly available. Data collection was conducted through surveys

rather than interviews. While I could have collected more detailed and in-depth data

through interviews, it would have been difficult to schedule, conduct, code, and analyze it

within the time constraints. To increase the feasibility of this study and maximize the

limited time and resources available, this study exclusively relied on surveys.

Conclusion

This study examined how those with influence in software purchasing decisions chose to host open-source software at their GLAM institution. Decisions are greatly determined by constraints and not preferences. Institutions are limited by the level of in-house technical expertise, the institutional resources that can be devoted to OSS, and funding. Institutions that can invest in in-house technical expertise are able to benefit from the increased control, influence, and customizability of open-source software. Other factors that impact their decisions include the amount of vendor/consortium technical support and level of customization. A commonly neglected factor that institutions should remember to consider is the overall costs of open-source software, particularly regarding the unexpected additional costs of self-hosting.

This research suggests that most institutions that adopt open-source software have low levels of regret, even when they do not thoroughly consider every factor. Academic libraries appear more likely to have regrets about their hosting services and to switch hosting services. However, future research may reveal otherwise.

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Appendix A. Survey Questions

* required responses

1) Please indicate your institution type: *
- Doctoral University
- Master's College and University
- Baccalaureate/Associate's College
- Public Library
- Archive
- Museum
- Gallery
- Other (please specify)

2) Do you have any input in or influence over software selection decisions at your institution? *
- No
- Yes

3) What type(s) of input/influence do you have in software selection decisions at your institution? (Select all that apply) *
- I have participated in the review of software for possible implementation
- I have conducted feasibility assessments of software under consideration
- I have proposed that a particular software be implemented
- I have made/coordinated final software selection decisions
- I have negotiated and/or allocated resources for software implementation
- Other (please specify)

4) In what area(s) of your institution do you use open-source software designed for GLAM? (Select all that apply) *
- Digital asset management (e.g. Islandora, ResourceSpace)
- Library services platforms (e.g. Evergreen Koha, FOLIO)
- Institutional repositories/institutional publishing (e.g. DSpace)
- Digital exhibits (e.g. Omeka)
- Digital preservation (e.g. Archivematica, LOCKSS)

- Archival management (e.g. ArchivesSpace, AtoM)
- Discovery layers (e.g. Blacklight, VuFind)
- Collections management (e.g. CollectionSpace, Collective Access)
- Other (please specify)

5) In situations where you chose not to use open-source software, please indicate the reason(s) why. (Select all that apply) *
- Proprietary software met more of our requirements
- Proprietary software met our requirements at a higher level of quality
- Proprietary software was more affordable, with all costs considered
- Proprietary software provided more predictable costs
- Proprietary software projects seemed more stable
- Not enough technical expertise within our institution to maintain the open-source software implementation
- Not enough technical support from the open-source software developers/vendors
- Our institution prohibits the use of open-source software
- Our institution discourages use of open-source software
- Other (please specify)

6) How is open-source software hosted at your institution? (Select all that apply) *
- Hosted by our own institution
- Fee-based hosting services from a vendor or consortium
- Non-fee-based hosting services from a consortium

7) How long has your institution used/supported open-source software? (Select one) *
- We do not intentionally use/support open-source software
- Less than 1 year
- 1 year
- 2-5 years
- 5-10 years
- 10 or more years

8) What factors affected your decision when choosing between vendor/consortial-hosted and self-hosted implementation of open-source software? (Select all that apply) *
- Vendor/consortial hosting services met more of our requirements
- Vendor/consortial hosting services met our requirements at a higher level of quality
- Vendor/consortial hosting services were more affordable, with all costs considered
- Vendor/consortial hosting services provided more predictable costs
- Vendor/consortial hosting services seemed more stable

- Self-hosting services met more of our requirements
- Self-hosting services met our requirements at a higher level of quality
- Self-hosting services were more affordable, with all costs considered
- Self-hosting services provided more predictable costs
- Self-hosting services seemed more stable
- Not enough technical expertise within our institution to maintain the self-hosted open-source software implementation
- Not enough technical support from the open-source software developers/vendors/consortia
- Other (please specify)

8.5) **Optional:** Please elaborate on your decision process and the factors you considered in Question 8.

9) Were there any factors that you feel you should have evaluated more thoroughly before selecting an open-source software implementation? (Select all that apply) *

- Whether vendor/consortial hosting services met more of our requirements
- Whether vendor/consortial hosting services met our requirements at a higher level of quality
- Whether vendor/consortial hosting services were more affordable, with all costs considered
- Whether vendor/consortial hosting services provided more predictable costs
- Whether vendor/consortial hosting services seemed more stable
- Whether self-hosting services met more of our requirements
- Whether self-hosting services met our requirements at a higher level of quality
- Whether self-hosting services were more affordable, with all costs considered
- Whether self-hosting services provided more predictable costs
- Whether self-hosting services seemed more stable
- Whether there was enough technical expertise within our institution to maintain the self-hosted open-source software implementation
- Whether there was enough technical support from the open-source software developers/vendors/consortium
- Other (please specify)

9.5) **Optional:** Please elaborate on the factors you feel you should have evaluated more thoroughly.

10) Do you have any regrets about your chosen method of open-source software implementation? (Select one) *
- No
- Yes

10.5) **Optional:** Please describe your regrets regarding your chosen method of open-source software implementation.

11) Has your institution ever switched from vendor-hosted open-source software to self-hosted open-source software, or vice versa? (Select one) *
- No
- Yes
- I don't know

12) What factors affected this decision to switch hosting services? (Select all that apply)
- Vendor/consortial hosting services met more of our requirements
- Vendor/consortial hosting services met our requirements at a higher level of quality
- Vendor/consortial hosting services were more affordable, with all costs considered
- Vendor/consortial hosting services provided more predictable costs
- Vendor/consortial hosting services seemed more stable
- Self-hosting services met more of our requirements
- Self-hosting services met our requirements at a higher level of quality
- Self-hosting services were more affordable, with all costs considered
- Self-hosting services provided more predictable costs
- Self-hosting services seemed more stable
- Not enough technical expertise within our institution to maintain the self-hosted open-source software implementation
- Not enough technical support from the open-source software developers/vendors/consortia
- Other (please specify)

12.5) **Optional:** Please elaborate on your decision to switch hosting services.

Appendix B. Email Soliciting Study Participants

Subject Line: Participation in a Research Study on Open-Source Software

Body of the Email:

Apologies for cross posting.

You are invited to participate in a research project studying how institutions choose to host open-source software designed for galleries, libraries, archives, and museums. The study is open to all who have input in IT purchasing decisions, whether they are members of IT units or not.

Participation includes filling out a brief anonymous survey that will take approximately 15-20 minutes to complete. This survey will ask you about open-source software at your institution and how your institution chose to host said software.

Participation is voluntary, and responses will be kept confidential. You can choose to stop taking the survey at any time and withdraw from the study. Participation or nonparticipation will not impact your relationship with the University of North Carolina at Chapel Hill.

Study Information

IRB Study #: 21-3376

Title of Study: Vendor-hosted versus Self-hosted Implementation of Open-Source Software at Academic Libraries

Principal Investigator: Kara Wong

Principal Investigator Department: UNC-CH School of Information and Library Science

If you have any questions about the research, please contact the Principal Investigator, Kara Wong, via email at krwong@email.unc.edu. If you have questions or concerns about your rights as a research subject, you may contact the UNC-CH Institutional Review Board at 919-966-3113 or IRB_subjects@unc.edu.

Thank you for your time and consideration.

Follow this link to the survey: Take the Survey

Or copy and paste the URL below into your browser: https://unc.az1.qualtrics.com/jfe/form/SV_0PNYZWlaEbJNMuG

Appendix C. Survey Consent Form

Study Information
IRB Study #: 21-3376
Title of Study: Vendor-hosted versus Self-hosted Implementation of Open-Source Software at Academic Libraries
Principal Investigator: Kara Wong
Principal Investigator Department: UNC-CH School of Information and Library Science
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Faculty Advisor: Jason Casden
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About the Study and Survey
The purpose of this research study is to better understand how institutions choose to host open-source software (OSS) designed for galleries, libraries, archives, and museums (GLAM). For this study, open-source software will refer to server-based open-source software designed specifically for GLAM. Widespread OSS infrastructure, such as Linux or Apache, are outside the scope of the survey.

The survey should take approximately 15-20 minutes to complete. There are 12 required multiple-choice questions and 4 optional free-response questions. This survey will ask you about open-source software at your institution and how your institution chose to host said software.

Eligibility to Participate
Anyone that is employed by a gallery, library, archive, or museum (GLAM institution) and has input in software purchasing decisions is eligible to participate in this study. You are not required to be a member of an IT unit. You must be at least 18 years old to participate.

Additional Information About the Study
Being in this study is completely voluntary. You may choose not to be in the study or to withdraw from the study at any time. Participation or nonparticipation will not affect your relationship with the University of North Carolina at Chapel Hill. You will not be offered or receive any special consideration if you take part in this research.

The possible risks to you in taking part in this research are:

- Breach of confidentiality
- Loss of professional reputation/standing

- Loss of reputation/standing within the community

There are no potential direct benefits to participants.

<u>Data Confidentiality</u>
To protect your identity as a research subject, the principal investigator will keep all survey responses on password-protected devices with two-factor authentication enabled (when available). Survey responses will be anonymized using Qualtrics, which prevents the collection of participant IP addresses, location data, and contact information. Any potentially identifying information in free-text responses will be redacted or generalized (e.g. "UNC-Chapel Hill" changed to "university"). Upon completion of the study, survey responses will be destroyed.

<u>Contact Information for Additional Questions</u>
If you have any questions about the research, please contact the principal investigator, Kara Wong, via email at krwong@email.unc.edu. If you have questions or concerns about your rights as a research subject, you may contact the UNC-CH Institutional Review Board at 919-966-3113 or IRB_subjects@unc.edu.

Appendix D. Optional Free-Response Text

P[number] indicates the participant identifier (e.g., Participant 3 or P3)

Participant Responses for Q8.5

Table 1. Participants' free-response text for optional question 8.5, "Please elaborate on your decision process and the factors you considered in Question 8"

Participant's Response	Code
P2: As part of a library consortium, Islandora sites were created and implemented without charge. For archives management, we implemented ArchivesSpace hosted by a vendor as we moved from Archon which we self-hosted.	Vendor/consortium agreements lowered costs, vendor-hosting cheaper
P3: Our previous ILS vendor was migrating to a new version of their software, so we would have had to change anyway. Our circulation figures were, and still are, in the high two figures per month, which meant that the vendor's licensing fees amounted to ten to twenty dollars per circulating book. The software was free, we bought a server, and we were ready to go.	Self-hosting cheaper, high vendor fees, outside factors (new version of vendor software), self-hosting's "only" cost is hardware
P4: our library tends towards commercial for library collections and is more open to open source for archives and special collections - sometimes library views influence decisions about other collections because it's familiar	Familiarity with software
P11: It was included in the contract agreement with the vendor.	Vendor/consortium agreement lowered costs, vendor hosting cheaper
P12: Our library wanted to join the large [state]-based Koha consortium, but it was closed to new members. Since I had 20 years of experience running Linux and implementing web servers I decided to try hosting Koha ourselves on Linode. We're now going on five years doing this, and since then I also helped another local library to self-host Koha on Linode.	In-house technical expertise, outside factors (state consortium closed to new members), learning/collaboration opportunities

P13: We had sufficient in house / volunteer technical expertise to get it up and running. We also have a very small budget.	In-house technical expertise, self-hosting cheaper, limited funds
P14: Generally when there is a free or low-cost option for consortial hosting we will take it unless we perceive it to be too low quality to use, or if we have additional requirements that the consortium doesn't support and the consortium will not work with us to implement said requirements.	Customization, use consortial hosting if it meets requirements
P15: There's a great deal of learning opportunities when adopting open source. It provides opportunities for direct involvement in the systems, tools, and methods used to manage, preserve, discover, and steward information and innovative services. It provides opportunities for organizations to build capacity and capabilities and to take more control of the content they create or contribute to. Increases opportunities for collaborations.	In-house technical expertise, learning/collaboration opportunities
P17: For "standard" implementations of OSS - i.e. Islandora, ArchivesSpace - we have tended to go with vendor support; for more customized software (Omeka) we have hosted locally after careful consideration. Its technology stack was familiar to staff, and overhead costs for local hosting remain relatively low.	In-house technical expertise, self-hosting cheaper, familiarity with software
P18: Self-hosting is ideal as it costs nothing but hardware, which hopefully already exists so that you don't have to beg for it to be purchased, but in the case of something like the Evergreen ILS, we're part of a cooperative as that would be way too much for me to manage alone	In-house technical expertise, self-hosting cheaper, self-hosting's "only" cost is hardware
P19: We have limited staff and could not afford to employ someone to maintain the open source package and the platform(s) it runs on	Lack of in-house technical expertise, limited funds
P21: We didn't seriously consider any vendor- or consortium-hosted open source options. Our main concern was that hosted instances would not be customized as we wanted. We accepted the trade off at times with proprietary software, but that was in cases where there were more bells and whistles in the proprietary option. In cases where there were hosted options for open source software, we asked for quotes and sometimes had follow-up meetings with representatives from the hosting service,	In-house technical expertise, customization, use proprietary software if it has more features, use consortial hosting if it meets requirements

to give them an opportunity to convince us they could provide the level of customization we desired.	

Participant Responses for Q9.5

Table 2. Participants' free-response text for optional question 9.5, "Please elaborate on the factors you feel you should have evaluated more thoroughly."

Participant's Response	Code
P2: We have very limited IT support within the library thus vendor-supported was crucial as was costs for the vendor.	Lack of in-house technical expertise, prefer/need vendor technical support
P3: Not really--I set up the software without knowing exactly what I was doing, learning along the way. Now I can use that experience to encourage libraries to self-host their ILS if they can't afford a vendor.	Satisfied, acquired in-house technical expertise
P4: we could choose to invest in or build local expertise	Could have acquired in-house technical expertise
P8: We didn't look into what additional customization/development would cost.	Unexpected/additional costs to self-hosting
P12: When I implemented our Koha installation, I was still not quite sure if I would be able to handle any issues that came up. But I have found that between the Koha mailing list and my own prior experience with Perl programming and Linux administration, I've been able to solve problems adequately.	Satisfied, acquired in-house expertise
P13: We're happy with the current setup.	Satisfied
P14: Its easy to be negative about the quality hosting done by someone else, but in reality we are often overly optimistic about the quality of our own hosting abilities. Additionally, the unpredictability of costs when hosting yourself is something we often underestimate.	Unexpected/additional costs to self-hosting
P16: Choosing an open source DAMS resulted in ongoing on often unpredictable fees related to basic feature implementation, theming and upgrades. Often vendor hosted solutions - even if they are open source - do not	Unexpected/additional costs to self-hosting, lack of vendor service quality

provide the level of access or customization that we require.	
P17: Sometimes the inflexibility of hosted software and being "locked in" at certain version numbers/patch levels means living with bugs for quite some time. All told, though, I'd prefer the support be someone else's job!	Lack of in-house technical expertise, lack of vendor service quality, prefer/need vendor technical support
P18: I would love to be able to replace our proprietary internet access / productivity zero-client setup (Userful, which is built on CentOS) with something homemade that provides a real Windows desktop but a lot of research would be required as to how to implement things like session timers and print cost dialogs.	Lack of resources to invest in OSS

Participant Responses for Q10.5

Table 3. Participants' free-response text for optional question 10.5, "Please describe your regrets regarding your chosen method of open-source software implementation."

Participant's Response	Code
P1: decision was made with little input was solicited from library staff	Lack of input from library staff
P2: We continue to struggle to maintain limited staff knowledge of the open-source software; it's great software except there are so many other libraries and institutions with dedicated staff and IT developers constantly adding plug-ins and changes to the software, we struggle to keep up. Our library IT person has little knowledge of the open-source software so it is left to the two Archives staff to attempt to keep up with training and changes.	Lack of in-house technical expertise, difficult to maintain institutional knowledge of OSS
P4: Not about our choice to have the provider host the software but our decisions about what kinds of local hardware to acquire rather than viewing this as a cloud (which could mean anything and likely won't meet standards) or us buying it; and about relying on servers managed by central IT in a secure data center (great!) but with inadequate support or options to achieve service levels.	Regrets regarding local hardware decisions, lack of support/options from central IT

| P18: I'm not happy with our Evergreen host and I feel as though they are concentrating on empire building rather than service quality. Among other things, a simple keyword OPAC search takes more than 10 seconds. New interfaces with made with shiny new frameworks don't have the features of the old interfaces. The decision to go with what is becoming a nationwide instance of Evergreen predated my employment and was essentially imposed on us by the province.

I would also say I'm unhappy with the direction Islandora has taken post version 7. The new one based on Drupal 8/9 has been out for a few years now but is lacking many features present in what is now called Legacy. 1.0 of the new one should have been called 0.1. | Lack of vendor service quality, lack of features/customization |

Participant Responses for Q12.5

Table 4. Participants' free-response text for optional question 12.5, "Please elaborate on your decision to switch hosting services."

Participant's Response	Code
P4: we shifted to vendor supported for DSpace and for ArchivesSpace - these were decisions made by my organization but not by a group I was working on. we sometimes decide to build rather than host or pay for hosting	Switch to vendor hosting, higher-level decision
P14: The consortial option was free, but experienced many outages, put severe limitations on what we could do with the system, wasn't open to the use of contributed or custom modules, and didn't keep the system updated which often left us lacking new features and open to security vulnerabilities. We rectified these issues by taking on hosting ourselves, but also took on a lot of cost and time commitment in doing so	Switch to self-hosting, consortial hosting free but limited, invested resources to self-host
P17: With vendor-hosted version, we were able to completely turn down requests to bend the software for local business rules, which was a godsend. Standardization is good!	Switch to vendor hosting, bypass local business rules with vendor hosting